Who Consumes the Credit Union Tax Subsidy?

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Abstract: Credit unions are exempt from paying income taxes, and these tax savings are meant to subsidize the provision of financial services to credit union members. However, weak governance and operational inefficiencies at these mutually owned cooperatives may result in inefficiencies that prevent credit union members from receiving the full measure of these tax subsidies. We estimate a structural model of profit inefficiency for a quarterly data panel of US commercial banks between 2005 through 2014, and use the estimated model parameters to evaluate the relative performance of 1,084 matched pairs of US credit unions and commercial banks. Our estimates show that the bulk of the tax subsidy does get passed along to credit union members, mainly in the form of above-market deposit interest rates. But an economically substantial amount of the subsidy gets diverted away from credit union members, mainly due to inefficiencies related to credit unions' non-loan investment activities. On average, net credit union inefficiencies are annually about 50 basis points per dollar of assets over-and-above the inefficiencies present at otherwise similar commercial banks.

Keywords: Agency costs, commercial banks, credit unions, mutual ownership, taxation

1. Introduction

Credit unions are non-profit, tax-exempt financial cooperatives that provide consumer credit, mortgage finance, savings vehicles, and payment services to their members. In exchange for their exemption from paying federal and state corporate income taxes, credit unions have historically accepted limits on their size and scope. Credit union membership is restricted to persons who share a common bond (e.g., members must be employed in the same firm or profession, or live in the same geographic area) and the financial activities of credit unions are limited (e.g., credit unions can only lend to their members, with a limited percentage of those loans going to member-owned businesses).

In recent years, the National Credit Union Administration (NCUA)—the chief regulator for the approximately 3,600 federally chartered credit unions in the US—has approved a series of new rules that relax the restrictions on credit union membership and financial activities.[1] These changes 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; new regulation approved by NCUA in June 2017).[2]

Because small and mid-sized commercial banks compete directly with credit unions in consumer credit, savings products, and payments services, bankers have long complained that the credit union tax exemption is an unfair competitive advantage—chiefly, that credit unions use these tax savings to subsidize below-market loan interest rates and above-market deposit interest rates for credit union members. From the banks' point of view, the recently relaxed restrictions on credit union activities and membership will simply amplify this unfair competitive advantage.[3]

In this paper, we ask and attempt to answer two questions related to this policy debate: Our first question is whether the entirety of the credit union tax subsidy is actually being passed along, as

[1] Rulings made by the NCUA also apply by default for a large percentage of state chartered credit unions.
[2] 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.
[3] For evidence that the presence of credit unions in the local market has a competitive impact on commercial bank deposit pricing and loan pricing, see Tokle and Tokle (2000), Feinberg (2001) and Hannan (2003).

implicitly mandated, to credit union members as above-market deposit rates and/or below-market loan rates? If so, then the credit union tax policy debate is limited to its allegedly unfair competitive effects on commercial banks, the effects of which are largely contained within the financial services industry. But if not, then our second question is whether a non-trivial portion of the tax subsidy being passed along to other credit union stakeholders (e.g., credit union employees) or getting consumed by inefficient management practices (e.g., mispricing of inputs or outputs, overuse of inputs, under-production of outputs)? If so, then the credit union tax policy debate extends to the allocative efficiency effects of the credit union tax subsidy itself.

There are good reasons to expect that credit union members will receive only an incomplete portion of the tax subsidy, and that some non-trivial residual amount of the tax subsidy will be consumed by inefficient credit union operations. First, credit unions are mutually owned by their depositor-members and control of the institution rests with these members. But control rights are widely dispersed—regardless of the size of their accounts, each member has equal voting power in director elections—and as a result individual credit union members have little incentive or ability to meaningfully engage in governance. Second, credit unions are not-for-profit organizations; any surplus generated during a given accounting period is typically retained as equity, not paid out as dividends to credit union members. The lack of a meaningful profit benchmark makes credit union performance difficult to gauge, and the lack of a profit motive further dampens member incentives to monitor management. Third, credit union members cannot sell their control rights—when they withdraw their deposits, their voting rights disappear—and hence there is no market for corporate control to monitor and discipline credit union management. Finally, while oversight by government supervisors could theoretically correct all of these private sector monitoring deficiencies, the primary focus of commercial bank and credit union examiners is safety and soundness (i.e., reducing the probability of insolvency), not value maximization.

We evaluate the financial performance of a matched sample of 1,048 small commercial banks and 1,048 credit unions operating in the US between 2005 and 2014, using publicly available data and a structural variable profit model (Berger, Hancock and Humphrey 1993, DeYoung and Nolle 1996). The variable profit model is well-suited for our task, as it allows us to separate the profitability of activities associated with credit unions' legal mandate (loans, depositor services) from the profitability of non-mandated activities (securities investments, labour inputs). We use the estimated parameters of the model to measure the profit inefficiency of each institution in the data; disaggregate profit inefficiency into its input-specific and output-specific sources; and then further disaggregate these sources of inefficiency into their price and quantity components. We address our main questions about credit union performance by comparing these various profit inefficiency measures for matched pairs of commercial banks and credit unions, using the banks as the profit performance benchmarks.

On average, we find that profit inefficiency at credit unions exceeded profit inefficiency at similar commercial banks by 122 basis points of assets each quarter. This inefficiency gap results from using an inefficiently large amount of deposit inputs as well as from paying above-market interest rates on these deposits, both of which are consistent with the objectives of the credit union tax-exemption. On average, credit unions generate 109 basis points of deposit inefficiencies per quarter, and these member benefits account for about 89% of credit unions' total profit inefficiency gap relative to banks. However, we also find that an economically large amount of the tax subsidy gets diverted away from credit union members. Credit unions tend to purchase too few interest-bearing financial securities, and this under-investment in their securities portfolios contributes 22 quarterly basis points on average to their profit inefficiencies *over-and-above* the profit inefficiencies at similar commercial banks. This misuse of the tax subsidy is economically substantial: Over an entire year, these inefficiencies accumulate to about 50 basis points per asset dollar. One can establish the economic significance of profit inefficiencies at credit unions by comparing this figure to the average 114 basis point *pre-tax* return on assets earned by their commercial bank competitors during our sample period.

Our analysis coincides with a re-emergence of the policy debate regarding the efficacy and fairness of the credit union tax exemption. In a January 2018 letter to the NCUA, Senator Orrin Hatch, chair of the US Senate Finance Committee, stated that "the credit union industry is evolving in ways that take many credit unions further from their tax-exempt purpose." Although the federal tax reform of 2017 left the credit union tax subsidy intact, pending legislation in Iowa would equalize the state income tax treatment of commercial banks and credit unions that operate there.[4] Another signal that efforts to reform the tax treatment of credit unions are gaining legitimacy is the publication of two separate in-house Federal Reserve Bank analyses, both of which focus on changes in the credit union industry and whether or not the credit union tax subsidy remains justified (DiSalvo and Johnston 2017, Marshall and Pellerin 2017).

This study adds to the literature in several related areas, including the corporate governance of regulated financial institutions (e.g., Caprio, Laeven and Levine 2007); the efficient performance of joint stock versus mutually owned financial institutions (e.g., O'Hara 1981, Mester 1989, 1993); and the potential conflicts of interest between depositors and borrowers at credit unions (Smith, Cargill and Meyer 1981, Flannery 1974, Leggett and Stewart 1999, McKillop and Wilson 2011). We refer to these and other related papers throughout the manuscript to better frame our analysis and our results. 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 conclude that at least a portion of the tax benefit was redirected away from credit union members.

The rest of this paper is structured as follows. Section 2 reviews the taxation and corporate governance environments at US credit unions. Section 3 presents two hypotheses—the *mandated inefficiencies* hypothesis and the *absolute inefficiencies* hypothesis—that posit testable relationships between the institutional environment at credit unions and their financial performance relative to commercial banks. Section 4 presents our estimable profit inefficiency model, which we augment based on earlier work by Berger, Hancock and Humphrey (1993) and DeYoung and Nolle (1996). Section 5 describes the data that we use to estimate our models. In section 6 we present and analyse the full sample results from the profit efficiency model, and in section 7 we use a matched pair sample of banks and credit unions to perform formal hypothesis tests. Section 8 concludes.

[4] "Tax credit unions? Iowa bill could lead the way," *American Banker*, February 28, 2018.

2. Credit unions

Credit unions originated as self-help cooperatives for persons and households of modest economic means that are not served well by commercial banks. Today, they are one of the major suppliers of consumer credit in the US. Credit unions tend to be small in size—three-quarters of US credit unions hold less than $100 million in assets, and only 5% hold more than $1 billion—but are plentiful in numbers, with nearly 6,000 individual credit unions serving 107 million members and collectively holding $1.3 trillion in assets (Credit Union National Association 2016). 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 small set of financial services, such as share draft (transactions) accounts, savings vehicles, personal loans, consumer credit, and home mortgages.

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 some of the idiosyncratic verbiage associated with credit unions. 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 words 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.

2.1. Tax treatment of credit unions

Credit unions are exempt from paying taxes on their 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 added)."[5] Clearly, the legislation specifies a mandate for credit unions 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 in the US typically pay higher interest rates on deposits, and often but not always charge lower interest rates on loans. (For some examples, see Figures 2 and 3, which we discuss in detail in a subsequent section.)

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 (CUNA, 2015) found that credit union members tend to be (48.5 year olds for credit union members versus 45.5 for non-members), employed full time (54% versus 39%), better educated (40% college degrees versus 24% without), and own homes (76% versus 52%). A study conducted by the US Government Accountability Office (GAO, 2006a) study found that 31% of credit union members have low-to-moderate incomes versus 41% of commercial bank customers, while 69% of credit union members have middle-to-upper incomes versus 59% for commercial bank customers. DiSalvo and Johnston (2017) show that credit unions reject mortgage applications twice as frequently as small commercial banks in low-to-moderate income census tracts.

In contrast, US commercial banks are for-profit, shareholder-owned corporations. For banks organized as corporations under Subchapter C of the US tax code, bank income is subject to double taxation: Earnings are fully taxed 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 taxed only at the personal level.[6]

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[5] 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.

[6] 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 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 2,092 (37% of all commercial banks) in 2014. 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.

In recent years, US credit unions have become increasingly similar to commercial banks in terms of asset size and lending mix. The Credit Union Membership Access Act of 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. At year-end 2016, 272 federally insured credit unions (4.3% of the total) held assets greater than $1 billion—the largest, the Navy Federal Credit Union, reported assets of over $80 billion—and 53 credit unions currently have over a quarter of a million members each.[7] This growth in the size of credit unions has coincided with an increase in business lending. Although only about one-in-three credit unions make any business loans at all (NCUA 2016), total business lending grew by approximately fourfold at credit unions between 2001 and 2014, leaving about one thousand credit unions at or near their statutory business loan limit of 12.5% of total assets.[8] In 2017, approximately 34% of all federally insured credit unions had business loans outstanding to their members; this figure was 90% for credit unions with more the $1 billion in assets.[9] In response to the growth in business lending by credit unions, new federal legislation passed in December 2017 lifted the statutory cap on member business loans from 12.5% to 27.5% of assets.

Although individual credit unions tend to be small, when aggregated their total tax subsidies are 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.[10] Banks argue that the tax exemption distorts competition in deposit and loan markets by conferring an unfair financial advantage to credit unions. Banks also argue that the tax-subsidized

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[7] Data from the NCUA Annual Report (2016) and www.usacreditunions.com.

[8] 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), Wilcox (2011) and DiSalvo and Johnston (2017) provide further analyses of credit unions' small business lending activities.

[9] Data from 2016 US Credit Union Profile, prepared by the Credit Union National Association (CUNA).

[10] Other studies have tax revenue losses of similar magnitudes. In a study for the US Tax Foundation, Tatom (2005) estimated a $2 billion annual loss of tax revenue, and an aggregate future loss of $30 billion over ten years. The Joint Committee on Taxation (2013) estimated a $500 million annual loss of tax revenue, projected to rise to $1 billion annually by 2017. The National Association of Federally-Insured Credit Unions (Feinberg and Meade 2017) counters such analyses with its own estimates that eliminating the tax subsidy would result in $38 billion less tax revenue over ten years.

stakeholder group now extends well beyond the original credit union mandate, including business borrowers, credit union employees, and members who do not truly share a strong common bond.[11] For a more detailed treatment of the historical origins and current justifications for a tax-free credit union industry, see Marshall and Pellerin (2017).

2.2. Corporate governance at credit unions

Any organization in which management is functionally separate from principal ownership is susceptible to principal-agent costs: If the incentives facing managers and owners are not aligned, managers may sacrifice some of the market value of the firm in order to increase their private benefits (Berle and Means 1932, Fama and Jensen 1983, Jensen and Meckling 1976). Separation of ownership from management is typically accompanied by a dispersed shareholdings, making it more difficult for shareholders to monitor managers, and this lack of monitoring may be detrimental to firm performance (Demsetz and Lehn 1985, Shleifer and Vishny 1986, Morck, Shleifer, Vishny 1988, Laeven and Levine 2008). Left unchecked, managers can destroy shareholder value by awarding themselves and colleagues expensive managerial perquisites, by (over)investing in negative net present value projects or acquisitions in order to build an empire, by taking unwarranted risks in order to increase the value of their stock options, or by rejecting risky but still positive NPV projects in order to lead a "quiet life."

Member-owned credit unions are significantly different from shareholder-owned financial institutions in terms of ownership and governance (Smith, Cargill and Mayer 1981; Flannery 1981). 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. 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. Even large member-depositors with the most at stake have little incentive to

[11] For a summary of the arguments made by the American Bankers Association for removing the tax exemption enjoyed by credit unions, see http://www.aba.com/issues/pages/tax-credit-unions.aspx.

monitor, because they have no more governing power than small member-depositors.[12] Relatively few members attend the annual general meeting, scrutinize the board's prudential measures, or otherwise actively monitor the board (Goth, McKillop and Wilson 2012). Given that credit unions are collectives of mostly small and unsophisticated savers, few if any have the experience or ability necessary to effectively monitor financial conditions and operations. Because credit union directors are drawn from within this general membership, elected directors have no greater stake in the credit union than any other member, and may possess insufficient business acumen for the task at hand.

The equity capital at credit unions is internally generated over time by the retention of surpluses derived from deposit and loan transactions involving credit union members (Goddard, McKillop and Wilson 2016). Equity capital belongs collectively to the credit union members—but members that wish to sever their ties with their credit union have no entitlement to any share of this accumulated communal wealth. 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. Government regulators require credit unions to retain minimum amounts of equity capital as a buffer against future losses.[13] If a credit union generates excessively large surpluses, it can distribute these sums to its members by increasing deposit rates and/or by reducing loan rates, obviating the need for an explicit financial dividend. Although credit union members sometimes receive taxable dividend earnings pay-outs, such payments are relatively rare.[14]

Credit union managers receive most of their compensation in salaries and cash bonuses; they cannot be awarded stock or stock option grants. Managerial salaries and benefits are typically lower than those paid by other financial institutions, and member-directors are often lower-salaried

[12] Ferretti, Pattitoni and Castelli (2017) 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.
[13] 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, Credit unions classified as well capitalized with a net worth to assets ratio exceeding 7% are free from supervisory intervention. Credit unions classified as adequately capitalized or below with a net worth to asset ratio less than 7% are required to take steps to restore net worth to adequate levels.
[14] Credit unions refer to these payouts 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 patronage dividends in a given year, and only about one in ten actually make these pay-outs.

professionals who will use their own incomes as benchmarks for setting manager compensation (Branch and Baker 2000). Moreover, credit unions tend to be small organizations, so opportunities for in-house or within-industry career advancement are limited. Given the limited professional and financial upsides available to credit union managers, combined with the non-functional governance environment in which they operate, credit union managers have at best weak incentives to run their organizations in a productively or financially efficient fashion.

3. Hypotheses for testing

By mandate, a credit union is supposed to pass along its tax subsidy to its members. If the credit union satisfies this mandate by paying above-market interest rates to its depositor members, 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] Similarly, if the credit union satisfies its mandate by charging below-market interest rates to its borrower members, 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): Credit unions operate under a legislative mandate to spend their tax subsidy (i.e., by incurring additional costs or foregoing potential revenues) in ways that expand households' access to financial services. Because of this, profits at credit unions will be lower than pre-tax profits at otherwise similar commercial banks.

[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 of 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.

Corporate governance at credit unions is weak relative to commercial banks, because internal stakeholders have little incentive (and external parties have no incentive) to monitor or discipline credit union management. As a result, credit union managers have greater opportunities to pursue their own self-interest via efficiency-reducing activities, such as including but not limited to shirking, empire building, overinvestment, excessive or deficient risk-taking, or pursuit of a quiet life. Such behaviour diverts a portion of the tax subsidy 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): The credit union corporate governance environment provides stronger incentives and greater opportunities for non-maximizing behaviour than at commercial banks. A portion of the credit union tax subsidy will be absorbed by these inefficiencies, thus reducing the generation of mandated member benefits.

Figure 1 illustrates the incidence of the credit union tax subsidy. By definition, the sum of the mandated and absolute inefficiencies is equal to the tax subsidy. Given the non-profit constraint under which credit unions operate—that is, retained profits are justifiable only if they are necessary to establish or maintain a prudentially sound cushion of equity capital—any increase (decrease) in absolute inefficiency must be offset dollar for dollar with a reduction (increase) in mandated inefficiency.

4. Modelling relative financial performance

To test hypotheses H1 and H2, we use the profit inefficiency model introduced by Berger, Hancock and Humphrey (1993), as modified by DeYoung and Nolle (1996), as well as some additional modifications and extensions of our own. This model is uniquely appropriate for our purposes, as it allows us to estimate the relative profit inefficiencies of credit unions and commercial banks, and also allows us to disaggregate these inefficiencies into mandated and absolute parts. The model assumes that firms attempt to maximize profits, but leaves room for them to operate with inefficiencies and hence fall short of maximum achievable profits. Nevertheless, while commercial banks arguably seek to maximize profits, credit unions by mandate are not profit maximizers. Hence, we will *estimate the* *parameters* of the profit inefficiency model using just data for commercial banks, and then apply the estimated model parameters to data for both banks and credit unions *to calculate* their relative profit inefficiencies.

In our model, each bank maximizes its short-run variable profits by choosing the levels of four variable netputs: It produces loans and investments each period, and it purchases labour and deposits each period. We assume that all netputs are traded in competitive markets, so that banks take netput prices as given. Banks also take their own fixed factors (physical assets, risk-weighted assets, equity capital, non-interest income) as given, which we assume are pre-determined by strategic business model decisions that banks made in the past. Short-run variable profits are an appropriate focus for our purposes, as the agency costs associated with managerial utility maximization are likely to be the results of managers' choices of variable netputs in the short-run. Definitions for the profit, netput, netput price, and fixed factor variables are provided in Table 1.

More formally, let bank i compete in market s=1,…, S at time t=1,…,T. The bank maximizes variable profits $\pi^*_{i,t} = \pi(\mathbf{p_{s,t}}, \mathbf{z_{i,t}})$ by choosing its optimal vector of n netputs $\mathbf{x^*_{i,t}} = \{x_{j,i,t} \text{ for } j=1,\ldots,n\}$, taking as given both the vector of n local netput prices $\mathbf{p_{s,t}} = \{p_{j,s,t} \text{ for } j=1,\ldots,n\}$ and its own vector of m fixed factors $\mathbf{z_{i,t}} = \{z_{r,i,t} \text{ for } r=1,\ldots,m\}$.[16] We adopt a Fuss normalized quadratic functional form for the variable profit function:

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

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

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:

[16] 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.

$$x^*_{j,i,t} = \alpha_j + \sum_{k=1}^{n-1} \varphi_{j,k}\left(\frac{p_{j,s,t}}{p_{n,s,t}}\right) + \sum_{r=1}^{m} \gamma_{r,j} z_{r,i,t} \qquad \text{for } j=1,\ldots,n\text{-}1 \qquad (2a)$$

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

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

Equations (1) and (2) 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 (2) yields the actual netput demand equations:

$$x_{j,i,t} = (\alpha_j - \xi_{j,i,t}) + \sum_{k=1}^{n-1} \varphi_{j,k}\left(\frac{p_{j,s,t}}{p_{n,s,t}}\right) + \sum_{r=1}^{m} \gamma_{r,j} z_{r,i,t} \qquad \text{for } j=1,\ldots,n\text{-}1 \qquad (3a)$$

$$x_{j,i,t} = (\alpha_j - \xi_{j,i,t}) - \frac{1}{2}\sum_{j=1}^{n-1}\sum_{k=1}^{n-1} \varphi_{j,k}\left(\frac{p_{j,s,t}p_{k,s,t}}{p^2_{n,s,t}}\right) + \sum_{r=1}^{m} \beta_r z_{r,i,t} + \frac{1}{2}\sum_{r=1}^{m}\sum_{q=1}^{m} \theta_{r,q} z_{r,i,t} z_{q,i,t} \qquad \text{for } j=n \qquad (3b)$$

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:

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

$$+ \sum_{r=1}^{m} \beta_r z_{r,i,t} + \frac{1}{2}\sum_{r=1}^{m}\sum_{q=1}^{m} \theta_{r,q} z_{r,i,t} z_{q,i,t} + \sum_{r=1}^{m}\sum_{j=1}^{n-1} \gamma_{r,j}\left(\frac{p_{j,s,t}}{p_{n,s,t}}\right) z_{r,i,t} \qquad (4)$$

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 (3, 4), 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.[17] 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, $v_{j,i,t} + (\xi_{j,mean} - \xi_{j,i,t})$, where $v_{j,i,t}$ 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 $\hat{v}_{j,i}$ of the regression residuals; these $\hat{v}_{j,i}$ converge in probability to $(\xi_{j,mean} - \xi_{j,i,t})$ because the random error $v_{j,i,t}$ attenuates to zero in the averaging.[18] Finally, we generate the netput j inefficiency for each bank i using the expression $\hat{\xi}_{j,i} = \bar{v}_j - \hat{v}_{j,i}$, where $\bar{v}_j$ is the maximum value (the least inefficient bank relative to the population mean) of $\hat{v}_{j,i}$ over all

[17] In equation (4) 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.

[18] 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).

banks.[19] $\hat{\xi}_{j,i} = 0$ for the least inefficient bank (that is, for $\hat{v}_{j,i} = \bar{v}_j$) and becomes increasingly positive (more inefficient) with increasing $\hat{v}_{j,i}$.

With the bank average netput inefficiencies $\hat{\xi}_{j,i}$ in-hand, we construct the total estimated profit inefficiency for each bank as follows: $Ineff_i = \sum_{j=1}^{n} \hat{p}_{j,s}\hat{\xi}_{j,i}$, where $\hat{p}_{j,s} = (1/T)\sum_{t=1}^{T} p_{j,s,t}$ is the average competitive netput j price facing bank i during the sample period. Netput-specific profit inefficiencies $\hat{p}_{j,s}\xi_{j,i}$ are obtained in straightforward fashion by undoing the summation $\sum_{j=1}^{n} \hat{p}_{j,s}\hat{\xi}_{j,i}$ into its n parts. In both of these expressions, netput inefficiencies are valued based on market prices $\hat{p}_{j,s}$. While this is the proper approach for measuring the social costs of these inefficiencies, this approach can misstate the costs of inefficiency to bank shareholders. On the one hand, if a bank is somehow able to pay substantially less than the market price for its inputs—or receives substantially more than the market price for its outputs—then our market-value profit inefficiency estimates for this bank may materially overstate inefficiency because they do not capture these internal, bank-specific pricing efficiencies. On the other hand, if a bank pays substantially more than the market price for its inputs—or receives substantially less than the market price for its outputs—then our market-value profit inefficiency estimates for this bank may materially understate inefficiency because they do not capture these internal, bank-specific pricing inefficiencies. We can extract such information by decomposing each of the netput-specific profit inefficiencies as follows:

$$\hat{p}_{j,i}\xi_{j,i} = \hat{p}_{j,s}\xi_{j,i} + (\hat{p}_{j,i} - \hat{p}_{j,s})\xi_{j,i} \tag{5}$$

where $\hat{p}_{j,s}$ is the average local market price for netput j and $\hat{p}_{j,i}$ is the average price actually paid or received by bank i for netput j. The left-hand side term is netput profit inefficiency valued at internal

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

bank prices. This is a *total inefficiency* measure, as it captures both inefficiencies from suboptimal netput choices as well as inefficiencies from suboptimal netput pricing decisions. The first right-hand side term is netput profit inefficiency valued at local market prices. We can think of this term as *quantity inefficiency*, as it values the inefficiencies of all banks based on the prices they face in their local markets, and does not reflect any pricing decisions made by individual firms. The second right-hand side term is the portion of netput profit inefficiencies that are attributable to deviations from local market prices. For inputs (outputs), a positive value indicates inefficient (efficient) internal pricing, while a negative value indicates efficient (inefficient) internal pricing.[20] We refer to this term as the *pricing difference*, as it captures the difference in measured profit inefficiency due to deviations in actual netput prices from local market prices. If commercial banks are indeed price takers as assumed by our model, then this term will be very small for banks; if credit unions use non-market netput pricing to distribute the tax subsidy with their members, it will be revealed in this term.

All of the preceding profit inefficiency measures are expressed in dollar terms. So in order to make meaningful comparisons across banks, we must scale these measures to control for bank size. For example, total profit inefficiency scaled as a proportion of assets is given by $Ineff_i/\widehat{assets_i}$, where $\widehat{assets_i}$ is the average assets of bank i during the sample period. Similarly, total profit inefficiency scaled as a proportion of potential variable profits is given by $Ineff_i/(Ineff_i + \hat{\pi}_i)$, where $\hat{\pi}_i$ is the average pre-tax profits of bank i during the sample period.

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 larger than the netput quantities themselves. Second, we divide the data into ten asset deciles, and then (before using the average residuals to calculate *Ineff*$_i$) we winsorize the average residuals $\hat{\nu}_{j,i}$ at the 5th and 95th percentiles of their distributions within those size deciles. We perform this winsorization to

[20] Alternatively, a positive value for outputs (inputs) could indicate that the bank is selling higher quality outputs (purchasing higher quality inputs) than other banks in its local market. Our matched-pairs analysis should minimize this possibility by comparing similar banks in similar markets.

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 (DeYoung and Nolle 1996).

5. Data

The main data are a balanced panel of 2,901 commercial banks and 1,358 credit unions operating in the US during each of the 40 quarters from 2005 through 2014. The commercial bank data come from the Reports on Condition and Income (Call Reports) published by the Federal Financial Institution Examination Council (FFIEC). The credit union data come from the Call Reports published by the National Credit Union Association (NCUA).

It is important to use a balanced data panel so that the averaged bank-specific residuals $\hat{v}_{j,i}$ are calculated using the same number of observations for each bank and credit union. Table 2 provides the numerical details of the sample selection process. We begin with the 5,217 banks and 6,335 credit unions that were operating in the first quarter of 2005 and were still operated in the final quarter of 2014. We exclude extremely small institutions with mean 2005-2014 assets less than \$50 million; large institutions in the 100^{th} percentile (above \$6.306 billion) of the combined distribution of average assets for banks and credit unions; and institutions with any missing data points during our 40-quarter sample period. Finally, to prevent outlying values from influencing our profit inefficiency estimates, we exclude institutions with mean 2005-2014 return on assets (ROA) in the 1^{st} or 100^{th} percentiles of the sample distribution. The resulting balanced panel contains 2,901 commercial banks and 1,358 credit unions. We estimate the profit inefficiency model for the 2,901 commercial banks, then use the estimated model parameters to calculate profit inefficiency measures for the 1,883 free-standing commercial banks (i.e., banks that are not affiliates in multi-bank holding companies) and for the 1,358 credit unions.[21]

[21] We remove the 1,108 commercial banks that are affiliates in MBHCs prior to comparing the profit inefficiency of commercial banks and credit unions, because the MBHC organizational form is not available to credit unions. However, we include these MBHC affiliates when we estimate the profit model to (a) increase estimation precision by increasing the number of observations, and (b) ensure that any inefficiencies from *not* being in an MBHC *are* captured in the measured profit efficiencies of commercial banks.

Using a balanced panel raises the possibility that our results will be influenced by survivorship effects. As shown in Table 3, the annual attrition rates for commercial banks were approximately three times greater than for credit unions during our sample period. Nevertheless, the profitability ratios for credit unions and banks followed approximately parallel paths: Annual ROA for credit unions (banks) averaged 0.74% (1.62%) in 2005, dipped to a low of -0.06% (0.18%) in 2009, and recovered to 0.57% (1.18%) in 2014. Hence, the attrition data are consistent with a market for corporate control that is active for banks but weak for credit unions. Because the consequences of a weak corporate governance environment are central to our hypothesis H2, we do not consider the differences in attrition rates a source of bias for the purposes of our investigation.

5.1. Variables

The balance sheet and income statement line items in the commercial bank Call Reports do not match up perfectly with the line items in the credit union Call Reports. We specify the variables in our model with these differences in mind, so that the variables π, $\mathbf{x}$, $\mathbf{p}$ and $\mathbf{z}$ are as similar as possible for banks and credit unions. Appendix Table A1 contains detailed definitions for all of these variables, including their underlying bank and credit union Call Report data codes. Summary statistics for all of the variables used to estimate our model are reported in Table 4.

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 the financial performances of (taxed) commercial banks and (non-taxed) credit unions. Moreover, it allows us to retain commercial banks organized as subchapter S corporations (100% of corporate profits are taxed at the personal level) in our data. This is crucial, as the commercial banks most comparable to credit unions in size and product mix are often subchapter S banks.

We specify four variable netputs in $\mathbf{x}$. *Loans* includes total on-balance sheet loans and lease contracts. *Investments* includes total securities (held for trading and held to maturity) 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 merely report the number of full-time and part-time workers. We estimate FTEs for credit unions as full-time workers plus 0.50 times part-time workers.[22] *Deposits* is equal to total deposits and other borrowings on which the bank or credit union pays 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. The netput prices in $\mathbf{p}_{s,t}$ are calculated as the aggregate (bank and credit union) revenue or expense flows associated with each netput in state s, divided by the aggregate (bank and credit union) quantity of each netput produced or used in that state, during quarter t. We use data from all of the banks and credit unions in each state in these calculations, not just those in our sample. *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*.

We specify six fixed factors in **z**. *Premises* includes the book values 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, fees earned from selling financial services, and capital gains income; we include this to control for the impact of non-loan and non-investment income on profits. *Risk-weighted assets* is the regulator-defined risk-weighted assets measure; we include this to control for the impact of asset risk on profits. *Subchapter S* is a dummy equal to one for banks organized as subchapter S corporations; we include this to control for the differential tax treatment of these banks, where profit is not subject to corporate taxation but instead is subject to personal taxation regardless of whether it is distributed to shareholders. *MBHC* is a dummy equal to one for banks that are affiliates in multibank holding company organizations; we include this to control for the effects of internal capital markets and similar cross-subsidies.

[22] This follows industry precedent. The Credit Union National Association (CUNA) 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 Table 8).

6. Estimating the profit model and calculating profit inefficiencies

We estimate the parameters of our four-equation model (3a, 4) for the balanced panel of 2,971 commercial banks and bank holding companies using seemingly unrelated regression (SUR) techniques.[23] We exclude credit unions from this estimation, because credit unions are neither profit-maximizers nor price-takers as assumed by the model. With the estimated parameters in-hand, we calculate profit inefficiency measures for all of the commercial banks and all of the 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-maximizing commercial bank that made the same variable netput decisions as did credit union *i*.

6.1. Total profit inefficiency

In Table 5 we report the estimated profit inefficiency measures for the full sample of 1,833 free-standing commercial banks and 1,358 credit unions (Panel A) and for the matched sample of 1,084 banks and 1,084 credit unions (Panel B). All of the inefficiency measures displayed in this table are valued using local market prices. The results are comparable in magnitude across the two panels; in the analysis that follows we refer to the data displayed in Panel A.

At commercial banks, the quarterly profit inefficiency per dollar of assets averages \$0.0153, or roughly \$0.0612 per dollar of assets when annualized. To put this in perspective, if the average bank was able to eliminate 100% of this profit inefficiency, it would experience a 528% increase in annual pre-tax ROA (0.0612/0.01159). Inefficiency as a percentage of potential profits averages 0.7980 for the commercial banks, and shedding 100% of inefficiency would increase pre-tax profits by 395% (0.7980/(1 - .7980)). While these profit inefficiency estimates may at first seem overly large, they are quite compatible with the wide inter-bank profitability differences observe in the raw ROA data in Table 6. For example, the 10th-to-90th percentiles of average ROA ranges from .00565 to .01861 (a three-fold

[23] We impose the usual symmetry restrictions on $\varphi_{j,k} = \varphi_{k,j}$ and $\theta_{r,q} = \theta_{q,r}$. 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. Appendix Table A2 displays the estimated parameters of the profit function (equation 4).

difference), the 5th-to-95th ROA spread ranges from .00317 to .02064 (a six-fold difference), and the 5th-to-99th ROA spread ranges from .00317 to .02412 (an eight-fold difference).

Credit unions exhibit larger amounts of variable profit inefficiency than commercial banks. On average, credit union inefficiency is about 27% larger (0.0195 > 0.0153) per dollar of assets and about 21% larger (0.9686 > 0.7980) per dollar of potential profits. Credit unions are also more profit inefficient than banks in each of the four asset-size subsamples. Notably, profit inefficiencies absorb approximately 100% of potential profits at credit unions, a not altogether unexpected outcome for non-profit organizations. Our results contain a suggestion of scale diseconomies, as *Ineff*/*Assets* increases non-trivially for both banks and credit unions with assets greater than $500 million. Nevertheless, evaluating scale economies is beyond the methodological scope of this paper, given that our modelling focuses on the relative inefficiencies of similar credit unions and commercial banks, not the relative profitability of different sized commercial banks or credit unions.

6.2. Disaggregated profit inefficiency

In Table 7 we more fully exploit the capabilities of our model. We decompose total profit inefficiency into individual netput inefficiencies for *Loans*, *Investments*, *Labour* and *Deposits*, and then decompose each of these netput inefficiencies into quantity inefficiencies and pricing differences.

Deposits. The average credit union operates with about 148 basis points (.01478) of total deposit inefficiency per dollar of assets each quarter (given their other netput choices and fixed netput levels). This substantial inefficiency is consistent with credit unions' mandate to provide access to savings and payment services. Valuing deposit inefficiencies using local market interest rates reveals that about 41% percent of the deposit inefficiency at credit unions (.00606/.01478) is quantity inefficiency (using too much deposit funding). The positive pricing difference indicates that credit unions pay above-market prices for deposit inputs, and these pricing inefficiencies account for the remaining 39% of total deposit inefficiency at credit unions (.00872/.01478). Assuming that the deposit supply curve facing credit unions has a positive slope, credit unions do more than just passively provide access to deposit services: They actively attract depositors by offering them higher returns than local banks.

In comparison, the average commercial bank operates with only about 47 basis points of total deposit inefficiency. The near-zero pricing difference of just 1.3 quarterly basis points per dollar of assets for banks is consistent with our assumption that commercial banks are price takers.[24] Hence, nearly all of the deposit inefficiency at commercial banks is quantity inefficiency.

Our results are consistent in spirit with product-line interest rate data collected annually by the NCUA. 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.[25] At this point a note of caution is necessary: The interest rate differences in Figure 2 cannot be directly compared to our estimated pricing difference terms; the former are raw interest rate differences, while the latter (see equation (5)) are interest rate differences multiplied by an estimated inefficiency term.

Labour. The average credit union operates with about 22 basis points of total labour inefficiency per dollar of assets each quarter. Because credit unions have no mandate to create jobs, these are absolute inefficiencies.[26] These inefficiencies stem from over-hiring: When valued at market wage rates, labour inefficiency expands to 30.6 quarterly basis points per asset dollar (credit unions hire too many workers). These quantity inefficiencies are partially offset by pricing *<u>efficiencies</u>* of 8.4 basis points; the negative pricing difference term indicates that credit unions paid their workers below market wages. In any case, all three of the credit union labour inefficiency terms are relatively small, and are not substantially different on average from the labour inefficiency terms for banks.

Recall that we measure the quantity of labour inputs at credit unions based on the assumption that part-time credit union employees work a half-time schedule (20 hours per week). If this assumption

[24] Because we calculate the market average prices **p** using data from the population of commercial banks and credit unions in the local market—not just for the banks and credit unions in our data sets—it is possible for both the credit unions and the banks to pay below (or above) the market average prices in Table 7.

[25] For additional research comparing the deposit rates and loan rate charged by credit unions and commercial banks, see Tatom (2005), Feinberg and Rahman (2006), Jackson (2006), GAO (2006b), Swidler (2010), and PolEcon Research (2017).

[26] The fact that most credit union employees are also credit union members is immaterial, as credit unions do not have a mandate to support local labour markets.

is incorrect, we may be over- or under-estimating the labour inefficiency of credit unions. To check, we re-calculated labour inefficiency under two alternative assumptions: That part-time credit union employees actually work either 16 hours per week (two days) or 24 hours per week (three days). Appendix Table A3 shows that these adjustments move labour inefficiency at credit unions in economically sensible directions, but only by economically insubstantial amounts.

Loans. The average credit union operates with about 55 basis points of total loan inefficiency per asset dollar each quarter. When valued at market interest rates, quantity inefficiencies (the under-production of loans) account for about 95% of total loan inefficiencies (.00522/.00547). Loan pricing *efficiencies* account for the remaining 5% (.00025/.00547) of total loan inefficiencies.[27] Neither the under-production of loans, nor the slightly above-market interest rates earned on loans, are consistent with credit unions' mandate to increase their members' access to credit. On average, credit unions were only slightly more loan-inefficient than banks, which averaged about 48 basis points of total loan inefficiency per asset dollar each quarter.

These results contradict the conventional wisdom that credit unions charge below-market rates on loans. But as indicated by the NCUA interest data in Figure 3, low credit union loan rates may not be as pervasive as conventional wisdom would have us believe. While credit unions have consistently under-priced commercial banks by 100 to 200 basis points on automobile loans and unsecured consumer loans, interest rates on residential mortgages—which are set in highly competitive national financial markets that leave little room for strategic pricing—are relatively similar for credit unions and banks. It may be that differences in the composition of bank and credit union loan portfolios are influencing our estimates. To investigate this possibility, we re-estimated our model after adding two loan mix ratios—*business loans-to-loans* and *real estate loans-to-total loans*—to the vector of fixed netputs $\boldsymbol{z}$. These controls effectively transform our loan-inefficiency measures into *consumer* loan-inefficiency measures. Our results, shown in Appendix Table A3, are robust to making this change.

[27] When valued at market prices, credit union loan inefficiency is .00522. But the opportunity cost of writing one fewer loan depends on the price the credit union would have actually earned. Hence, re-valuing quantity inefficiencies at internal loan prices results in the higher total loan inefficiency of .00547.

We remind the reader again that of the interest rate differences in Figure 3 and the estimated loan pricing inefficiencies in Table 7 are conceptually different economic concepts and the magnitudes of the two cannot be meaningfully compared. For example, our pricing difference term $(\hat{p}_{j,i} - \hat{p}_{j,s})\xi_{j,i}$ compares the loan interest rate of credit union *i* to the average rates charged across *all market s banks*, not just the relatively small commercial banks surveyed by the NCUA or included in our full data sample. Thus, the benchmark average interest rate $\hat{p}_{j,s}$ may include data from larger, transactions-based banks (i.e., securitized lenders) that can under-price both small banks and credit unions on consumer loans. And in any event, imprecision in the *pricing difference* terms resulting from our inability to accurately characterize the individual loan price vectors at banks and credit unions has no impact for our *quantity* inefficiency estimates, as the former are based on average local market loans prices.

Investments. The average credit union operates with about 65 basis points of total investments inefficiency per asset dollar each quarter. Because credit unions have no mandate to use tax breaks to subsidize non-loan investments, these are absolute inefficiencies. About 80% of these inefficiencies (.00520/.00650) are quantity inefficiencies due to the under-investment in interest-bearing securities. Credit unions earn returns on investment securities in excess of those earned by other firms in the local market—as indicated by the positive loan pricing difference term—and these pricing *efficiencies* account for the remaining 20% (.00130/.00650) of total investments inefficiencies.[28] Compared to the average bank, which operates with only about 45 basis points of total investments inefficiency per asset dollar each quarter, the average credit unions is approximately two-thirds more investments inefficient.

There are two potential explanations for credit unions' investments inefficiencies relative to commercial banks. First, credit unions (or their surrogates) may be sub-par investment managers. This seems quite plausible. As small non-profit cooperatives with little upward mobility for specialized talent, credit unions may be unable to hire high quality investment professionals. Consistent with this,

[28] When valued at market prices, credit union investments inefficiency is .00520. But the opportunity cost of investing in one fewer security depends on the price the credit union would have actually earned. Hence, re-valuing quantity inefficiencies at internal investments prices results in the higher total loan inefficiency of .00650.

many credit unions simply rely on larger 'corporate credit unions' to invest their assets for them.[29] During the 2000s, some of these corporates invested heavily in private issue mortgage-backed securities, leading to low returns for credit union assets under their management. Second, regulations may prohibit credit unions from investing in some asset classes that are permissible for commercial banks. This explanation seems unlikely, given the investment pricing efficiencies revealed in our analysis. And while regulations do place many types of financial assets beyond the reach of credit unions, commercial banks face similar prohibitions. For example, credit unions with federal charters are permitted to invest in many of the same financial securities as commercial banks (e.g., residential and commercial mortgage-backed securities, state and municipal securities, US Treasury securities, variable rate investments, and derivative securities related to the core business activities of the credit union).[30] Credit unions with federal charters are also permitted to engage in many of the same investment activities as commercial banks (e.g., fed funds transactions, repurchase agreements, securities lending, securities trading) so long as the securities in these transactions are permissible investments for credit unions.[31] Credit unions with state charters can face either tighter or looser restrictions, although some states simply link allowable investments to those that are permissible for federal credit unions, state or federal savings banks, or state or federal commercial banks (CUNA 2013).

7. Testing hypotheses *H1* and *H2*

We conduct formal statistical tests of hypotheses *H1* and *H2* on a matched pair sample of banks and credit unions. For each quarterly observation for the 1,358 credit unions in our data, we search (with replacement) among the 2,901 commercial banks for a bank that is similar along six dimensions: Observed in the same quarter, has similar asset size, is of similar age, is not an affiliate in a MBHC, is

[29] There are approximately two dozen corporate credit unions in the US. These organizations provide investment, liquidity, payments and settlement services for credit unions. They are non-profit institutions and are jointly owned by the credit unions for which they provide services.
[30] See 12 CFR 703.14 – Permissible investments. As with commercial banks, certain restrictions apply. For example, securities must have at least an investment grade rating, while variable rate investments must be indexed to domestic interest rates.
[31] See 12 CFR 703.13 – Permissible investment activities.

located in the same broad US Census region, and is located in a local market with similar urban density (i.e., in a large urban metro area, a smaller urban micro area, or in a rural area).[32]

We construct the pairs using a nearest-neighbour matching procedure. The nearest-neighbour commercial bank is the one that minimizes the value of a quadratic distance function, specified in terms of the differences between the standardized natural logs of assets and ages for the bank-credit union pair. We apply an arbitrary maximum quadratic distance threshold to eliminate any credit union for which a closely matching commercial bank cannot be found within its geographic area. Our procedure generates a full set of matches (40 quarterly bank observations) for 1,048 of the 1,358 credit unions in our data. Summary statistics for the matched pair data sample are displayed above in Table 4. Further details of our matching procedure are provided in Appendix Table A4.

For each matched credit union-commercial bank pair *p*, we calculate the *profit inefficiency gap* as follows:

$$\textit{Profit inefficiency gap}_p = (\textit{Ineff/Assets})_{p,\, credit\ union} - (\textit{Ineff/Assets})_{p,\, bank} \qquad (6)$$

which corresponds conceptually to the inefficiency gap illustrated in Figure 1. By definition, a commercial bank must use its pre-tax profits to make a tax payment to the government and pay a post-tax return to equity shareholders (either distributed or retained). A credit union does not have to make either of these payments, as it is a tax-exempt non-profit with no equity ownership. These benefits—that is, the sum of (a) the taxes credit unions do not have to pay plus (b) the equity returns credit unions do not have to pay—must accumulate somewhere. They will either be passed along to credit union

[32] We match on asset size because credit unions tend to be smaller than commercial banks. There is near complete agreement among banking researchers that nontrivial scale efficiencies exist within the size range of the small banks in our sample (Berger and Mester, 1997; Wheelock and Wilson, 2011, 2012; Hughes and Mester, 2013). There is less agreement regarding the relationship between bank size and technical efficiency, with some studies find positive relationships and others finding negative relationships (see Berger, Demsetz and Strahan, 1999). We match on age because previous studies find that both technical efficiency and scale efficiency improve with bank age (DeYoung and Hasan 1998, DeYoung 2005). We include only non-MBHC banks as potential matches because credit unions tend to be stand-alone operations. We match on metro, micro and rural to control for differences in competitive conditions, business practices, demographics, and cultural norms. The broad economic regions are based on geographic lines drawn by the US Census Bureau: The North East region comprises New England and Mid-Atlantic divisions; the Midwest region comprises East North Central and West North Central divisions; the South region comprises the South Atlantic division, East South Central and West South Central divisions; and the West region comprises Mountain and Pacific divisions.

members via mandated inefficiency (excessive lending and/or below-market loan interest rates, excessive deposit funding and/or above-market deposit interest rates, or hypothesis *H1*) or absorbed as absolute inefficiency (excessive hiring and/or above-market wages and benefits, deficient investments and/or lower returns on investments, or hypothesis *H2*). Thus, the profit inefficiency gap must be equal to the sum of (a) and (b).

The profit inefficiency gap is a natural vehicle for testing our hypotheses, as it captures the net inefficiency of credit unions relative to commercial banks. Furthermore, by decomposing the gap into its component parts, we can uncover how much of the tax subsidy reaches credit union members, and how much is diverted to other stakeholders.

7.1. Test results

Table 8 reports the average estimated profit inefficiency gaps for the matched pairs. The average gap is positive and statistically significant for the matched pair sample, indicating greater amounts of profit inefficiency at credit unions than at similar commercial banks. When expressed in terms of market netput prices, the quarterly profit inefficiency gap averages about 24 basis points (0.00237) per dollar of assets, or approximately 95 basis points annually. When expressed in terms of the netput prices actually paid or received by individual banks and credit unions, the quarterly inefficiency gap expands to 122 basis points (0.01224) per dollar of assets, or approximately 490 basis points annually. Hence, quantity inefficiencies account for only about 19% (.00237/.01224) of the profit inefficiency gap at credit unions, with pricing inefficiencies accounting for the remaining 81%.

The matched sample results in Table 8 are robust in size and significance to disaggregation across the asset-size subsamples. The only exception is the market-value profit inefficiency gap for the largest credit unions: When all netputs are valued at market prices, credit unions with assets greater than $500 million are neither more nor less profit inefficient than similar commercial banks. Consistent with the findings of Wheelock and Wilson (2011), this could indicate the existence of positive scale effects that allow large credit unions to shed quantity inefficiencies faster than banks, either by increasing the production of loans and investments and/or by decreasing the use of labour and deposit funding. For example, larger size and greater fixed resources might give these credit unions access to "commercial bank quality" management or attract more capable and more focused directors.

Regardless, the reduction in quantity inefficiencies at these large credit unions is offset by (mainly deposit) pricing inefficiencies, as indicated by the internal value inefficiency gap of 0.01205 for these firms.

In Table 9 we decompose the profit inefficiency gaps into four netput-specific inefficiency gaps. Deposit inefficiencies account for the lion's share of the profit inefficiency gap between credit unions and banks. Credit unions are a statistically and economically significant 109.3 basis points per dollar of assets more deposit-inefficient each quarter than similar commercial banks. This result is consistent with mandated inefficiencies, as both over-using deposit inputs (quantity inefficiency) and paying super-market deposit rates (a positive pricing difference) relative to banks are consistent with the credit union mandate to subsidize depositor members. The investment inefficiencies gap is also statistically significant and economically large, as credit unions are 22.2 basis points per dollar of assets more investment-inefficient than banks. This result is consistent with absolute inefficiency, as credit unions have no mandate to subsidize non-loan investments. Credit unions are 8.8 basis points per dollar of assets less loan-inefficient (more loan efficient) than banks. This result is consistent with mandated inefficiencies so long as it is driven by high production of loan outputs (quantity efficiency) rather than by charging high loan rates (a positive pricing difference) relative to banks. The labour inefficiency gap is not statistically different from zero. By construction, these four netput inefficiency gaps sum to the corresponding total profit inefficiency gap of 0.01224 in the first row of Table 8.

Decomposing the deposit inefficiency gap, we find that credit unions are more quantity inefficient by 15.7 basis points, and more price inefficient by 93.6 basis points, per quarter than similar commercial banks. While both of these differences are statistically significant, the pricing difference (paying high deposit rates) is economically substantial and comprises 86 percent of the total gap.[33] For investments, credit unions are more quantity inefficient (produce fewer investment outputs) by 13.9 basis points relative to banks, but have a larger pricing difference (earn higher percent returns) by 8.3

[33] A portion of this deposit pricing inefficiency is driven by differences in the mix of deposit products at bank and credit unions deposit mixes. For example, 19.3% of commercial banks' deposits are non-interest bearing business accounts, compared to only 13.7% for credit unions. Nevertheless, systematic differences in deposit mix across credit unions and commercial banks do not invalidate our inefficiency calculations, because both banks and credit unions freely choose these mixes.

basis points relative to banks.[34] Both differences are statistically and economically significant. For loans, credit unions are less quantity inefficient (produce more loan outputs) by 7.1 basis points relative to banks, and have a smaller loan pricing difference (charge lower loan rates) by 1.7 basis points relative to banks.[35] Both of these results are statistically significant and consistent with mandated inefficiencies—however, these results are economically small compared to the gaps for deposits and investments. For labour, credit unions have a statistically significant 1.4 basis point smaller price difference (pay lower wages) relative to banks, but this difference is hardly economically significant.

We find relatively robust results when we decompose the profit inefficiency gap separately for each of the four asset-size subsamples. For the *Deposits* and *Labour* netputs, the economic magnitudes and statistical significance of the total inefficiency, quantity inefficiency, and pricing difference gaps are relatively robust to changes in size. For the *Loans* netput, the total inefficiency gap decreases (becomes more negative) by about 200 basis points with firm size. This pattern is chiefly driven by reductions in the quantity inefficiency gap ($-.00016$, $-.00029^{**}$, $-.00092^{***}$, $-.00216^{**}$); the pricing inefficiency gap remains stable, with the exception that the mandated loan pricing inefficiencies disappear for the largest credit unions ($.00022^{***}$, $.00017^{***}$, $.00024^{***}$, $.00004$). For the *Investments* netput, the total inefficiency gap increases by about 200 basis points with firm size. This pattern is driven approximately equally by increases in the quantity inefficiency and pricing inefficiency gaps; under-production of investments grows worse at larger credit unions, despite that fact that these firms are earning an above-market return on these investments. Thus, as the matched pairs grow larger, credit unions become about 200 basis points less loan quantity inefficient (they increase loan production) relative to banks, but about 100 basis points more investments inefficient (they reduce investments in interest-bearing securities) relative to banks. This trade-off once again suggests the existence of scale effects that improve credit unions' ability to satisfy their credit provision mandate.

7.2. Summary of test results

[34] Both the banks and the credit unions earn above-market investment returns on average, but the credit unions' premium exceeds the banks' premium.

[35] Both banks and credit unions charge above-market loan rates on average, but the banks' premium exceeds the credit unions' premium.

The matched pair analysis confirms the existence of substantial mandated inefficiencies at credit unions (our hypothesis H1) as well as non-trivial absolute inefficiencies at credit unions (our hypothesis H2). Credit unions are an estimated 122 quarterly basis points on average more profit inefficient per dollar of assets than similar commercial banks, and mandated inefficiencies in the form of benefits to credit union depositors comprise the largest portion of this profit inefficiency gap. Relative to banks, credit unions use inefficiently large amounts of deposit inputs and pay inefficiently high interest rates to these depositors; together, these relative deposit inefficiencies account for 109 basis points of the total 122 basis point quarterly inefficiency gap.

In contrast, credit unions are slightly *more* loan efficient on average than similar banks, as indicated by their negative quarterly loan inefficiency gap of about 9 basis points. The two behaviours underlying this productive efficiency—all else equal, credit unions produce more loan outputs than banks but charge their borrowers slightly lower interest rates—are both consistent with credit unions' mandate to provide credit to their members. The resulting small net increase in loan revenues supplements credit unions' tax subsidies, providing additional capacity for credit unions to pursue their overall mandate by operating inefficiently.

Still, credit unions operate with economically non-trivial levels of absolute inefficiencies. Despite earning above-market returns on investment securities, credit unions under-produce these assets relative to banks; on average, this adds 22 basis points per dollar of assets to their quarterly inefficiency gap. Thus, for every dollar of tax subsidy that gets passed through as intended to depositor members, an additional 20 cents of the tax subsidy (22/109) is wasted—that is, not passed along to credit union members via mandated inefficiencies—by credit unions *over and above* the levels of inefficiency already present at similar commercial banks. On an annualized basis, the investments inefficiency gap of 88.8 basis points per dollar of assets (4*22.2) is nearly as large as the 113.6 basis point pre-tax return on assets earned annually by similar commercial banks (see Table 4).

To better grasp the overall and interactive roles of these various profit and netput inefficiency measures, the following equation (based on quarterly figures) may be helpful: 122 basis points (total profit inefficiency gap) + 9 basis points (supplement from mandated loan efficiencies gap) = 109 basis points (mandated deposit inefficiencies gap) + 22 basis points (absolute investment inefficiencies gap)

+ 0 basis points (absolute labour inefficiencies gap). Thus, giving credit unions deserved credit for generating 9 basis points of loan efficiency, their *net* profit inefficiency gap is 22 – 9 = 13 quarterly basis points per dollar of assets, or about basis points 52 annually, still an economically significant amount.

8. Conclusions

In the US, credit unions are exempt from paying federal income taxes (and in most cases, state income taxes), yet they compete directly in credit and deposit markets with small commercial banks that do pay income taxes. This tax policy dates back to 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 meant to encourage the credit unions to organize and supply credit to low and moderate income households, at a time when neither commercial banks nor savings banks made very many consumer loans. But considerable changes in the banking industry, financial markets, and information technology over the past 80 years, and as a result low and moderate income households now have plentiful (some might argue too plentiful) access to credit. And over the past several years, new regulatory rulings have allowed credit unions to make more business loans, tap external sources for equity capital, and expand membership almost without boundaries, changes that are lessening credit unions' historical distinctions from commercial banks. These developments invite the question: Should credit unions still be exempt from income taxes?

We provide new evidence to help answer this question, by scrutinizing the manner in which credit unions exploit their income tax exemptions. We begin by estimating a structural profit inefficiency model (Berger, Hancock and Humphrey 1993, DeYoung and Nolle 1996) for a quarterly data panel of small US commercial banks between 2005 through 2014. We then use the estimated model parameters to evaluate the relative performance of 1,084 matched pairs of US credit unions and commercial banks. The evidence indicates that a large majority of the credit union tax subsidy does get passed along to credit union members—predominantly by way of above-market interest rates paid to depositor-members—but also shows that an economically substantial amount of the tax subsidy gets diverted away from credit union members, predominantly due to inefficiencies in non-loan investments portfolios. On average, these non-mandated profit inefficiencies consume about 50 net basis points per dollar of credit union assets annually, *over and above* the total profit inefficiencies that exist at comparable commercial banks. Thus, while the average credit union has been in substantial compliance with its legislative mandate to use the tax exemption to benefit its members, the average credit union has also been wasting economically large amounts of the tax subsidy and hence fallen short of full compliance with its mandate.

When we evaluate how effectively credit unions utilize their tax subsidy for the benefits of their members, it may be tempting to discount this net inefficiency gap. After all, according to our estimates the mandated deposit inefficiencies that credit unions transfer to their members are on average five times larger than the absolute investments inefficiencies that credit unions leave on the table. But this relativism would miss the point. The credit union tax subsidy represents foregone tax revenue that must be made up by either increasing taxes on others or by increased government borrowing. And these absolute inefficiencies represent taxpayer dollars that are not being passed through as mandated to credit union members; as a result, member benefits are approximately one-fifth smaller than they would be in the absence of these non-mandated inefficiencies.

These findings are consistent with our priors that weak governance arrangements and poor monitoring incentives at credit unions allow credit union managers to operate more inefficiently than comparable commercial banks, thus allowing operational inefficiencies to consume a non-trivial portion of the tax subsidy that is supposed to be passed along to credit union members. As such, our findings have implications for three sets of stakeholders. First, credit union members are receiving fewer benefits than intended by the legislation that established the tax exemptions (Revenue Act of 1916, Federal Credit Union Act of 1934). Second, taxpayers' funds are being misallocated because "tax expenditures" are being diverted away from their intended beneficiaries. Third, these inefficiencies buttress arguments that the tax exemption provides credit unions with an unfair competitive advantage over commercial banks.

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Table 1

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.

	Banks	Credit unions
Profit		
Profits $\pi_{i,t}$	Pre-tax net income	Surplus
Netputs		
Loans $x_{1,i,t}$	Total loans	Total loans and 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)
MBHC $z_{5,i,t}$	Equal to 1 if organized as a multibank holding company	Equal to 0
Subchapter S $z_{6,i,t}$	Equal to 1 if organized as a Subchapter S corporation	Equal to 0
Other		
Assets	Total assets	Total assets
Age	Age in years	Age in years

Table 2

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 prices.

	Banks	Credit unions
Institutions reporting in every quarter from 2005.1 through 2014.4	5,217	6,335
Mean quarterly assets less than $50 million	(1,118)	(4,414)
Mean quarterly assets greater than $6.306 billion	(114)	(10)
Missing data	(1,025)	(526)
Institutions between $50 million and $6.306 billion with complete data	2,960	1,385
Mean ROA in the 1^{st} or 100^{th} percentile of its distribution	(59)	(27)
Institutions used to estimate the profit function	2,901	0
Members of multi-bank holding companies	(1,018)	0
Institutions for which we calculate profit inefficiency ("full data set")	1,883	1,358
Institutions for which we test hypotheses *H1* and *H2* ("matched data set")	1,084	1,084

Table 3

This table reports the number of survivors, annual rates of attrition, and mean annual return on assets (ROA) for banks and credit unions. The data begin in the first quarter of 2005 and include all institutions with assets between $50 million and $6.306 billion at that date, in 2010 prices. (Note: The numbers of observations in this table do not match the numbers of observations in Table 2, due to the different methodological objectives of the tables.)

	Banks			Credit unions		
	Number	% rate of attrition	Average ROA	Number	% rate of attrition	Average ROA
2005	6,003	-	.01617	2,180	-	.00742
2006	5,759	*4.1*	.01609	2,161	*0.9*	.00708
2007	5,530	*4.0*	.01395	2,128	*1.5*	.00601
2008	5,287	*4.4*	.00601	2,102	*1.2*	.00014
2009	5,077	*4.0*	.00183	2,079	*1.1*	-.00062
2010	4,881	*3.9*	.00540	2,044	*1.7*	.00279
2011	4,636	*5.0*	.00809	2,013	*1.5*	.00467
2012	4,490	*3.1*	.01064	1,989	*1.2*	.00573
2013	4,329	*3.6*	.01089	1,955	*1.7*	.00536
2014	4,159	*3.9*	.01181	1,937	*0.9*	.00572

Table 4

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 2005-2014. Number of firms are reported in parentheses. All monetary amounts in 2010 prices. Netputs, Fixed factors, and Other variables are end-of-quarter values. Netput market prices and Netput internal prices variables are constructed using quarterly flows. Profitability variables are annualized.

	Data for profit model		**Full data set**				**Matched data set**			
	Banks and BHCs (n=2,901)		Free-standing banks (n=1,883)		Credit unions (n=1,358)		Free-standing banks (n=1,084)		Credit unions (n=1,084)	
	mean	std dev	mean	std dev	mean	std dev	mean	std dev	mean	std dev
Profitability										
Profit ($ million, pre-tax, annualized)	4.6	9.5	2.8	4.5	2.2	4.9	3.1	4.0	1.6	2.7
Return on assets (pre-tax, annualized)	.01219	.00521	.01159	.00519	.00503	.00353	.01136	.00484	.00500	.00355
Netputs ($ million)										
Loans	234.4	411.2	149.0	215.2	223.5	393.8	171.7	209.6	182.0	234.3
Investments	94.8	174.7	66.2	111.7	85.9	186.4	86.0	114.7	65.9	100.6
Labour	97.1	172.4	63.2	74.6	94.1	123.5	77.6	73.2	83.7	82.5
Deposits	289.5	504.7	184.7	264.0	313.1	526.1	226.5	276.8	252.5	304.8
Netput market prices										
Price(Loans)	.01491	.00149	.01485	.00154	.01445	.00232	.01456	.00147	.01457	.00207
Price(Securities)	.00854	.00056	.00858	.00057	.00871	.00083	.00859	.00065	.00872	.00080
Price(Labour) ($ thousand)	17.15	3.06	17.29	3.18	18.88	3.85	18.04	3.37	18.55	3.61
Price(Deposits)	.00439	.00047	.00435	.00047	.00422	.00055	.00430	.00050	.00428	.00048
Netput internal prices										
Price(Loans)	.01633	.00194	.01648	.00213	.01554	.00264	.01694	.00493	.01559	.00184
Price(Securities)	.00850	.00154	.00847	.00142	.01011	.00638	.00839	.00128	.01025	.00671
Price(Labour) ($ thousand)	14.67	3.51	14.71	3.54	14.23	3.13	14.33	3.32	14.09	3.10
Price(Deposits)	.00450	.00096	.00452	.00098	.01059	.00327	.00410	.00114	.01053	.00318
Fixed factors ($ million)										
Premises	6.6	11.6	4.2	6.1	8.0	12.0	4.9	5.9	7.1	8.5
Equity	37.7	67.0	24.7	38.5	36.9	60.4	30.2	43.0	30.5	38.0
Noninterest Income	1.0	3.1	0.5	1.1	1.2	2.1	0.6	0.9	1.1	1.3
Risk-weighted Assets	254.6	449.8	162.1	247.6	222.7	383.3	189.5	234.8	182.9	228.8
MBHC	.3509	-	-	-	-	-	-	-	-	-
Subchapter S	.3975	-	.3967	-	-	-	.3297	-	-	-
Other										
Assets ($ million)	366.7	628.3	239.1	345.3	353.2	590.6	286.3	344.0	285.5	344.7
Age (years)	81.9	38.6	81.1	38.6	59.1	14.6	62.2	17.8	59.9	14.6

Table 5

This table reports estimated profit inefficiencies. The profit model (3a) and (4) was estimated using quarterly 2005-2014 data from 2,901 commercial banks. The estimated parameters were then used to calculate profit inefficiencies for both commercial banks and credit unions. Panel A shows the results for the full sample of 1,883 free-standing banks and 1,358 credit unions. Panel B shows the results for the matched pair sample of 1,084 free-standing banks and 1,084 credit unions. The raw estimated inefficiency measures were winsorized at the 5th and 95th percentiles of the sample distributions before calculating the statistics in this table. All measures reported here are expressed in terms of local market netput prices.

	Number	Mean *Ineff* ($ million)	Std Dev *Ineff* ($ million)	Mean *Ineff/Assets*	Mean *Ineff* / (*Ineff*+ π)
Panel A: Full sample					
Banks	1,883	4.121	8.060	.0153	.7980
Credit unions	1,358	7.717	13.293	.0195	.9686
Banks					
$50 to $100 million	593	1.152	0.320	.0159	.8471
$100 to $200 million	632	2.030	0.651	.0142	.8134
$200 to $500 million	488	4.100	1.762	.0136	.7071
$500 million to $6.306 billion	170	22.318	18.226	.0224	.8311
Credit unions					
$50 to $100 million	452	1.303	0.365	.0184	.9967
$100 to $200 million	347	2.396	0.741	.0173	.9999
$200 to $500 million	320	5.488	2.259	.0177	.9500
$500 million to $6.306 billion	239	30.557	18.701	.0275	.8948
Panel B: Matched pairs sample					
Banks	1,084	6.320	11.625	.0173	1.0080
Credit unions	1,084	6.858	12.013	.0196	.9680
Banks					
$50 to $100 million	349	1.227	0.324	.0164	1.0105
$100 to $200 million	286	2.128	0.832	.0148	1.2505
$200 to $500 million	277	4.756	2.352	.0146	.8461
$500 million to $6.306 billion	172	26.144	19.080	.0274	.8601
Credit unions					
$50 to $100 million	349	1.325	0.354	.0186	.9929
$100 to $200 million	286	2.440	0.736	.0176	.9979
$200 to $500 million	277	5.535	2.240	.0178	.9462
$500 million to $6.306 billion	172	27.567	19.377	.0282	.9032

Table 6

This table displays the distribution of average annualized return on assets (ROA) for the 1,833 free-standing commercial banks, calculated using 40 quarters of data (2005-2014) for each bank.

Percentile	ROA
99th	.02412
95th	.02064
90th	.01861
75th	.01559
50th	.01226
25th	.00890
10th	.00565
5th	.00317
1st	-.00165

Table 7

This table reports the mean values of profit inefficiency per dollar of assets (*Ineff/Assets*) decomposed across four netput categories (*Loans*, *Securities*, *Labour*, *Deposits*) and three measures of inefficiency (*total inefficiency*, *quantity inefficiency*, *pricing difference*). We perform the decompositions as follows:

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

for netputs *j*, netput prices *p*, firms *i*, and local markets *s*. Results are reported for 1,833 free-standing banks and 1,358 credit unions. The raw estimated inefficiency measures were winsorized at the 5^{th} and 95^{th} percentiles of the sample distribution before calculating the mean values in this table.

	Loans	*Investments*	*Labour*	*Deposits*
Banks				
Total inefficiency/Assets (internal prices)	.00475	.00447	.00207	.00467
Quantity inefficiency/Assets (market prices)	.00424	.00399	.00255	.00455
Pricing differnce/Assets	.00051	.00048	-.00048	.00013
Credit unions				
Total inefficiency/Assets (internal prices)	.00547	.00650	.00222	.01478
Quantity inefficiency/Assets (market prices)	.00522	.00520	.00306	.00606
Pricing difference/Assets	.00025	.00130	-.00084	.00872

Table 8

This table reports the average profit inefficiency gaps (5) from difference-in-means tests (mean credit union inefficiency minus mean bank inefficiency) for 1,084 matched pairs of commercial banks and credit unions. We calculate the profit inefficiency gap as follows:

$$\textit{Profit inefficiency gap}_p = (\textit{Ineff/Assets})_{p,\ credit\ union} - (\textit{Ineff/Assets})_{p,\ bank}$$

z-statistics (in parentheses) refer to difference-in-means tests (mean credit union *Ineff/Assets* minus mean bank *Ineff/Assets*). The raw estimated inefficiency measures were winsorized at the 5^{th} and 95^{th} percentiles of the sample distribution before calculating the measures displayed in this table. ***, ** and * indicate a statistically significant difference at the 1%, 5% and 10% levels, respectively.

		Profit inefficiency gaps	
	# of pairs	market prices	internal prices
All matched pairs	1,084	.00237***	.01224***
		(9.29)	(32.99)
Size subsamples			
\$50m-\$100m	349	.00216***	.01279***
		(8.41)	(25.27)
\$100m-\$200m	286	.00275***	.01214***
		(10.14)	(21.12)
\$200m-\$500m	277	.00315***	.01176***
		(9.15)	(21.62)
\$500m-\$6.306b	172	.00089	.01205***
		(0.66)	(7.27)

Table 9

This table decomposes profit inefficiency gaps for 1,084 matched pairs of credit unions and banks. We calculate the profit inefficiency gap as follows:

$$\textit{Profit inefficiency gap}_p = (\textit{Ineff/Assets})_{p,\ credit\ union} - (\textit{Ineff/Assets})_{p,\ bank}$$

We perform the decompositions as follows:

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

for netputs *j*, netput prices *p*, firms *i*, and local markets *s*. z-statistics (in parentheses) refer to difference-in-means tests (mean credit union *Ineff/Assets* minus mean bank *Ineff/Assets*). The raw estimated inefficiency measures were winsorized at the 5th and 95th percentiles of the sample distribution before calculating the measures reported in this table. ***, ** and * indicate a statistically significant difference at the 1%, 5% and 10% levels, respectively.

Inefficiency Gaps	*Loans*	*Investments*	*Labour*	*Deposits*
All				
Total inefficiency/Assets (internal prices)	-.00088***	.00222***	-.00003	.01093***
	-4.54	*9.03*	*-0.57*	*55.16*
Quantity inefficiency/Assets (market prices)	-.00071***	.00139***	.00011	.00157***
	-3.67	*11.63*	*1.51*	*18.13*
Pricing inefficiency/Assets	-.00017***	.00083***	-.00014***	.00936***
	-3.46	*4.27*	*-3.95*	*56.61*
\$50m-\$100m				
Total inefficiency/Assets (internal prices)	-.00039**	.00151***	-.00002	.01169***
	-2.18	*4.33*	*-0.22*	*29.84*
Quantity inefficiency/Assets (market prices)	-.00016	.00080***	.00006	.00146***
	-1.04	*4.58*	*0.45*	*7.78*
Pricing inefficiency/Assets	-.00022***	.00070**	-.00008	.01023***
	-4.58	*2.47*	*-1.20*	*32.32*
\$100m-\$200m				
Total inefficiency/Assets (internal prices)	-.00046**	.00178***	.00003	.01081***
	-2.51	*3.89*	*0.26*	*27.03*
Quantity inefficiency/Assets (market prices)	-.00029*	.00147***	.00006	.00151***
	-1.76	*6.79*	*0.37*	*10.19*
Pricing inefficiency/Assets	-.00017***	.00031	-.00004	.00929***
	-2.83	*0.82*	*-0.41*	*27.21*
\$200m-\$500m				
Total inefficiency/Assets (internal prices)	-.00116***	.00262***	.00002	.01027***
	-6.15	*5.27*	*0.22*	*34.55*
Quantity inefficiency/Assets (market prices)	-.00092***	.00180***	.00031**	.00196***
	-5.19	*6.41*	*2.14*	*13.96*
Pricing inefficiency/Assets	-.00024***	.00082**	-.00029***	.00832***
	-5.06	*2.40*	*-4.94*	*33.79*
\$500m-\$6,306m				
Total inefficiency/Assets (internal prices)	-.00212**	.00372***	-.00023*	.01068***
	-1.97	*4.59*	*-1.89*	*21.33*
Quantity inefficiency/Assets (market prices)	-.00216**	.00179***	.00000	.00126***
	-1.97	*5.62*	*-0.02*	*6.32*
Pricing inefficiency/Assets	.00004	.00194***	-.00023***	.00941***
	0.14	*2.90*	*-3.22*	*22.31*

Figure 1

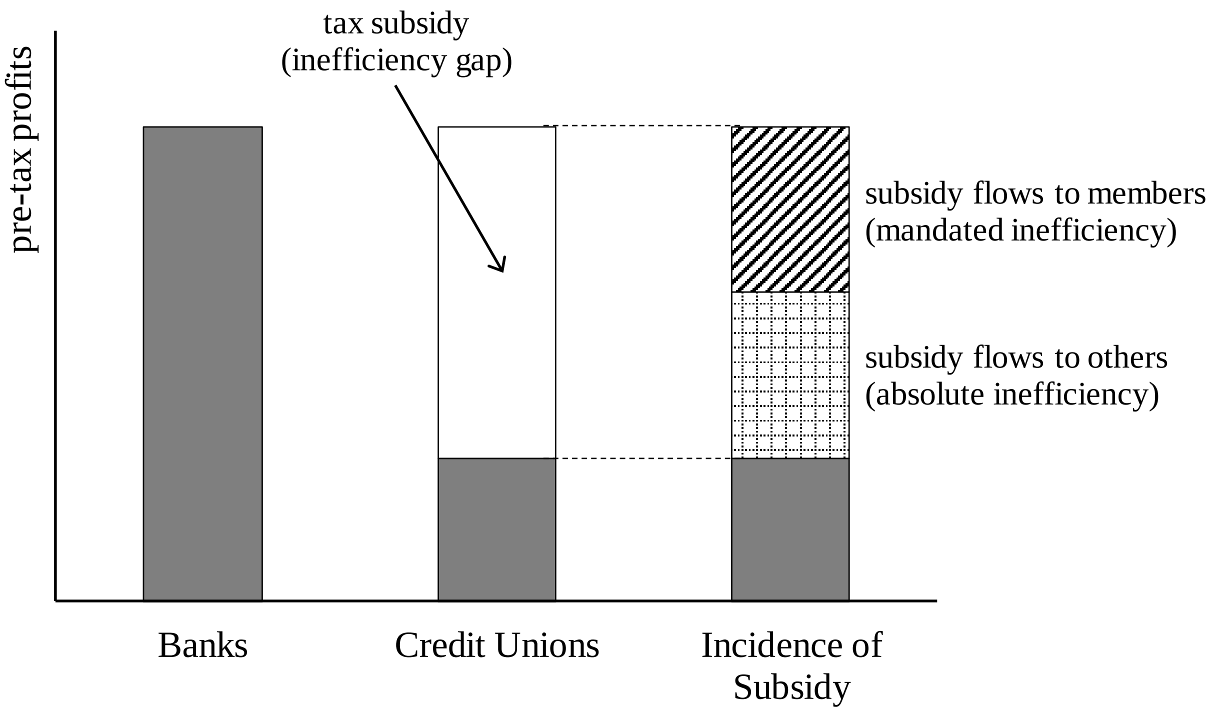

pre-tax profits
tax subsidy
(inefficiency gap)
subsidy flows to members
(mandated inefficiency)
subsidy flows to others
(absolute inefficiency)
Banks
Credit Unions
Incidence of
Subsidy

Figure 2

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.

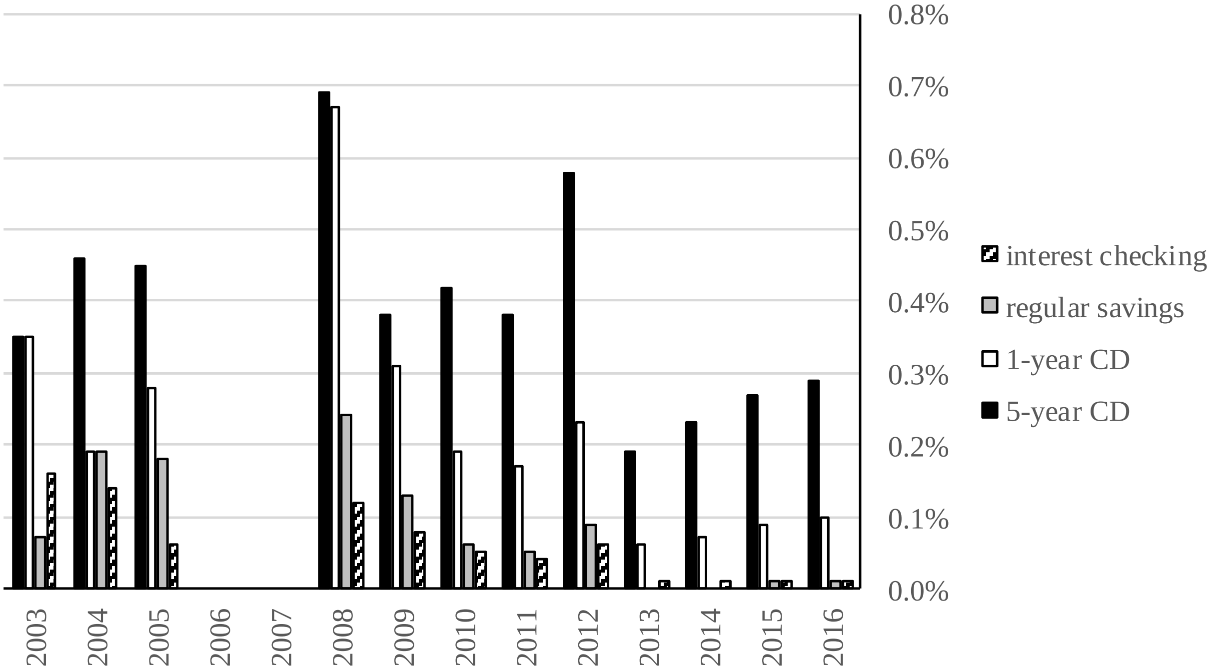
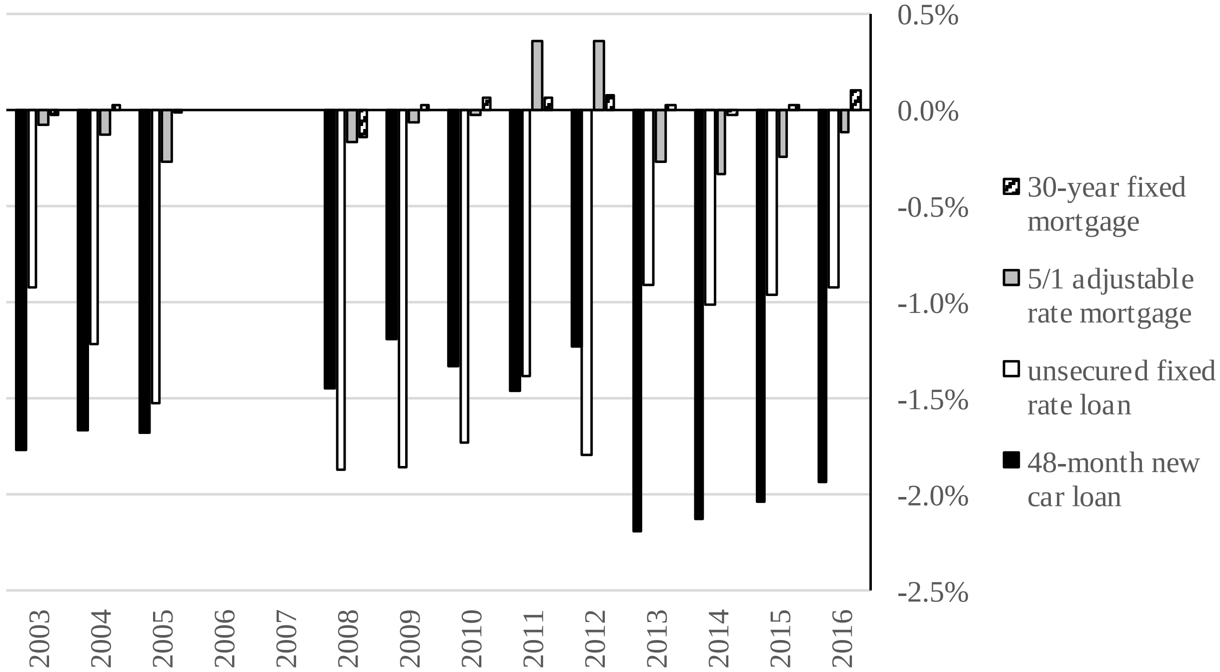


Figure 3

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.



Appendix Table A1

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 Table A2

Estimated profit function

The profit function specification is shown as equation (4). The dependent variable is $\pi_{i,t}/p_{4,s,t}$. The fixed effects estimation uses 116,040 observations on 2,901 banks with 40 complete quarterly observations for the period 2005.1-2014.1. ***, ** and * indicate coefficients statistically significant at the 1%, 5% and 10% levels, respectively.

Covariate	Coefficient	Covariate	Coefficient	Covariate	Coefficient
$p_{1,s,t}/p_{4,s,t}$	2596.2	$z_{1,i,t}^2$	.000248***	$p_{1,s,t}z_{1,i,t}/p_{4,s,t}$	4.2225***
$p_{2,s,t}/p_{4,s,t}$	-114648***	$z_{1,i,t}z_{2,i,t}$	.000061***	$p_{1,s,t}z_{2,i,t}/p_{4,s,t}$	-.6264***
$p_{3,s,t}/p_{4,s,t}$	9.3709***	$z_{1,i,t}z_{3,i,t}$	-.000136***	$p_{1,s,t}z_{3,i,t}/p_{4,s,t}$	-19.837***
		$z_{1,i,t}z_{4,i,t}$	-.000008***	$p_{1,s,t}z_{4,i,t}/p_{4,s,t}$	.2623***
$p_{1,s,t}^2/p_{4,s,t}^2$	-3542.3***	$z_{1,i,t}z_{5,i,t}$	-22.828***	$p_{1,s,t}z_{5,i,t}/p_{4,s,t}$	22037***
$p_{1,s,t}p_{2,s,t}/p_{4,s,t}^2$	19255***	$z_{1,i,t}z_{6,i,t}$	-15.450***	$p_{1,s,t}z_{6,i,t}/p_{4,s,t}$	5909.7
$p_{1,s,t}p_{3,s,t}/p_{4,s,t}^2$	-.2469	$z_{2,i,t}^2$	-.000003***	$p_{2,s,t}z_{1,i,t}/p_{4,s,t}$	35.055***
$p_{2,s,t}^2/p_{4,s,t}^2$	-15517***	$z_{2,i,t}z_{3,i,t}$	.000386***	$p_{2,s,t}z_{2,i,t}/p_{4,s,t}$	.3155
$p_{2,s,t}p_{3,s,t}/p_{4,s,t}^2$	-2.7742**	$z_{2,i,t}z_{4,i,t}$	-.000003***	$p_{2,s,t}z_{3,i,t}/p_{4,s,t}$	-48.888***
$p_{3,s,t}^2/p_{4,s,t}^2$	.000257	$z_{2,i,t}z_{5,i,t}$	7.2922***	$p_{2,s,t}z_{4,i,t}/p_{4,s,t}$	.0747
		$z_{2,i,t}z_{6,i,t}$	.7819	$p_{2,s,t}z_{5,i,t}/p_{4,s,t}$	-153935***
$z_{1,i,t}$	-69.446***	$z_{3,i,t}^2$	.000648***	$p_{2,s,t}z_{6,i,t}/p_{4,s,t}$	44134***
$z_{2,i,t}$	-1.9792***	$z_{3,i,t}z_{4,i,t}$	-.000068***	$p_{3,s,t}z_{1,i,t}/p_{4,s,t}$	-.00904***
$z_{3,i,t}$	226.5***	$z_{3,i,t}z_{5,i,t}$	-29.940***	$p_{3,s,t}z_{2,i,t}/p_{4,s,t}$	.00104***
$z_{4,i,t}$	-.3837***	$z_{3,i,t}z_{6,i,t}$	-77.631***	$p_{3,s,t}z_{3,i,t}/p_{4,s,t}$	.02102***
$z_{5,i,t}$	83170***	$z_{4,i,t}^2$	.0000003***	$p_{3,s,t}z_{4,i,t}/p_{4,s,t}$	.000005
$z_{6,i,t}$	-155787***	$z_{4,i,t}z_{5,i,t}$	.2257***	$p_{3,s,t}z_{5,i,t}/p_{4,s,t}$	18.016***
		$z_{4,i,t}z_{6,i,t}$	1.0000***	$p_{3,s,t}z_{6,i,t}/p_{4,s,t}$	-1.839
		$z_{5,i,t}z_{6,i,t}$	-12086		

Appendix Table A3

This table displays robustness tests for Table 7. In Panel A, we re-calculated labour inefficiency under two alternative assumptions: Part-time credit union employees actually work either 16 hours per week (two days) or 24 hours per week (three days). In Panel B, we re-calculated loan inefficiency after expanding the vector of fixed netputs ***z*** to included the *business loans-to-loans* ratio and the *real estate loans-to-total loans* ratio.

Panel A

	Loans	*Investments*	*Labour*	*Deposits*
Credit unions (a part timer works 0.4 FTE)				
Total inefficiency/Assets (internal prices)	.00547	.00650	.00222	.01478
Quantity inefficiency/Assets (market prices)	.00522	.00520	.00303	.00606
Pricing inefficiency/Assets	.00025	.00130	-.00081	.00872
Credit unions (a part timer works 0.6 FTE)				
Total inefficiency/Assets (internal prices)	.00547	.00650	.00221	.01478
Quantity inefficiency/Assets (market prices)	.00522	.00520	.00309	.00606
Pricing inefficiency/Assets	.00025	.00130	-.00088	.00872

Panel B

	Loans	*Investments*	*Labour*	*Deposits*
Banks				
Total inefficiency/Assets (internal prices)	.00515	.00725	.00186	.00360
Quantity inefficiency/Assets (market prices)	.00459	.00651	.00230	.00350
Pricing inefficiency/Assets	.00056	.00074	-.00045	.00010
Credit unions				
Total inefficiency/Assets (internal prices)	.00753	.00560	.00226	.01353
Quantity inefficiency/Assets (market prices)	.00713	.00451	.00312	.00552
Pricing inefficiency/Assets	.00040	.00108	-.00086	.00800

Appendix Table A4

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 search from among all of the banks headquartered in the same state as to locate, for each credit union, the bank whose values of the covariates ln(Assets) and ln(Age) minimize a quadratic distance function, specified using an inverse variance weighting matrix to normalize the covariates. Each bank is eligible to be paired with more than one credit union. Only those credit unions headquartered in states with at least 20 banks are considered.

The initial matching procedures located 899 matched pairs of credit unions and banks. We then apply an arbitrary cut-off threshold of distance < 0.3 to eliminate poorly matched pairs.

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. The following table illustrates the performance of the matching procedure, by reporting the values of the asset size and age covariates for the pairs located at various percentiles of the distribution of the matched-pairs samples ranked in ascending order of the minimized value of the distance function. The differences between the absolute values of the asset size and age covariates for each matched pair are smallest (largest) at the lowest (highest) distance function percentiles.

	p5	p25	p50	Threshold	p75	p95
Assets: Credit unions	181.4	58.9	134.2	392.8	69.1	50.3
Assets: Banks	186.4	52.3	120.4	291.5	77.4	120.4
Age: Credit unions	70	75	84	85	78	84
Age: Banks	68	72	72	70	55	70
Distance function	.0033	.0235	.0788	.2186	.2993	.7174

Our results are robust to using different values for the distance function cut-off threshold used to define the matched-pairs samples created by the nearest-neighbour matching procedure. The distance function 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 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 distance function cut-off threshold of 0.3 replicate results reported in the body of the paper.

Distance function cut-off	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* $\hat{p}_{4,s}\xi_{4,i} / \hat{a}_i$
0.2	957	.01238*** *32.39*	-.00082*** *-4.44*	.00228*** *8.54*	-.00004 *-0.78*	.01096*** *52.62*
0.3	1,084	.01224*** *32.99*	-.00088*** *-4.54*	.00222*** *9.03*	-.00003 *-0.57*	.01093*** *55.16*
0.4	1,155	.01219*** *33.56*	-.00082*** *-4.26*	.00215*** *8.94*	-.00001 *-0.20*	.01087*** *56.86*
None	1,320	.01144*** *29.62*	-.00052*** *-2.70*	.00150*** *5.45*	-.00008* *-1.75*	.01055*** *56.44*