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, credit union members may not receive the full measure of these subsidies, due to weak governance and operational inefficiencies at these mutually owned cooperatives. 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 618 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 by hiring excess workers and by earning below-market returns on investment securities. These two inefficiencies amount to 48 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

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1. Introduction

Nearly 6,000 credit unions operate in the US, collectively holding $1.3 trillion in assets and serving 107 million members (Credit Union National Association, 2016). Credit unions tend to be very small institutions, offer a standard menu of transactions and savings accounts, and extend credit to households predominately in the form of unsecured consumer credit, automobile loans, and home mortgages. While popular with the banking public, credit unions are under renewed legal pressure from commercial bankers. The American Bankers Association (ABA) is currently suing the National Credit Union Administration (NCUA) to forestall changes in 'field-of-membership' rules that would expand the geographic area from which a credit union can draw its membership.[1] The Independent Community Bankers of America (ICBA) is also suing the NCUA, over plans that would let credit unions invest a larger portion of their loan portfolios in business loans.[2]

The underlying motivation for these law suits lies in US tax policy. As member-owned, non-profit organizations, credit unions are exempt from paying taxes on their net income. The implicit understanding is that this tax subsidy will pass-through to credit union members in the form of higher deposit interest rates and/or lower loan interest rates.[3] Because credit unions compete directly with banks in deposit and loan markets, banks argue that this tax subsidy gives credit unions an unfair competitive advantage. From the banks' point of view, relaxing the rules on credit unions' membership and business lending activities will amplify this tax-subsidized advantage. But credit union advocates feel that these concerns are overblown. By commercial bank standards, most credit unions are very small—73% hold less than $100 million in assets, and only 5% hold more than $1 billion—which strongly suggests that their members do indeed share a common bond. And only about one-in-three

[1] ABA press release: http://www.aba.com/Press/Pages/120716ABANCUALawsuit.aspx.
[2] ICBA press release: https://www.icba.biz/stopcugrab/Documents/ICBAReleaseOnCreditUnionLawsuit.pdf.
[3] For the purposes of clarity, we discard some of the idiosyncratic verbiage associated with credit unions. For example, we use "depositors" rather than "savers," and we use "transactions accounts" rather than "share draft accounts," because these different words refer to identical functions at both banks and credit unions. However, 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. We also retain the use of the word credit union "surplus" as separate from bank "profits," because credit union managers are under no obligation to maximize these residual flows in either the short-run or in the long-run.

credit unions make any business loans at all, with business loans comprising just 5% of credit union industry assets (NCUA 2016).

In this paper, we ask two important related questions: First, is the entirety of the credit union tax subsidy actually being passed along, as implicitly mandated, to credit union members as above-market deposit rates and/or below-market loan rates? If so, then the policy debate is limited to the allegedly unfair competitive effects on commercial banks, the effects of which are largely contained within the financial services industry. Second, is a portion of the tax subsidy being passed along to other credit union stakeholders, such as credit union employees? If so, then the policy debate expands to consider the allocative efficiency of the credit union tax subsidy itself.

There are good reasons to suspect that some of the credit union tax subsidy will be misallocated. Chief among these reasons is the weak oversight of credit union management and the decisions that they make. Credit unions are mutually owned by their depositor-members and control of the institution rests with these members. Control rights are widely dispersed; regardless of the size of their accounts, all members have equal voting power in director elections. So an individual credit union member has neither the incentive nor the ability to meaningfully engage in governance. Moreover, because members cannot sell their control rights, there is no market for corporate control to monitor and discipline management. Credit union managers are unlikely to operate the institution efficiently, and the resulting inefficiencies will divert a portion of the tax subsidy away from credit union members.

To investigate these questions, we estimate a structural model of variable profits (Berger, Hancock and Humphrey 1993, DeYoung and Nolle 1996) for a large quarterly data panel of US commercial banks between 2005 and 2014. We use the estimated parameters of this model to evaluate the financial performance of 1,850 small commercial banks and 1,270 credit unions, generating a 'profit inefficiency' score for each institution. We disaggregate these inefficiency scores into their input-specific and output-specific sources, and further disaggregate these sources of profit inefficiency into quantity inefficiencies and pricing inefficiencies. Finally, we construct 618 matched pairs of banks and credit unions, and evaluate the relative inefficiencies of credit unions using the banks' inefficiency scores as benchmarks.

On average, we find that profit inefficiency at credit unions exceeded profit inefficiency at commercial banks by 92 basis points of assets, an economically substantial result given that credit union ROA averaged just 49 basis points for the firms in our sample. But much of this 'inefficiency gap' is explained by the high interest rates that credit unions pay to their member-depositors, consistent with the objectives of the credit union tax-exemption. These deposit flows account for 76% of credit unions' profit inefficiency gap when valued at market average interest rates, and 92% of the inefficiency gap when valued using credit unions' above-market interest rates. But our estimates also suggest that an economically substantial amount of the tax subsidy gets diverted to non-member credit union stakeholders. Relative to commercial banks, credit unions hire an inefficiently large number of employees, and earn an inefficiently low return on the portions of their portfolios that are invested in securities (as opposed to invested in loans), benefiting credit union counterparties in the labour and securities markets, at the expense of tax payers and credit union members. Combined, this misallocation of the tax subsidy is equivalent to 48 basis points per dollar of credit union assets. These results are consistent with the notion that weak corporate governance at credit unions relative to commercial banks creates an environment less conducive to efficient operations.

Our analysis connects to several strands of literature. First, we extend a long established literature that examines the importance of ownership form for the efficiency and performance of financial institutions. Previous work comparing the efficiency of US shareholder and mutual financial institutions has found that mutually owned banks operate more efficiently than shareholder-owned banks (O'Hara, 1981; Mester, 1989, 1993). Evidence from Europe appears to confirm that mutual banks are slightly more efficient than commercial banks (Altunbas, Evans and Molyneux, 2001; Makinen and Jones, 2015). In contrast, we find that cooperative depository institutions are less efficient than shareholder-owned banks. Unlike the aforementioned studies, our empirical analysis is conducted using a matching procedure, which enables us to better isolate the implications of ownership differences for financial performance.

Second, we contribute to the literature on ownership concentration and performance. According to this literature, when ownership structure is dispersed, shareholders typically fail to monitor managers sufficiently to ensure value maximization (Shleifer and Vishny, 1986; Laeven and

Levine, 2008). This lack of monitoring may be detrimental to performance (Demsetz and Lehn, 1985; Morck, Shleifer, Vishny, 1988; Caprio, Laeven and Levine, 2007; Laeven and Levine, 2008), with the firm's assets deployed to the advantage of managers rather than shareholders. Our results suggest that monitoring is weakened by the atomistic ownership structure and widely dispersed control rights at credit unions, leading to poor financial performance.

Third, we contribute to the literature on the tax treatment of financial institutions.[4] There has been a lengthy policy debate on the issue of whether credit unions should be taxed in the same way as commercial banks, in the interests of fair competition (Flannery, 1974; Cook and D'Antonio, 1984; Tatom, 2005). Central to this debate is whether credit unions use their preferential tax treatment to the benefit of members (Frame, Karels and McClatchey, 2003; Feinberg and Meade, 2012). Our results suggest that the preferential tax treatment of credit unions does translate into large economic benefits for credit union members, but also that a non-trivial amount of the tax subsidy gets diverted to non-member stakeholders in labour markets and securities markets.

Fourth, we contribute to the literature on conflicts-of-interest between depositor-members of cooperative financial institutions seeking to maximize the return on their savings, and borrower-members who want access to low-cost credit (Smith, Cargill and Meyer, 1981). The evidence as to whether credit unions tend to favor borrower-members, saver-members, or neither, is mixed and inconclusive (Flannery, 1974; Leggett and Stewart, 1999; McKillop and Wilson, 2011). Our results indicate that while credit unions share a significant portion of their tax subsidy with depositor-members, they share little of the tax subsidy with borrower-members on average.

The rest of this paper is structured as follows. Section 2 provides an overview of the tax treatment and governance environment at US credit unions. In Section 3 we present two hypotheses concerning the generation and distribution of financial inefficiencies at credit unions. Section 4 develops our profit efficiency methodology. In Section 5 we present the data that we use to estimate our model. Our empirical results are presented in Section 6. Section 7 concludes.

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[4] See Keen and De Mooj (2016) for a cross country analyses of the impact of the asymmetric tax treatment on debt and equity capital structure decisions of banks.

2. Credit unions

Credit unions are mutually owned, not-for-profit depository institutions. Credit unions began as self-help cooperatives for persons and households of modest economic means whose financial needs were not being well-served by for-profit commercial banks. 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 (checking) accounts and personal loans, consumer credit, and home mortgages.

2.1. Tax treatment of credit unions

Given their self-help mission, US credit unions have long been fully exempt from corporate taxes. This tax subsidy is meant to accrue to credit union members in the form of higher deposit rates and/or lower loan rates.[5] Although credit union members are sometimes paid dividends, which are taxable as personal income, these payments are small and relatively rare. In contrast, US commercial banks are for-profit, shareholder-owned corporations. For banks that are organized 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 portion of post-tax earnings distributed to shareholders as dividends is taxed again at the personal level. For banks that are organized under Subchapter S of the US tax code, earnings are fully taxed at the personal level.[6]

In recent years, US credit unions have become increasingly similar to small commercial banks. Over 36% of all credit unions offered member business loans in 2014, and these loans accounted for about 7% of credit union assets.[7] (Unless otherwise noted, all data in this paragraph come from the

[5] Credit unions' tax-exempt status 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 excluded from electing 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.

[7] Real estate loans accounted for 51.0% of aggregate credit union assets in the US in 2014, followed by auto loans at 32.3%; member business loans at 7.3%, and credit card loans at 6.5% (NCUA Annual Report, 2014).

NCUA 2014 Annual Report.) By current US law, a credit union can invest no more than 12.5% of its assets in business loans.[8] According to the NCUA 2014 Annual Report, member business loans increased fourfold between 2004 and 2014, leaving over 1,000 credit unions at or near this cap. Federal legislation has been introduced that would lift the statutory cap from 12.5% to 27.5%.[9] 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. Similarly, for some state-chartered credit unions the field of membership now comprises the entire state. At the end of 2014, the average credit union held $179 million in assets and the largest credit union (the Navy Federal Credit Union) reported assets of $69.8 billion.[10] A Federal Reserve Survey of Consumer Finance (GAO, 2006) concluded that credit unions overall served a membership comprised 31% of low-to-moderate income and 69% of middle-to-upper income; the comparable figures for commercial banks were 41% and 59%, respectively.

Although credit unions tend to be small, their tax subsidies are non-trivial when aggregated to the industry level. 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 over 10 years.[11] The commercial banking industry is a vocal advocate for limiting or terminating credit unions' preferred tax status. 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 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.[12]

2.2. Corporate governance at credit unions

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[8] See Ely and Robinson (2009) and Wilcox (2011) for analyses of credit unions' small business lending activities.
[9] American Banker, "Credit Unions Poised to Be Bigger Business Lending Foe," June 22, 2015, pp. 1-4.
[10] For comparison, one-half of all US commercial banks in 2012 held less than $170 million in assets, and less than one percent held more than $50 billion in assets.
[11] 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.
[12] 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.

Any organization in which management is functionally separate from principal ownership is susceptible to principal-agent costs (Berle and Means, 1932; Fama and Jensen, 1983). 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 (Jensen and Meckling, 1976). 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 directors elected by shareholders whose voting power is based on the number of shares they own. At credit unions, there is no profit motive to guide managers' resource allocation decisions, and directors are elected by credit union members each with one vote only.

Credit union management must balance the interests of multiple corporate stakeholder groups—including depositors, borrowers, and employees—none of which has a strong incentive to monitor management. Even large member-depositors with the most at stake have little incentives to monitor, because they have no more governing power than small member-depositors. 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.

All of the capital at credit unions is held internally and belong to all of the members collectively. Capital is generated over time by the retention of surpluses derived from transactions with credit union members (Goddard, McKillop and Wilson, 2016). Members that wish to sever their ties with their credit union have no entitlement to any share of the 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 capital surplus as buffers against future losses.[13] If a credit union generates an excessively large surplus, 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.

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; member-directors are often lower-salaried professionals who will use their own incomes as compensation benchmarks (Branch and Baker, 2000). Moreover, credit unions tend to be small organizations, so opportunities for 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 productively or financially efficient fashion.

3. Hypotheses for testing

When weak governance results in production or financial inefficiencies at a private firm, those inefficiencies are a private concern.[14] Although credit unions are private institutions, the tax subsidy that they receive elevates such inefficiencies to the public policy sphere. To the extent that credit union managers make inefficient decisions based on their own self-interest—whether this takes the form of shirking, wasteful spending, excessive risk-taking, overinvestment, or self-enrichment—some portion

[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] This statement is true so long as the inefficiencies do not cause large spill-over costs or have systemic consequences.

of these inefficiencies is being funded by taxpayers.[15] For the remainder of this paper, we shall refer to these inefficiencies as *absolute inefficiencies*.

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.[16] 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*.

At an efficiently run credit union, there will be zero absolute inefficiencies and the dollar value of mandated inefficiencies will be exactly equal to the dollar value of the tax subsidy. At an inefficiently run credit union, there will be non-zero absolute inefficiencies and the dollar value of the tax subsidy will be equal to the sum of the dollar values of the absolute and mandated inefficiencies. Thus, any increase in absolute inefficiencies must be offset dollar for dollar by a reduction in mandated inefficiencies (i.e., a reduced pass-through of the tax subsidy to credit union members in the form of financial services). It is in this context that we state our two main hypotheses:

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[15] A substantial literature compares the efficiency of shareholder and mutual financial institutions. O'Hara (1981) and Mester (1989, 1993) find mutual banks are more efficient than shareholder-owned banks. Cebenoyan et al. (1993) find no difference between the efficiency of mutual and joint stock Savings and Loans institutions. Frame, Karels and McClatchey (2003) compare the financial performance of US credit unions and US mutual thrift institutions, in order to test the degree to which the tax subsidy accrues as intended to credit union members or supports expense-preference behaviour by credit union management. They find that credit unions with residential common bonds incurred higher costs than mutual thrifts, and concluded that this redirected at least a portion of the tax benefit away from credit union members.

[16] 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.

Mandated Inefficiencies (H1): Because credit unions have a regulatory mandate to provide financial services to their members at sub-market prices, credit unions will earn lower profits than otherwise similar commercial banks.

Absolute Inefficiencies (H2): Because the corporate governance environment at credit unions provides opportunities and incentives for non-maximizing behaviour, a portion of the credit union tax subsidy will be transferred from mandated member benefits to absolute inefficiencies.

4. Modelling relative financial performance

To test hypotheses H1 and H2, we must estimate credit union inefficiency relative to commercial bank inefficiency, and we must be able to separate credit union inefficiency into mandated inefficiencies and absolute inefficiencies. To do so, we use the profit efficiency approach introduced by Berger, Hancock and Humphrey (1993) as modified by DeYoung and Nolle (1996), and make some additional modifications of our own. For simplicity of exposition, we refer to all financial institutions as "banks" in this section.

In our model, each bank maximizes its short-run variable profits by choosing the levels of four variable netputs: it produces loans and securities 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, proportions of loans portfolio allocated to real-estate lending and business lending) 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 set of netputs $\mathbf{x}^*_{i,t} = \{x_{j,i,t}$ for $j=1,\ldots,n\}$, taking both the vector of local netput prices $\mathbf{p}_{s,t} = \{p_{j,s,t}$ for $j=1,\ldots,n\}$ and its own vector of fixed factors $\mathbf{z}_{i,t}$ =

$\{z_{r,i,t}$ for r=1,…,m$\}$ as given.[17] 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 optimal netput demand equations:

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

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

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:

[17] 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.

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

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

Actual profit can 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:

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

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 $\sum_{j=1}^{n} p_{j,s,t}\xi_{j,i,t}$. In this formulation, the netput prices $p_{j,s,t}$ are observable, but the netput inefficiencies $\xi_{j,i,t}$ are unobservable and must be estimated.

We can recover estimates for all of the model parameters by estimating the profit function (4) and using the fitted coefficients to generate the n netput demand functions (3a). Before doing so, we need to specify a random error term on each of these equations. The 'intercept' term $(\alpha_j - \xi_{j,i,t})$ in each of these equations contains two terms: A parameter α_j that is constant across banks and time, and an unobservable inefficiency term $\xi_{j,i,t}$ that varies across both banks and time.[18] Hence, when these

[18] In the parent profit function (4), this intercept term $(\alpha_j - \xi_{j,i,t})$ falls cleanly out of the specification for the j=n[th] netput, because $p_{j,s,t}/p_{n,s,t} = 1$. Thus, we can use equation (4) to recover the n[th] netput inefficiency term.

equations are estimated, the $\xi_{j,i,t}$ terms will naturally be captured in the regression residuals.[19] Our challenge is to extract these netput inefficiency terms from the regression residuals.

Following Berger, Hancock and Humphrey (1993), we replace each of the intercept terms $(\alpha_j - \xi_{j,i,t})$ with $(\alpha_j - \xi_{j,mean})$, where $\xi_{j,mean}$ is the theoretical population mean of $\xi_{j,i,t}$. The intercept terms are now pure constants. The remainders from these substitutions get absorbed into the regression residuals, $\nu_{j,i,t} + (\xi_{j,mean} - \xi_{j,i,t})$, where $\nu_{j,i,t}$ is a standard random disturbance term and $(\xi_{j,mean} - \xi_{j,i,t})$ is a relative netput inefficiency term.[20] 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 $\nu_{j,i,t}$ attenuates to zero in the averaging.[21] Finally, we generate the netput j inefficiency for each bank i using the expression $\hat{\xi}_{j,i} = \overline{v}_j - \hat{v}_{j,i}$, where $\overline{v}_j$ is the maximum value (the least inefficient bank relative to the population mean) of $\hat{v}_{j,i}$ over all banks.[22] $\hat{\xi}_{j,i} = 0$ for the least inefficient bank (that is, for $\hat{v}_{j,i} = \overline{v}_j$) 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 can construct the total estimated profit inefficiency for each bank as follows: $Ineff_i = \sum_{j=1}^{n} \hat{\xi}_{j,i}\hat{p}_{j,s}$, where $\hat{p}_{j,s} = (1/T)\sum_{t=1}^{T} p_{j,s,t}$ is the average netput j price facing bank i during the sample period. Netput-specific profit inefficiencies $\hat{p}_{j,L}\xi_{j,i}$ are obtained in straightforward fashion by undoing the summation $\sum_{j=1}^{n} \hat{\xi}_{j,i}\hat{p}_{j,s}$ into its n parts.

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[19] We follow Berger, Hancock and Humphrey (1993) in assuming that the inefficiency terms $\xi_{j,i,t}$ are uncorrelated with the market-determined netput prices $p_{j,s,t}$ and the pre-determined fixed factors $z_{r,i,t}$.

[20] Our model assumes that the regression residual terms are distributed symmetrically with zero mean. This follows the 'distribution-free' convention of Berger (1993).

[21] This intra-bank averaging is essentially an application of the distribution-free efficiency introduced by Berger (1993).

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

Ineff and its component netput profit inefficiency terms $\hat{p}_{j,L}\xi_{j,i}$ value netput inefficiencies at their market prices. While this is the proper approach for gauging costs to society from these inefficiencies, this approach can misstate the costs of netput inefficiencies to bank shareholders and credit union members. 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 may materially overstate inefficiency because they do not capture these internal 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 may materially understate inefficiency because they do not capture these internal pricing inefficiencies. We can investigate these issues by decomposing each of the netput-specific profit inefficiencies as follows: $\hat{p}_{j,s}\xi_{j,i} = \hat{p}_{j,b}\xi_{j,i} + (\hat{p}_{j,s} - \hat{p}_{j,b})\xi_{j,i}$, where $\hat{p}_{j,s}$ is the average local market price for netput j and $\hat{p}_{j,b}$ 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 local market prices. The first right-hand side term is *netput profit inefficiency* valued at internal bank prices. The second right-hand side term is the portion of netput profit inefficiencies that are attributable to a *pricing effect*: For outputs (inputs), a positive value indicates inefficient (efficient) internal pricing, while a negative value indicates efficient (inefficient) internal pricing.[23]

All of the preceding profit inefficiency measures are expressed in dollar terms. In order to make useful comparisons across banks, we need to 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.

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

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 $\hat{v}_{j,i}$ at the 5th and 95th percentiles of their distributions within those size deciles. We perform this winsorization to limit the effects of outlying $\hat{v}_{j,i}$ on the calculation of $Ineff_i$; we let the winsorization thresholds vary with bank size to purge $Ineff_i$ of scale effects (DeYoung and Nolle 1996).

5. Data

The data are a balanced panel of quarterly observations of 2,736 US commercial banks and 1,270 US credit unions from 2005 through 2014. The commercial bank data come from the Reports on Condition and Income published by the Federal Financial Institution Examination Council (FFIEC), while the credit union data come from the Call Reports published by the National Credit Union Association (NCUA).

We use a balanced data panel to ensure that the averaged bank-specific residuals $\hat{v}_{j,i}$ are calculated using the same number of observations for each bank. Table 2 provides the numerical details of the sample selection process. We begin by retaining only those banks and credit unions that existed in both 2005 and 2014 and reported all of the data necessary to calculate the model variables. To prevent outlying values of profitability from influencing our estimates, we exclude all institutions with average 2005-2014 return on assets (ROA) in either the 1st or 100th percentiles of the data. So that the banks and credit unions in our sample are relatively comparable in size, we exclude institutions with average 2005-2014 assets less than \$50 million and more than \$1.133 billion (2010 dollars), the latter of which is the 95th percentile of the distribution of average assets. The resulting balanced panel contains 40 quarterly observations each of 2,736 commercial banks and 1,270 credit unions, and we use this panel of observations to estimate the profit inefficiency model. Post-estimation, we remove all commercial banks that are affiliates of multi-bank holding companies; this results in a balanced panel of 1,850 commercial banks and 1,270 credit unions, and we use this panel of observations to test our hypotheses.

Using a balanced panel raises the possibility that our results will be influenced by survivorship effects. Table 3 shows the annual rates of attrition for all US banks and credit unions of comparable size to those in our data ($50 million to $1,133 million in assets) between 2005 and 2014. The attrition rates are roughly three times as large for banks (3.1% to 4.9%) than for credit unions (0.8% to 1.7%). This difference in attrition rates is certainly not surprising, as the market for corporate control is relatively active for banks but is virtually non-existent for credit unions. Indeed, our balanced panel approach increases the likelihood of finding high levels of profit inefficiency at credit unions relative to commercial banks. But this difference cannot be considered a bias for the purposes of our investigation, because these low credit union attrition rates are symptoms of the weak corporate governance effects for which we are testing in hypothesis H2.

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 1 shows the call report items used to define all of the bank and credit union variables.

We measure *Profit* π as pre-tax net income at commercial banks and as total surplus at credit unions. We define four variable netputs $\mathbf{x}$. *Loans* includes total on-balance sheet loans and lease contracts. *Securities* includes total securities investments plus deposits held in, loans made to, and 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.[24] *Deposits* is equal to total deposits and other borrowings on which the bank or credit union pays interest.

We use the borders of the 50 US states to define local netput markets, and we assign banks and credit unions to these local markets based on the location of their headquarters offices. The netput prices **p** in each state are calculated as the aggregate revenue or expense flows associated with each netput in that state, divided by the aggregate quantity of each netput produced or used in that state, in any given time period. We use data from all of the banks and credit unions in each state, not just those in our sample, in these calculations. *Price(Loans)* is the aggregate interest revenues from loans divided by aggregate *Loans*. *Price(Securities)* 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 define four fixed factors **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.

Summary statistics for all of the variable used to estimate our model are reported in Table 4. Note that pre-tax ROA is 59% lower for credit unions than for commercial banks on average (0.490% versus 1.214%). This crude comparison is consistent with our expectations (hypothesis H1) that credit unions will operate with larger amounts of profit inefficiency than commercial banks, by tax-policy mandate. The summary statistics do not contain any insights regarding the misallocation of the credit union tax subsidy absolute profit inefficiencies (hypothesis H2).

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[24] We are following 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 calculations of credit union FTEs that use part-time worker weights both larger and smaller than 0.50 (Table 1S and Table 2S).

5.2. Matched pairs sample

To more cleanly compare the estimated profit inefficiencies of credit unions and commercial banks generated from our model, we construct matched-pairs samples. We use a nearest-neighbour matching procedure. For each credit union in our full sample, we search for a commercial bank of similar age and asset size, that is not affiliated with a MBHC, and is located in that credit union's home state.[25] In each case, 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. The selection of matching commercial banks is made with replacement. We apply an arbitrary maximum quadratic distance threshold to eliminate credit unions for which a closely matching commercial bank cannot be found in their home states, and we exclude from consideration any states for which our full sample contains fewer than 20 commercial banks. This procedure generates 618 matched pairs of credit unions and commercial banks. We also construct a larger sample of 1,081 matched pairs credit unions and commercial banks, replacing the home-state restriction with the less binding home-region restriction based on geographic lines drawn by the U.S. Census Bureau.[26] Further details on the matching procedure are included in Appendices 2 and 3.

6. Results

We estimate the parameters of our four-equation model (3a) and (4) using seemingly unrelated regression (SUR) techniques using only the sample of 2,736 commercial banks (both MBHC affiliates

[25] 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 home state to control for differences in economic conditions and state-level regulation and supervision.

[26] The four regions, subdivided into nine divisions, widely used for statistical reporting purposes, are as follows: North East region comprises New England and Mid-Atlantic divisions; Midwest region comprises East North Central and West North Central divisions; South region comprises the South Atlantic division, East South Central and West South Central divisions; and West region comprises Mountain and Pacific divisions.

and non-MBHC affiliates).[27] We exclude the 1,270 credit unions from the estimation, because credit unions are clearly neither profit-maximizers nor price-takers as assumed by the model. With the estimated parameters of the model in-hand, we calculate a full set of inefficiency measures for both banks and credit unions. Thus, the profit inefficiency measures for credit union *i* can be interpreted as the inefficiencies of a profit-maximizing, price-taking commercial bank that makes the same variable netput decisions as credit union *i*.

We present our results in two parts. We begin with an informal comparative analysis of the estimated profit inefficiencies from our full (un-matched) sample of commercial banks and credit unions. This serves to familiarize the reader with the concepts being measured, and to check if the signs and magnitudes of our model estimates are economically reasonable. We then turn to formal statistical tests of H1 and H2, using matched-pairs samples of commercial banks and credit unions.

6.1. Full-sample estimates

Table 5 displays our estimates of profit inefficiency for the full sample of 1,850 (non-MBHC) commercial banks and 1,270 credit unions. The economic magnitudes are large. At commercial banks, quarterly profit inefficiency per dollar of assets (*Ineff/Assets*) averages \$0.0117. Thus, if the average bank was able to shed 100% of its variable profit inefficiency, its quarterly ROA could increase from 0.0029 (the quarterly sample average) to 0.0146, a five-fold increase.[28] In annual terms, commercial bank *Ineff/Assets* averages approximately 0.0468, which is about one-quarter smaller than the 0.0656 estimate reported by DeYoung and Nolle (1996) for US commercial banks with more than \$300 million in assets in 1985-1990. This decline in measured profit inefficiency is quite reasonable, as deregulation and industry consolidation during the intervening years created competitive incentives for banks to

[27] We impose the usual symmetry restrictions on $\varphi_{j,k} = \varphi_{k,j}$ and $\theta_{r,q} = \theta_{q,r}$.

[28] We find similarly large amounts of profit inefficiency per dollar of potential profits. *Ineff/(Ineff + π)* is 0.8143 for the average commercial bank, which thus could have increased its pre-tax profits by 0.8143/(1–0.8143) = 439% by shedding 100% of its variable profit inefficiency. This estimate is substantially larger than the estimated 0.556/(1 – 0.556) = 125% in DeYoung and Nolle (1996) for banks with more than \$300 million. The difference most likely reflects the wider range of potential profits earned by U.S. commercial banks during our 2005-2014 sample period (quarterly pre-tax ROA averaged an annualized 1.14% and ranged between -1.51% and 2.01%) compared with DeYoung and Nolle's 1985-1990 sample period (quarterly pre-tax ROA averaged an annualized 0.50% and ranged between -0.99% and 0.99%). Data from the FDIC Quarterly Banking Profile (www.fdic.gov/bank/analytical/qbp/).

either operate more efficiently or exit the market (DeYoung, Hasan and Kirchhoff 1998; Evanoff and Örs 2008).

Relative to the commercial banks, credit unions exhibit substantially larger amounts of profit inefficiency. Credit union inefficiency averages about 25% larger (0.0148 > 0.0117) per dollar of assets and about 20% larger (0.9831 > 0.8143) per dollar of potential profits. A disproportionate amount of these performance deficiencies are attributable to the smaller credit unions. For example, while large and small banks exhibit relatively similar levels of *Ineff/Assets* on average, the smallest credit unions exhibit 26% larger *Ineff/Assets* than do the largest credit unions (0.0165 versus 0.0131). These results likely reflect the active market for corporate control of banks—which removes or otherwise disciplines small inefficient banks—and the lack of such external pressures for small inefficient credit unions.

In Table 6 we decompose profit inefficiency into its individual netput components (*Loans*, *Securities*, *Labour* and *Deposits*) and by the associated netput price effects. Credit unions' profit inefficiency disadvantages emanate mainly from the input side, and are attributable about equally to *Deposits* and *Labour* inefficiencies. When valued using market netput prices, credit unions are on average 50.4% more *Labour*-inefficient per dollar of assets than commercial banks (i.e., comparing 0.00338 to 0.00225) and are 45.3% more *Deposit*-inefficient. On the output side, credit unions are on average 26.9% more *Securities*-inefficient per dollar of assets than commercial banks, and are 9.0% less *Loans*-inefficient.

Following industry conventions for measuring labour inputs, we have been assuming that the average part-time credit union employee works 50% of a full-time schedule (20 hours per week). If this assumption is incorrect, then we may be either over-estimating or under-estimating *Labour*-inefficiencies at credit unions. We re-estimate profit inefficiency using the alternative assumptions of 40% work weeks (16 hours per week, or two days) and 60% work weeks (24 hours per week, or three days for part-time employees) for these employees. As seen in Supplemental Tables 1S and 2S, our results are both qualitatively and quantitatively robust to these alternative assumptions.

It is also instructive to consider these inefficiencies valued at the prices that credit unions actually paid and charged (internal prices). Credit unions' 45.3% *Deposits*-inefficiency disadvantage explodes to 248.5% when we value these inefficiencies using actual credit union deposit rates. Hence, credit unions are *Deposits*-inefficient in two ways: They pay above-market prices for deposit inputs, and these prices attract an inefficiently large amount of deposit funding (given their other variable netputs). As indicated by the *pricing effect*, credit unions paid their depositors a quarterly 73 basis point premium (2.92 percentage point annually) per dollar of assets on average during our sample period. Clearly, credit unions are not price takers in deposit markets. However, while the data indicate that credit unions are substantially deposit-inefficient relative to small commercial banks, these inefficiencies are evidence that credit unions are operating in compliance with their chartered mandate to pass-through the tax subsidy to their members. (Because the estimated pricing effects for the other three netputs are smaller by an order of magnitude, we will delay their discussion until the matched pair results.)

Hence, the raw full-sample data are consistent with both of our hypotheses. A large portion of credit unions' profitability disadvantage can be explained by excessive use of deposit funding and the inefficiently high prices that they pay on deposits, both of which are consistent with their mandate to pass along the tax subsidy to their members (H1). But a large portion of credit unions' profitability disadvantage can also be explained by excessive use of labour inputs, which is consistent with the notion that the poor governance environment at credit unions allows some of the tax subsidy to be wasted (H2). Nevertheless, these full-sample results do not come from controlled statistical tests, and as such they are merely suggestive. We now turn to more careful analysis, using matched pair data samples.

6.2. Matched-pairs tests

Tables 7 and 8 report the results of differences-in-means tests for various measures of profit inefficiency applied to 618 matched pairs of credit unions and commercial banks. We shall refer to these differences as *profit inefficiency gaps*. For example, the profit inefficiency gap for *Ineff/Assets* is defined as:

$$\textit{Profit inefficiency gap} = \text{mean } \textit{Ineff/Assets}_{\text{credit unions}} - \text{mean } \textit{Ineff/Assets}_{\text{banks}}$$

By definition, banks use their pre-tax profits to make tax payments to the government and pay a post-tax return to equity shareholders (either distributed or retained). Credit unions make neither of these payments. So all else equal, credit union profits will be lower than commercial bank pre-tax profits by the sum of (a) the taxes they do not have to pay (i.e., credit unions are tax-exempt) plus (b) the equity returns they do not have to pay (i.e., credit unions are non-profit cooperatives). Hence, by definition, the *profit inefficiency gap* is also the sum of (a) and (b), and 100% of this sum should be received, in one form or another, by credit union members. By decomposing the profit inefficiency gap into its component parts, we can uncover how much does reach members, and how much is diverted to other stakeholders.

Table 7 displays overall inefficiency gaps for *Ineff/Assets* and *Ineff/(Ineff+π)*, and Table 8 decomposes the profit inefficiency gap for *Ineff/Assets* into its *Loans*, *Securities*, *Labour*, and *Deposits* components, valued using both market prices and internal prices. In each of these tables, we also include results based on a larger set of 1,081 matched pairs generated by relaxing the geographic restrictions in our matching procedure from US state boundaries to broader US regional boundaries.[29]

We begin by focusing on Panel B of Table 7, where the profit inefficiency estimates are trimmed at the 5th and 95th percentiles prior to calculating the inefficiency gaps, in order to reduce the impact of outlying individual estimates. Quarterly profit inefficiency is 0.00248 per dollar of assets (*Ineff/Assets*) larger at credit unions than at their matched commercial bank counterparts (Table 7, Panel B). This inefficiency gap is statistically significant at the 1% level and is economically large, and is equivalent to an annual 92 basis points (0.00248×4) of average credit union ROA. Credit unions' inefficiency disadvantage declines substantially and monotonically with asset size (from 0.00304 for $50-to-$100 million credit unions, to 0.00147 for credit unions above $500 million), which suggests the presence of better corporate governance at larger credit unions. For *Ineff/(Ineff+π)*, the estimated quarterly profit inefficiency gap is 0.09398 (see Panel B), equivalent to an annual 37.6% of potential annual credit union profits (0.09398×4).

We now move our focus to Panel B of Table 8. At market prices, deposit inefficiencies account for the largest portion of the profit inefficiency gap between credit unions and commercial banks. Credit

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[29] We also performed robustness tests using different threshold parameters for defining the maximum quadratic distance for which we accepted matched pairs into our analysis. Appendix 3 demonstrates that our results are not sensitive to variations in the threshold parameter.

unions are an estimated 0.00188 per dollar of assets (*Ineff/Assets*) more *Deposit*-inefficient per quarter than comparable commercial banks, or about 75 basis points of assets per year. These deposit inefficiencies account for 75.8% of credit unions' total market-value profit inefficiency gap (0.00188/0.00248). But valued at the above-market deposit rates that credit unions are actually paying, the *Deposits* inefficiency gap leaps to 414 basis points of assets per year (0.01035×4). But not all 414 of these basis points qualify as efficient pass-throughs to depositors: 339 of these basis points (414 - 75) are a pricing effect that clearly benefits credit union members, but the remaining 75 basis points represent an allocative inefficiency from purchasing excess deposit funding relative to similar commercial banks.[30]

Labour inputs account for the second-largest portion of credit unions' market-value profit inefficiency gap. At market values, credit unions are an estimated 0.00069 per dollar of assets more *Labour*-inefficient per quarter than comparable commercial banks. This inefficient transfer of wealth is partially mitigated because credit unions pay below-market wages (it is likely that credit union staff have less financial expertise on average than commercial bank staff) as indicated by the *Labour* pricing effect of 0.00025. Nonetheless, a positive and statistically significant *Labour* inefficiency gap of 0.00044 remains, evidence that credit union employees are consuming a portion of the credit union tax subsidy that is meant for members. The fact that credit union employees tend to also be credit union members is immaterial in this context; while the tax subsidy is meant to subsidize financial services, these numbers indicate that a portion of the tax subsidy is leaking into labour markets.

Measured at market values, the credit union inefficiency gap is statistically insignificant for *Securities*-inefficiencies (-0.00001) and *Loans*-inefficiencies (-0.00008). In both cases, however, we find statistically significant pricing effects. Credit unions earn below-market returns on their securities investments of 0.00077 per quarter, or about 31 basis points of assets annually. This is an economically significant pricing inefficiency, and likely reflects a combination of risk aversion and lack of financial expertise among credit union management. Credit unions receive above-market returns from their borrowers of 0.00022 per quarter, or about 9 basis points of assets annually. This pricing effect is

[30] Technically the situation is a bit more complicated. The pricing effect overstates the pure tax subsidy pass-through, because a portion of these above-market interest rate flows are received by the excess depositors.

economically trivial, but surprising given the expectation that credit unions would charge below-market loan rates. Any inferences about *Loans*-inefficiencies and their associated pricing effects must be drawn with caution, however, as these estimates are jointly capturing (a) deviations from competitive market pricing along with (b) different loan portfolio compositions at credit unions and commercial banks.[31] Data restrictions prevent us from separately estimating these two effects.

The matched pair tests in Tables 7 and 8 provide strong statistical evidence in support of both of our hypotheses. Credit unions are substantially more profit inefficient than commercial banks of comparable size, location and age. Measured at market values, we find an annual estimated inefficiency gap equivalent to 92 basis points of credit union assets. Consistent with hypothesis H1, 75.8% of this inefficiency gap is explained by *Deposits* inefficiencies, evidence that a large portion of the credit union tax subsidy is being passed through to credit union members. Consistent with hypothesis H2, 27.8% of this inefficiency gap is explained by *Labour* inefficiencies, evidence that a substantial portion of the credit union tax subsidy is being transferred to the labour market. (These two elements sum to 103.6% of the market-value inefficiency gap; the extra 3.6% is offset by small negative market-value inefficiency gaps for *Securities* and *Loans*.)

But when we measure the profit inefficiency gap based on the netput prices that credit unions actually pay and receive, a very different picture emerges. At these internal prices, the annual estimated inefficiency gap is equivalent to 450 basis points of credit union assets. (This is calculated by summing the quarterly netput inefficiency gaps 0.01035, 0.00044, 0.00076, and -0.00030, and then multiplying by four.) Deposit inefficiencies account for 92% of this profit inefficiency gap, very strong evidence consistent with hypothesis H1 that the tax subsidy is passed through to credit union members. The remaining 8% contains roughly equal amounts of inefficiency gaps associated with securities activities and labour inputs, and provides little support for hypothesis H2 that a meaningful portion of the tax subsidy gets wasted as pure inefficiency.

[31] In separate tests, we attempt to control for loan portfolio composition by including control variables for *business loans* and *real estate loans* in the z-vector. While our main results are robust to making this change (see Supplementary Tables 3S and 4S), by controlling for business and real estate loans this alternative specification effectively transforms our *Loans*-netput estimates into a test of *Consumer Loans*-netputs only. The authors are investigating alternative methods for solving this problem.

It is difficult to reconcile these two disparate conclusions. One-the-one-hand, when valued using internal prices, the *Deposits*-inefficiency gap overstates the degree to which credit unions pass-through the tax subsidy to their members, because it counts the overuse of deposit inputs (an allocative inefficiency) as part of the pass-through. On-the-other-hand, when valued at market prices, the *Labour*-inefficiency gap overstates the degree to which credit unions are wasteful, because credit unions are able to attract their workforce at below-market prices.

In either case, the majority of the profit inefficiency gap is explained by benefits being passed along to depositor members. Accepting this very affirming result at face value, it only remains to determine whether the absolute economic size of the inefficiency gap being diverted away from credit union members is non-trivial. We note that *Securities*-inefficiency and *Labour*-inefficiency gaps, when valued at internal prices, sum to 0.00076 + 0.00044 = 0.00120 per dollar of assets per quarter, or 48 basis points of assets in annual terms. These *non-member-related* inefficiencies are equivalent to 42% of annual post-tax ROA at U.S. commercial banks (1.14%) during our 2005-2014 sample period.[32] Interpreted in this fashion, it becomes clear that there is an economically substantial misallocation of the credit union tax subsidy. This evidence is consistent with hypothesis H2 that the weak corporate governance environment at permits an economically substantial amount of the credit union tax subsidy to be diverted from credit union members to non-member stakeholders or investors.

7. Conclusion

In the US, credit unions are exempt from paying federal taxes (and in most cases, state taxes) on their bottom line income. These tax savings are meant to subsidize the provision of financial services to credit union members. But credit unions are organized as mutually owned cooperatives, so both internal and external governance is likely to be very weak. As such, operational inefficiencies are likely to consume a portion of the tax subsidy, preventing it from being fully passed along to credit union members. In this paper, we investigate the presence and economic magnitudes of these inefficiencies.

[32] Data from FDIC Quarterly Banking Profile. See earlier footnote.

We estimate a structural model of profit inefficiency (Berger, Hancock and Humphrey 1993, DeYoung and Nolle 1996) for a quarterly data panel of small US commercial banks between 2005 through 2014, and then use estimated model parameters to evaluate the relative performance of 618 matched pairs of US credit unions and commercial banks. We find that the large majority of the credit union tax subsidy does get passed along to credit union members, by way of above-market interest rates paid to depositor-members. But our estimates also suggest that an economically substantial amount of the tax subsidy gets diverted away from credit union members. Relative to the matched pair commercial banks, credit unions hire an inefficiently large number of employees and earn an inefficiently low return on assets invested in securities. These relative inefficiencies amount to 48 basis points per dollar of credit union assets.

These findings are consistent with our priors that weak governance arrangements and poor monitoring incentives allow credit union managers to operate more inefficiently than comparable commercial banks. 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 strengthen commercial bank arguments that the tax exemption provides credit unions with an unfair competitive advantage.

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Table 1 – Variable definitions

This table reports definitions of the variables used in the profit function estimations and the matched-sampling procedure. Netput prices are calculated using aggregate industry data in the headquarters state of each bank or credit union. All other variables are observed at the individual bank or credit union. Appendix 1 provides a detailed mapping of these definitions from the FFIEC call reports for banks and the NCUA call reports for credit unions.

	Credit Unions	**Banks**
Profit		
Profits $\pi_{i,t}$	Surplus	Pre-tax net income
Netputs		
Loans $x_{1,i,t}$	Total loans and leases	Total loans
Securities $x_{2,i,t}$	Total investments	Total securities investments
Labour $x_{3,i,t}$	Full-time employees + 0.5 × Part-time employees	Full-time employees
Deposits $x_{4,i,t}$	Member shares, non-member deposits, and other borrowings	Deposits and all other borrowed funds
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 $z_{1,i,t}$	Land, buildings and other fixed assets	Premises and fixed assets
Equity $z_{2,i,t}$	Net worth	Equity capital
Noninterest Income $z_{3,i,t}$	Non-interest income	Non-interest income
Risk-weighted Assets $z_{4,i,t}$	Risk-weighted assets (using NCUA formula)	Risk-weighted assets (using Federal Reserve formula)
Other		
Assets	Total assets	Total assets
Age	Age in years	Age in years

Table 2 – Sample selection procedure

This table summarizes the procedures used to filter the raw Call Report data, by filtering out banks or credit unions with incomplete data or with outlier observations. Mean assets filters are based on assets data expressed in 2010 prices. $1,133m is the 95th percentile in the combined distribution of 3,467 banks and 2,889 credit unions by mean asset size.

	Credit Unions	Banks
Institutions reporting positive assets in 2005.1	9,089	7,766
of which:		
Exited the industry during 2005.1-2014.4	(2,676)	(2,096)
Reporting positive assets in 2014.4	6,413	5,670
Institutions with missing data	(3,457)	(2,128)
Institutions with complete data	2,956	3,542
Institutions with 40-quarter average pre-tax ROA in the 1st or 100th percentiles of the combined distribution of credit unions and banks	(67)	(75)
Institutions remaining after trimming for outliers	2,889	3,467
Institutions with mean assets > $1,133 million	(92)	(225)
Institutions with mean assets < $50 million	(1,527)	(506)
Institutions used in the profit function estimations	**1,270**	**2,736**
Banks within multi-BHC	-	(886)
Institutions used to test hypotheses	**1,270**	**1,850**

Table 3 – Numbers of survivors and rates of attrition

This table reports the numbers of survivors and the annual rates of attrition among banks and credit unions that reported Call Report data, and assets of at least $50 million and not more than $1,133 million (in 2010 prices), in the first quarter of 2005. Survivors and rates of attrition are calculated at yearly intervals, up to the first quarter of 2014.

	Credit unions		Banks	
Year	Number	% rate of attrition	Number	% rate of attrition
2005	2,066	-	5,680	
2006	2,049	0.8	5,451	4.0
2007	2,017	1.6	5,237	3.9
2008	1,993	1.2	5,014	4.3
2009	1,970	1.2	4,818	3.9
2010	1,936	1.7	4,638	3.7
2011	1,907	1.5	4,413	4.9
2012	1,883	1.3	4,278	3.1
2013	1,851	1.7	4,119	3.7
2014	1,834	0.9	3,963	3.8

Table 4 – Summary statistics

This table reports the sample means and standard deviations for the variables used in the profit function estimations. Quarterly observations for 2005-2014. All monetary amounts in 2010 prices. Summary statistics are reported separately for banks that were not members of a multi-Bank Holding Company (non-MBHC), for banks that were members of a multi-Bank Holding Company (MHBC), and for all banks. For profits, return on assets and non-interest income, the means and standard deviations are annualized. For the netput prices, the means and standard deviations are based on quarterly values.

	Credit unions		Banks						All institutions	
			non-MBHC		MBHC		All			
	(n=1,270)		(n=1,850)		(n=886)		(n=2,736)		(n=4,006)	
	mean	st.dev	mean	st.dev	Mean	st.dev	Mean	st.dev	mean	st.dev
Profitability										
Profit ($ million)	1.3	1.9	2.4	2.4	4.1	3.9	2.9	3.1	2.4	2.9
Return on assets	.00490	.00353	.01161	.00517	.01325	.00500	.01214	.00518	.00985	.00580
Netputs ($ million)										
Loans	145.0	152.9	127.7	122.8	206.2	178.4	153.1	147.8	150.5	149.5
Securities	54.6	69.6	50.8	56.4	74.0	71.4	58.3	62.6	57.1	64.9
Labour	71.0	62.8	56.8	50.8	92.7	111.6	68.4	77.8	69.2	73.4
Deposits	203.0	198.0	157.5	149.3	252.1	215.3	188.1	179.0	192.9	185.3
Netput prices (market)										
Price(Loans)	.01446	.00234	.01473	.00156	.01496	.00128	.01480	.00148	.01469	.00180
Price(Securities)	.00871	.00084	.00858	.00057	.00846	.00053	.00854	.00056	.00859	.00067
Price(Labour) ($ thousand)	18.82	3.85	17.23	3.12	16.71	2.57	17.06	2.96	17.62	3.37
Price(Deposits)	.00421	.00056	.00436	.00047	.00447	.00044	.00439	.00046	.00434	.00050
Netput prices (internal)										
Price(Loans)	.01561	.00268	.01646	.00214	.01616	.00148	.01636	.00196	.01612	.00224
Price(Securities)	.01013	.00644	.00847	.00142	.00851	.00180	.00849	.00155	.00901	.00392
Price(Labour) ($ thousand)	13.85	2.93	14.59	3.32	14.35	3.32	14.51	3.32	14.30	3.22
Price(Deposits)	.01048	.00323	.00453	.00098	.00452	.00092	.00453	.00096	.00641	.00340
Fixed factors ($ million)										
Premises	5.9	6.1	3.7	4.0	6.5	6.8	4.6	5.2	5.0	5.6
Equity	24.5	24.7	21.1	18.2	32.4	26.5	24.7	21.9	24.7	22.8
Noninterest Income	3.4	3.9	1.8	2.9	3.5	7.8	2.4	5.1	2.7	4.8
Risk-weighted Assets	146.6	150.6	137.3	130.4	221.7	189.6	164.6	157.1	158.9	155.3
Other										
Assets ($ million)	229.5	223.7	203.9	179.8	318.4	259.3	241.0	215.6	237.4	218.2
Age (years)	58.8	14.4	81.0	38.4	83.9	37.3	81.9	38.1	74.6	34.2

Table 5 – Average profit inefficiency scores

This table reports summary statistics for various measures of profit inefficiency for various bank size subsamples. All figures are institution-level averages estimated using equations (3a) and (4) and quarterly observations for 2005-2014. All variables are defined in the text.

	Number	Mean *Ineff* ($ million)	Standard deviation *Ineff* ($ million)	Mean *Ineff/Assets*	Mean *Ineff/(Ineff+π)*
Credit unions					
$50m-$100m	452	1.152	.287	.0165	1.0294
$100m-$200m	347	1.926	.531	.0141	1.0006
$200m-$500m	320	4.325	1.560	.0139	.9545
More than $500m	151	9.356	2.324	.0131	.8647
All	1,270	3.139	2.850	.0148	.9831
Banks					
$50m-$100m	593	.933	.276	.0131	.8511
$100m-$200m	632	1.583	.512	.0111	.8084
$200m-$500m	489	3.284	1.373	.0109	.7806
More than $500m	136	8.097	2.433	.0118	.8028
All	1,850	2.303	2.132	.0117	.8143

Table 6 – Decomposing profit inefficiency

This table reports values for estimated netput inefficiency scores (for Loans, Securities, Labour and Deposits). The first two panels report raw averages. The third panel shows the percentage differences between credit unions and banks. All variables are defined in the text.

	Loans	Securities	Labour	Deposits
Credit unions (n=1,270)				
Netput inefficiency/Assets (market value)	.00322	.00314	.00338	.00503
Netput inefficiency/Assets (internal value)	.00351	.00379	.00240	.01234
Pricing effect/Assets	-.00029	-.00065	.00098	-.00731
Banks (n=1,850)				
Netput inefficiency/Assets (market value)	.00354	.00248	.00225	.00346
Netput inefficiency/Assets (internal value)	.00401	.00243	.00180	.00354
Pricing effect/Assets	-.00047	.00005	.00045	-.00008
Credit unions *versus* Banks (% differences)				
Netput inefficiency/Assets (market value)	*-9.0*	*26.9*	*50.4*	*45.3*
Netput inefficiency/Assets (internal value)	*-12.5*	*56.3*	*33.0*	*248.5*

Table 7 – Profit Inefficiency Gaps for matched pairs sample

Panel A. This panel reports the average *Profit Inefficiency Gaps* from difference-in-means tests (mean credit union inefficiency minus mean bank inefficiency) for various bank size subsamples. Results are reported for 618 matched pairs of credit unions and banks matched within states, and for 1,081 matched pairs matched within regions. z-statistics appear in italics. ***, ** and * indicate a statistically significant difference at the 1%, 5% and 10% levels, respectively. All variables are defined in the text.

	All	\$50m-\$100m	\$100m-\$200m	\$200m-\$500m	Over \$500m
Matching within states: Number of matched pairs	618	190	175	179	74
Ineff/Assets	.00231*** *14.26*	.00298*** *10.55*	.00207*** *7.76*	.00215*** *7.59*	.00150** *2.34*
Ineff/(Ineff+π)	.03304 *1.51*	.08714*** *3.89*	-.09216 *-1.31*	.08364*** *5.99*	.06787*** *2.79*
Matching within regions: Number of matched pairs	1,081	370	294	282	135
Ineff/Assets	.00232*** *17.08*	.00262*** *10.58*	.00228*** *9.60*	.00234*** *9.71*	.00155*** *3.47*
Ineff/(Ineff+π)	.02744* *1.68*	.04691** *2.11*	-.07981 *-1.61*	.10229*** *6.63*	.05132** *2.26*

Panel B. This panel is identical to Panel B, except for adjustments performed to reduce the impact of outlying values of *Ineff/(Ineff+π)*. The samples of matched pairs are trimmed at the 5th and 95th percentiles of the distribution of this measure.

	All	\$50m-\$100m	\$100m-\$200m	\$200m-\$500m	Over \$500m
Matching within states: Number of matched pairs	557	177	149	166	65
Ineff/Assets	.00248*** *15.31*	.00304*** *10.66*	.00237*** *8.60*	.00237*** *8.64*	.00147** *2.28*
Ineff/(Ineff+π)	.09398*** *15.94*	.09774*** *8.98*	.11644*** *10.32*	.08954*** *9.10*	.04355** *2.40*
Matching within regions: Number of matched pairs	973	344	248	255	126
Ineff/Assets	.00255*** *18.13*	.00278*** *10.97*	.00266*** *10.81*	.00260*** *10.53*	.00160*** *3.49*
Ineff/(Ineff+π)	.08494*** *14.88*	.07469*** *7.71*	.11126*** *9.85*	.08401*** *8.14*	.06302*** *3.63*

Table 8 -- Decomposition of Profit Inefficiency gaps for matched pairs sample

Panel A. This panel reports the average *Profit Inefficiency Gaps* from difference-in-means tests (mean credit union inefficiency minus mean bank inefficiency) for netputs *Loans*, *Securities*, *Labour* and *Deposits*). Results are reported for 618 matched pairs of credit unions and banks matched within states, and for 1,081 matched pairs matched within regions. z-statistics appear in italics. ***, ** and * indicate a statistically significant difference at the 1%, 5% and 10% levels, respectively. All variables are defined in the text.

	Loans	*Securities*	*Labour*	*Deposits*
Matching within states (618 matched pairs)				
Netput inefficiency/Assets (market value)	-.00009 *-0.78*	-.00004 *-0.58*	.00056*** *6.17*	.00188*** *22.59*
Netput inefficiency/Assets (internal value)	-.00040*** *-3.02*	.00072*** *5.65*	.00040*** *6.57*	.01014*** *45.18*
Pricing effect/Assets	.00031*** *6.90*	-.00076*** *-7.85*	.00016*** *4.04*	-.00826*** *-42.92*
Matching within regions (1,081 matched pairs)				
Netput inefficiency/Assets (market value)	-.00006 *-0.64*	.00003 *0.50*	.00059*** *8.46*	.00176*** *25.28*
Netput inefficiency/Assets (internal value)	-.00041*** *-3.80*	.00076*** *7.35*	.00038*** *8.26*	.00946*** *56.46*
Pricing effect/Assets	.00035*** *8.74*	-.00073*** *-8.91*	.00021*** *6.05*	-.00770*** *-55.60*

Panel B. This panel is identical to Panel B, except for adjustments performed to reduce the impact of outlying values of *Ineff/(Ineff+π)*. The samples of matched pairs are trimmed at the 5th and 95th percentiles of the distribution of this measure.

	Loans	*Securities*	*Labour*	*Deposits*
Matching within states (557 matched pairs)				
Netput inefficiency/Assets (market value)	-.00008 *-0.69*	-.00001 *-0.14*	.00069*** *8.22*	.00188*** *21.38*
Netput inefficiency/Assets (internal value)	-.00030** *-2.16*	.00076*** *5.53*	.00044*** *7.58*	.01035*** *43.52*
Pricing effect/Assets	.00022*** *5.37*	-.00077*** *-7.27*	.00025*** *6.98*	-.00847*** *-41.87*
Matching within regions (973 matched pairs)				
Netput inefficiency/Assets (market value)	-.00004 *-0.46*	.00006 *0.92*	.00072*** *11.05*	.00181*** *24.65*
Netput inefficiency/Assets (internal value)	-.00033*** *-2.86*	.00074*** *7.06*	.00042*** *9.10*	.00973*** *54.79*
Pricing effect/Assets	.00028*** *7.74*	-.00068*** *-8.42*	.00030*** *9.75*	-.00792*** *-53.69*

Appendix 1
Detailed mapping of variable definitions from the call reports

Banks				
Variable Name	**Generic Definition**	**Definition**	**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
Securities	Total securities investments	Securities (held to maturity and available for sale)	RCON1754+RCON1773	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 (Securities)	Price of Securities	(interest and dividend income from Securities)/ Securities	RIADB488+RIADB489+RIAD4060/ 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**	**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
Securities	Total securities 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+2137 76+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+21400 0)+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 2
Characteristics of matched pairs and the distribution of the minimized distance function

This appendix describes the details of our matched-pairs sampling procedure. 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	71.6	132.1	84.2	170.6	768.6	57.2
Assets: Banks	73.4	142.8	92.8	201.3	849.5	63.6
Age: Credit unions	52	55	35	50	56	54
Age: Banks	50	63	28	39	82	87
Distance function	.0043	.0406	.1424	.2972	.3909	.9207

Appendix 3
Profit inefficiency comparisons: Effect of variation in the distance function cut-off threshold parameter

This table investigates the sensitivity of the principal results reported in Tables 8 and 9 to variation in 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 previously in Tables 8 and 9.

Distance function cut-off	No. of matched pairs	*Ineff/assets* $\sum_j \hat{p}_{j,s}\xi_{j,i} / \hat{a}_i$	*Loans* $\hat{p}_{1,s}\xi_{1,i} / \hat{a}_i$	*Securities* $\hat{p}_{2,s}\xi_{2,i} / \hat{a}_i$	*Labour* $\hat{p}_{3,s}\xi_{3,i} / \hat{a}_i$	*Deposits* $\hat{p}_{4,s}\xi_{4,i} / \hat{a}_i$
0.2	536	.00248*** *14.72*	-.00008 *-0.64*	-.00001 *-0.15*	.00062*** *6.37*	.00195*** *21.98*
0.3	618	.00231*** *14.26*	-.00009 *-0.78*	-.00004 *-0.58*	.00056*** *6.17*	.00188*** *22.59*
0.4	679	.00217*** *13.56*	-.00005 *-0.43*	-.00011 *-1.57*	.00050*** *5.60*	.00183*** *22.48*
None	899	.00189*** 13.13	.00006 *0.59*	-.00022*** *-3.55*	.00036*** *4.34*	.00170*** *23.34*

Supplementary Tables

Table 1S – Average profit efficiency scores and the definition of part-time workers

This table reports summary statistics for various measures of profit inefficiency for various bank size subsamples, and examines the effect of varying the full-time equivalent proportion attributed to part-time employees in credit unions. All figures are firm-level averages estimated using equations (3a) and (4) and quarterly observations for 2005-2014. All variables are defined in the text.

	Number	Mean *Ineff* ($ million)	Standard deviation *Ineff* ($ million)	Mean *Ineff/Assets*	Mean *Ineff/(Ineff+π)*
Credit unions (p/t = 0.4 f/t equivalent)					
$50m-$100m	452	1.151	0.288	.0164	1.0132
$100m-$200m	347	1.981	0.541	.0144	.9833
$200m-$500m	320	4.274	1.426	.0138	.9461
More than $500m	151	9.090	2.333	.0127	.8542
All	1,270	3.108	2.752	.0148	.9692
Credit unions (p/t = 0.5 f/t equivalent)					
$50m-$100m	452	1.156	.288	.0165	1.0197
$100m-$200m	347	1.990	.543	.0145	.9909
$200m-$500m	320	4.295	1.434	.0139	.9512
More than $500m	151	9.129	2.336	.0128	.8589
All	1,270	3.123	2.764	.0149	.9755
Credit unions (p/t = 0.6 f/t equivalent)					
$50m-$100m	452	1.162	0.289	.0166	1.0260
$100m-$200m	347	1.998	0.544	.0146	.9998
$200m-$500m	320	4.315	1.440	.0140	.9563
More than $500m	151	9.167	2.341	.0128	.8638
All	1,270	3.137	2.775	.0149	.9820
Banks					
$50m-$100m	593	.928	.274	.0130	.8453
$100m-$200m	632	1.654	.536	.0116	.8141
$200m-$500m	489	3.313	1.308	.0110	.7808
More than $500m	136	8.195	2.454	.0119	.8037
All	1,850	2.341	2.141	.0119	.8145

Table 2S – Decomposing profit inefficiency and the definition of part-time workers

This table reports average values for estimated netput inefficiency scores (for Loans, Securities, Labour and Deposits), and examines the effect of varying the full-time equivalent (FTE) proportion attributed to part-time employees in credit unions. The first three panels show percent differences between credit unions and banks, on varying assumptions concerning FTE. The final four panels report raw averages. All variables are defined in the text.

	Loans	**Securities**	**Labour**	**Deposits**
Credit unions (n=1,270)				
Netput inefficiency/Assets (market value)	.00362	.00283	.00331	.00510
Netput inefficiency/Assets (internal value)	.00394	.00343	.00238	.01251
Pricing effect/Assets	-.00032	-.00060	.00093	-.00740
Credit unions; p/t = 0.4 f/t equivalent				
Netput inefficiency/Assets (market value)	.00362	.00283	.00324	.00510
Netput inefficiency/Assets (internal value)	.00394	.00343	.00236	.01251
Pricing effect/Assets	-.00032	-.00060	.00089	-.00740
Credit unions; p/t = 0.6 f/t equivalent				
Netput inefficiency/Assets (market value)	.00362	.00283	.00338	.00510
Netput inefficiency/Assets (internal value)	.00394	.00343	.00240	.01251
Pricing effect/Assets	-.00032	-.00060	.00098	-.00740
Banks (n=1,870)				
Netput inefficiency/Assets (market value)	.00360	.00258	.00225	.00346
Netput inefficiency/Assets (internal value)	.00408	.00252	.00181	.00354
Pricing effect/Assets	-.00048	.00006	.00045	-.00008
Credit unions *versus* banks (% differences)				
Netput inefficiency/Assets (market value)	*0.4*	*9.6*	*47.0*	*47.4*
Netput inefficiency/Assets (internal value)	*-3.5*	*35.8*	*31.6*	*252.9*
Credit unions *versus* banks; p/t = 0.4 f/t equivalent				
Netput inefficiency/Assets (market value)	*0.4*	*9.6*	*43.9*	*47.4*
Netput inefficiency/Assets (internal value)	*-3.5*	*35.8*	*30.4*	*252.9*
Credit unions *versus* banks; p/t = 0.6 f/t equivalent				
Netput inefficiency/Assets (market value)	*0.4*	*9.6*	*50.2*	*47.4*
Netput inefficiency/Assets (internal value)	*-3.5*	*35.8*	*32.8*	*252.9*

Table 3S – Average profit efficiency scores and controlling for loan portfolio mix

This table reports summary statistics for various measures of profit inefficiency for various bank size subsamples, and examines the effect of varying the full-time equivalent proportion attributed to part-time employees in credit unions. All figures are firm-level averages estimated using equations (3a) and (4) and quarterly observations for 2005-2014. All variables are defined in the text.

	Number	Mean *Ineff* ($ million)	Standard deviation *Ineff* ($ million)	Mean *Ineff/Assets*	Mean *Ineff/(Ineff+π)*
Credit unions					
$50m-$100m	452	1.152	.287	.0165	1.0294
$100m-$200m	347	1.926	.531	.0141	1.0006
$200m-$500m	320	4.325	1.560	.0139	.9545
More than $500m	151	9.356	2.324	.0131	.8647
All	1,270	3.139	2.850	.0148	.9831
Credit unions (z-vector includes *business loans* and *real estate loans*)					
$50m-$100m	452	1.162	0.289	.0166	1.0260
$100m-$200m	347	1.998	0.544	.0146	.9998
$200m-$500m	320	4.315	1.440	.0140	.9563
More than $500m	151	9.167	2.341	.0128	.8638
All	1,270	3.137	2.775	.0149	.9820
Banks					
$50m-$100m	593	.933	.276	.0131	.8511
$100m-$200m	632	1.583	.512	.0111	.8084
$200m-$500m	489	3.284	1.373	.0109	.7806
More than $500m	136	8.097	2.433	.0118	.8028
All	1,850	2.303	2.132	.0117	.8143
Banks (z-vector includes *business loans* and *real estate loans*)					
$50m-$100m	593	.928	.274	.0130	.8453
$100m-$200m	632	1.654	.536	.0116	.8141
$200m-$500m	489	3.313	1.308	.0110	.7808
More than $500m	136	8.195	2.454	.0119	.8037
All	1,850	2.341	2.141	.0119	.8145

Table 4S – Decomposing profit inefficiency and controlling for loan portfolio mix

This table reports average values for estimated netput inefficiency scores (for Loans, Securities, Labour and Deposits), and examines the effect of varying the full-time equivalent (FTE) proportion attributed to part-time employees in credit unions. The first three panels show percent differences between credit unions and banks, on varying assumptions concerning FTE. The final four panels report raw averages. All variables are defined in the text.

	Loans	Securities	Labour	Deposits
Credit unions (n=1,270)				
Netput inefficiency/Assets (market value)	.00362	.00283	.00324	.00510
Netput inefficiency/Assets (internal value)	.00394	.00343	.00236	.01251
Pricing effect/Assets	-.00032	-.00060	.00089	-.00740
Credit unions (z-vector includes *business loans* and *real estate loans*)				
Netput inefficiency/Assets (market value)	.00322	.00314	.00338	.00503
Netput inefficiency/Assets (internal value)	.00351	.00379	.00240	.01234
Pricing effect/Assets	-.00029	-.00065	.00098	-.00731
Banks (n=1,870)				
Netput inefficiency/Assets (market value)	.00360	.00258	.00225	.00346
Netput inefficiency/Assets (internal value)	.00408	.00252	.00181	.00354
Pricing effect/Assets	-.00048	.00006	.00045	-.00008
Banks (z-vector includes *business loans* and *real estate loans*)				
Netput inefficiency/Assets (market value)	.00354	.00248	.00225	.00346
Netput inefficiency/Assets (internal value)	.00401	.00243	.00180	.00354
Pricing effect/Assets	-.00047	.00005	.00045	-.00008
Credit unions *versus* banks (% differences)				
Netput inefficiency/Assets (market value)	*0.4*	*9.6*	*47.0*	*47.4*
Netput inefficiency/Assets (internal value)	*-3.5*	*35.8*	*31.6*	*252.9*
Credit unions *versus* banks (z-vector includes *business loans* and *real estate loans*)				
Netput inefficiency/Assets (market value)	*-9.0*	*26.9*	*50.4*	*45.3*
Netput inefficiency/Assets (internal value)	*-12.5*	*56.3*	*33.0*	*248.5*