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Bank liquidity creation and real economic output[☆]

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We find that bank liquidity creation (*LC*) is statistically and economically significantly positively related to real economic output (*GDP*). This is robust to using instrumental variables and many robustness checks. *LC* also beats bank assets in "horse races." *On-balance sheet LC* matters more for small banks and *off-balance sheet LC* matters more for large banks. Small bank *LC* generates more *GDP* per dollar than large bank *LC*, but large bank *LC* matters more overall because large banks provide much more *LC* than small banks. The *LC*-output relation is strongest in bank-dependent industries, consistent with the hypothesized transmission mechanism.

1. Introduction

A large literature over the last quarter century links finance to the real economy, usually focusing on international comparisons (e.g., Greenwood and Jovanovic, 1990; King and Levine, 1993; Levine, 1997; Demirgüç-Kunt and Maksimovic, 1998; Levine and Zervos, 1998; Bekaert et al., 2005; Demirgüç-Kunt and Levine, 2008; Arcand et al., 2015). A number of studies also focus on the role of banks. They find, for example, that U.S. bank deregulation results in increases in entrepreneurship, more small businesses, and improved economic growth (e.g., Jayaratne and Strahan, 1996; Black and Strahan, 2002; Cetorelli and Strahan, 2006; Rice and Strahan, 2010; Krishnan et al., 2015). In this paper, we address *how* banks improve the real economy by focusing on bank liquidity creation (*LC*). *LC* is a comprehensive measure of bank output that includes all assets, liabilities, equity, and off-balance sheet guarantees and derivatives, each with different theoretically-driven weights. As shown below, *LC* beats measures of bank assets in "horse races" predicting real economic output, and the driving force is *off-balance sheet LC*, which is not included in the asset measures.

LC is one of the most important roles that banks play and its components are theoretically linked to the economy. Bank loans, particularly those to bank-dependent customers without capital market opportunities, are often thought to be primary engines of economic growth (e.g., Smith, 1776; Levine and Zervos, 1998). These loans also play an important role in affecting output through the bank lending channel of monetary policy (e.g., Bernanke and Blinder, 1998), particularly for small banks that tend to cater to small, bank-dependent firms (Kashyap and Stein, 2000; Berger and Bouwman, 2017). Transactions deposits, another key component of *LC*, provide liquidity and payments services which are essential to a well-functioning economy (Kashyap et al., 2002). Off-balance sheet guarantees like loan commitments and standby letters of credit allow customers to expand their economic activities because they are able to plan their investments and other expenditures, knowing that the funds to finance these expenditures will be forthcoming in the future when needed (e.g., Boot et al., 1993). Moreover, these guarantees are often used as backups for other capital market financing, such as commercial paper and municipal revenue bonds, and in this way assist the capital markets in financing

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economic growth. Similarly, derivatives, the other main type of bank off-balance sheet activity, aid real economic activity by allowing firms to hedge risks related to future changes in interest rates, foreign exchange rates, and other market prices (e.g., Stulz, 2003).

Despite the theoretical links between *LC* and the economy, the empirical literature until now is missing comprehensive tests of whether *LC* affects real economic output, measurement of how large such an effect may be, the extent to which the effect derives from small versus large banks and from on- or off-balance sheet activities, and whether this effect is stronger than that of more traditional measures of bank output, total assets (*TA*) or gross total assets (*GTA*), discussed further below.[1] Note that this study is distinguished from studies that examine the determinants of *LC* (e.g., Jiang et al., 2016) and the effects of *LC* on bank failure (e.g., Fungacova et al., 2015). Our work is also related to the research noted above that links banks to real output (e.g., King and Levine, 1993; Levine and Zervos, 1998). However, this literature has not focused on *LC*, which includes different weights on all of the bank assets, and also includes liabilities and off-balance sheet activities.

The goal of this paper is to fill these gaps in the literature. Specifically, we test if real economic output is higher in U.S. states in which *LC* is relatively high after controlling for other determinants of real output. In addition, we measure how large this effect of *LC* on real economic output is. We also test whether *LC* is better than the asset measures *TA* and *GTA* in predicting real economic output. In addition, we distinguish between *small-bank* and *large-bank LC* and between *on-* and *off-balance sheet LC*. Finally, we hypothesize that the primary transmission mechanism through which *LC* impacts *GDP* is through bank-dependent industries. Our results support this view.

Until recently, *LC* was mostly relegated to a theoretical concept and was not often used in empirical studies. Berger and Bouwman (2009) provide the first comprehensive measure of *LC* that takes into account the contributions of all bank assets, liabilities, equity, and off-balance sheet activities. To summarize briefly, measured *LC* is the weighted sum of all assets, liabilities, equity, and off-balance sheet activities, where the weights are based on the liquidity and the location on or off of the balance sheet of each item. Since liquidity is created when banks transform illiquid assets into liquid liabilities, positive weights are given to both illiquid assets and liquid liabilities (e.g., Bryant, 1980; Diamond and Dybvig, 1983). Banks in this situation are taking something illiquid from the public and giving it something liquid. Similarly, negative weights are given to liquid assets, illiquid liabilities, and equity because banks destroy liquidity when they transform liquid assets into illiquid liabilities or equity. In these cases, banks are taking something liquid from the public and giving it something illiquid. Off-balance sheet activities are assigned weights consistent with those assigned to functionally similar on-balance sheet activities. For example, unused loan commitments are assigned a positive weight because they provide liquidity to the public similar to that of transactions deposits (e.g., Boot et al., 1993; Holmstrom and Tirole, 1998; Kashyap et al., 2002). See Berger and Bouwman (2009) for more details.

LC is also a measure of the output of a bank. According to the modern theory of financial intermediation, banks' two major roles in the economy are liquidity creation and risk transformation. According to the risk transformation theories, banks transform risk by issuing riskless deposits to finance risky loans (e.g., Diamond, 1984; Ramakrishnan and Thakor, 1984; Boyd and Prescott, 1986). While *LC* is only one of the two major functions of a bank, the two roles often coincide, given that both riskless deposits and risky loans contribute positively to *LC*. It is therefore expected that the output of *LC* is highly correlated with the output of risk transformation. Since there is not as yet any empirical measure of risk transformation, *LC* may be viewed as the best available measure of total bank output.

The vast majority of empirical studies in banking use one of two measures of bank assets, total assets (*TA*) or gross total assets (*GTA*), as their main measure of bank output. *GTA* equals *TA* plus allowances for loan and lease losses and the allocated transfer risk reserve. *GTA* may be considered to be a superior measure of the size of the balance sheet to *TA* because *GTA* includes all of the items that are part of the balance sheet that must be financed. The empirical research includes studies of the effects of bank output or size on corporate governance (e.g., Laeven and Levine, 2009), small business lending (e.g., Berger et al., 2005), the effects of government interventions and bailouts (e.g., Duchin and Sosyura, 2014), and many other topics. The measures of bank assets are also used as a size cutoff to determine which banks are classified as community banks (e.g., DeYoung et al., 2004), and which banks are subject to different regulatory treatment, such as extra supervision as Systemically Important Financial Institutions (SIFIs), stress tests, and consumer protections.[2]

We argue that *LC* is a superior measure of bank output to *TA* or *GTA* because *LC* takes into account off-balance sheet guarantees and derivatives, deposits and other liabilities, and equity in addition to assets, and because it weights various asset categories differently. As noted above, off-balance sheet guarantees allow customers to expand their economic activities by helping them plan expenditures and are often used as backups for other capital market financing. Similarly, off-balance sheet derivatives allow customers to engage in economic activities without facing significant price risks. *TA* and *GTA* do not include off-balance sheet activities. Off-balance sheet activities make up about half of all *LC* in the U.S. (Berger and Bouwman, 2016), so neglecting off-balance sheet activities fails to take into account a major part of bank output. By including transactions deposits with positive weights, *LC* also helps capture the value to the economy of both the liquidity provided by these deposits and the payments services associated with them. Deposits are not included in the asset measures. Another potentially important difference is that *TA* and *GTA* both weight all assets equally and positively, whereas *LC* applies positive, negative, and zero weights to different assets. To illustrate, marketable securities held by a bank increase measured bank output when *TA* or *GTA* are used, but they decrease measured output when *LC* is used. We argue that the negative weight is more appropriate, since holding such securities takes something liquid away from the public and provides no direct benefit to bank customers.[3] As a result of all of these differences, we expect that *LC* to be more strongly related to economic output than *TA* or *GTA*.

As indicated above, we test if real economic output is higher in states in which *LC* is relatively high, measure the size of this effect, and test whether *LC* dominates *TA* and *GTA* in predicting real economic output. We specifically regress *GDP per capita* on *LC per capita*, both measured in real 2010 dollars, in all 50 U.S. states annually from 1984 to 2010, controlling for a number of state conditioning variables, as well as state and year fixed effects. We normalize both *GDP* and *LC* by state population because oth-

[1] We acknowledge the contribution of Fidrmuc, Fungacova, and Weill (2015), which examines the effects of *on-balance sheet LC* on real economic output. However, it does not consider *off-balance sheet LC* (which we find to be most important), or the effects of small versus large banks. It also focuses on Russia, where many of the banks are state-owned, and may have very different economic objectives.

[2] For a list of studies using assets to measure bank output or size, as well as regulatory treatments that are based on assets, see Berger and Bouwman (2016, pp. 48-49, Box 5.1).

[3] This is not to suggest that holding securities is not valuable to the bank in terms of reducing liquidity risk, but rather that there is no direct benefit to the customers of the bank.

erwise the results would be driven primarily by the large states, as large states mechanically have higher *GDP*. We also regress industry-level *GDP per capita* on *LC per capita*, and test whether the mechanism is through bank-dependent industries.

By way of preview, we find that *LC per capita* is positively related to *GDP per capita*, and that these results are both statistically and economically significant. A one standard deviation increase in *LC per capita* is related to a 2.57% increase in *GDP per capita*. This relation holds in both OLS and instrumental variable estimations, and is robust to many robustness checks. Moreover, we find that when *TA per capita* or *GTA per capita* are included in the regressions, *LC per capita* remains statistically and economically significant, while these alternative measures of bank output are not significant.

When splitting bank *LC* by size class, we find positive, significant effects on *GDP per capita* for both small and large bank *LC per capita*, although small bank *LC* matters more per dollar, where small banks are measured as those with less than or equal to $1 billion in GTA. The greater effect per dollar of small bank *LC per capita* is consistent with the literature suggesting that small banks often provide financial services to small businesses that cannot be replicated by capital markets, while large banks more often serve large companies that have outside capital market alternatives, making the large bank *LC per capita* less important (e.g., Berger et al., 2005).[4] Importantly, despite the per-dollar results, large-bank *LC* matters more to the economy than small-bank *LC* because large banks provide so much more liquidity than small banks. To illustrate, for the last year of our sample, 2010, large bank *LC* was $13.85 trillion, more than seven times the quantity of $1.80 trillion for small banks.

In addition, we find that *off-balance sheet LC per capita* matters more to *GDP per capita* than *on-balance sheet LC per capita*. This may help explain why *LC per capita* is significantly related to *GDP per capita*, whereas *TA per capita* and *GTA per capita* are not when they are included in the same regressions – *TA per capita* and *GTA per capita* exclude off-balance sheet activities. This result is consistent with Berger and Bouwman (2017), who find that detrended *off-balance sheet LC* is more important than detrended *on-balance sheet LC* for predicting future financial crises. In contrast, Chatterjee (2015) shows that *on-balance sheet LC* predicts future recessions. Thus, the relative importance of *on-* and *off-balance sheet LC* is an unsettled issue. When the results are broken down by both bank size class and *on-* versus *off-balance sheet LC* together, the data suggest that *on-balance sheet LC* matters more for small banks and *off-balance sheet LC* matters more for large banks. This result stems from the fact that small banks tend to specialize in on-balance sheet activities (including providing relationship-based loans to bank-dependent small businesses) and have relatively few off-balance sheet activities. In contrast, large banks more often provide transaction loans to large businesses that have alternative external financing options, and generate most of their *LC* off the balance sheet. Thus, while *LC* by both sizes of banks contribute significantly to economic growth, the primary mechanism behind these results differ – *on-balance sheet LC* by small banks and *off-balance sheet LC* by large banks. The reason why *off-balance sheet LC* dominates overall when both small and large banks are included is that large banks provide so much more *LC* in aggregate than small banks, as shown above.

We also investigate whether and how the effects of *LC* vary during normal times and financial crises and find mixed results – the effects of *LC per capita* on *GDP per capita* are stronger than in normal times during some crises and weaker during other crises. In addition, we investigate the dynamics of the relation between *LC per capita* and *GDP per capita*, and find the effects of *LC per capita* are strongest in the first year. We also conduct a number of robustness checks that support our main results.

Finally, we analyze the relation between state-level *LC per capita* and state-industry-level *GDP per capita.* This allows us to test our hypothesized transmission mechanism – that *LC* affects *GDP* primarily through its effect on bank-dependent industries. We find that the relation is positive for nearly all industries, and statistically and economically significant in industries considered to be more bank-dependent, consistent with the hypothesized transmission mechanism.

The remainder of the paper is organized as follows. Section 2 discusses the data. Section 3 presents the main results of the effects of state *LC per capita* on state *GDP per capita*, some robustness checks, analyses by bank size class, and instrumental variable estimation. Section 4 investigates the effects during financial crises versus normal times, probes the dynamics of the relation between *LC* and real economic output, and presents some additional robustness tests. Section 5 examines our results on a state-industry level. Section 6 concludes by providing a summary of the results, policy implications, and suggestions for future research.

2. Data

Table 1 Panel A reports the definitions and sources for the variables used in the analysis, Panel B shows summary statistics for these variables, and Panel C gives a correlation matrix for the main dependent and independent variables. The sample consists of annual state level observations over 1984–2010. The dependent variable is *GDP per capita*. We collect *GDP* by state from the Bureau of Economic Analysis (BEA) and normalize this variable by the state's population in each year using annual US Census intercensal population estimates. We normalize by population so that our results are not driven by the largest states. Over the course of the sample, the average state *GDP per capita* was $39,089.95. All financial variables are calculated in real 2010 dollars throughout the analysis.[5]

Our key independent variable is *LC per capita*. We use Berger and Bouwman's (2009) preferred CATFAT liquidity creation measure. These data are available on the bank level at a quarterly frequency.[6] In order to match the frequency of reporting of *GDP* data, we calculate all *LC* measures at the annual frequency. We calculate the annual average CATFAT for each bank for each sample year and convert these data to the state level. For some of the analyses, we also compute *LC* for small and large banks. We additionally compute *on-balance sheet LC* and *off-balance sheet LC*. *On-balance sheet LC* data is computed as Berger and Bouwman's (2009) CATNONFAT measure, and *off-balance sheet LC* is calculated as the difference between CATFAT and CATNONFAT.

Most banks operate solely in one state. In these cases, we simply include the bank's *LC* in the state's total. For multistate banks, we assume that *LC* is geographically distributed according to the deposits of the bank, taken from the FDIC's Summary of Deposits (SoD) database, which reports the amount of deposits held in each office of each bank in the U.S. This assumption is necessary because deposits is the only balance sheet variable we can use to determine location, although we recognize that this creates measurement error, since *LC* reflects more outputs than just deposits. This measurement error creates an attenuation bias against finding any

[4] Small businesses are often thought of as the engine of economic growth in the United States. Small business accounted for 63% of net new jobs between 1993 and 2013 and comprise 99.7% of U.S. employer firms (Small Business Administration, 2014).

[5] We use annual data despite the fact that the *LC* data are available quarterly. This is because quarterly *GDP per capita* data on the state level only goes back to 2005 at the BEA. Restricting ourselves to this small subsample would severely erode our sample size and ability to draw meaningful inferences over a long time period.

[6] These data are available at: https://sites.google.com/a/tamu.edu/bouwman/data.

Table 1

Variable definitions, sources, summary statistics, and correlations. This table presents definitions, sources, summary statistics, and correlations for key variables used in the analysis below. The sample period is 1984–2010. Bank-level data are reported as of December of each year; state-level data are reported on an annual basis. All financial variables are calculated in real 2010 dollars using the GDP price deflator. Washington, DC is dropped due to a lack of data availability and extreme outlier GDP figures. For bank variables, we use the proportions of the variables in the states, where the weights are the proportions of deposits in the different states where banks operate based on the June FDIC Summary of Deposits (SoD) data. Bank-level data are winsorized at the 5% level.

Panel A: Definitions and Sources

Dependent Variables:	**Definition**	**Source**
GDP per capita ($/capita)	Annual GDP of the state, normalized by the state's population.	GDP - Bureau of Economic Analysis (BEA): http://bea.gov/regional/index.htm Population–US Census: http://www.census.gov/popest/
Alternative Key Independent Variables:	**Definition**	**Source**
Liquidity Creation (LC) per capita ($/capita)	Total liquidity creation of all banks in the state, normalized by the state's population.	CATFAT data, Berger & Bouwman (2009): http://faculty.weatherhead.case.edu/bouwman/data.html
Large Bank Liquidity Creation (LC) per capita ($/capita)	Total liquidity creation of banks in the state with greater than $1 billion in gross total assets, normalized by the state's population.	CATFAT data, Berger & Bouwman (2009): http://faculty.weatherhead.case.edu/bouwman/data.html
Small Bank Liquidity Creation (LC) per capita ($/capita)	Total liquidity creation of banks in the state with less or equal to $1 billion in gross total assets, normalized by the state's population.	CATFAT data, Berger & Bouwman (2009): http://faculty.weatherhead.case.edu/bouwman/data.html
Liquidity Creation (LC) per capita (Single State, $/capita)	Total liquidity creation of all banks in the state that operate *only* in that state, normalized by the state's population.	CATFAT data, Berger & Bouwman (2009): http://faculty.weatherhead.case.edu/bouwman/data.html
Large Banks Liquidity Creation (LC) per capita (Single State, $/capita)	Total liquidity creation of banks in the state that operate *only* in that state with greater than $1 billion in gross total assets, normalized by the state's population.	CATFAT data, Berger & Bouwman (2009): http://faculty.weatherhead.case.edu/bouwman/data.html
Small Bank Liquidity Creation (LC) per capita (Single State, $/capita)	Total liquidity creation of banks in the state that operate *only* in that state with less or equal to $1 billion in gross total assets, normalized by the state's population.	CATFAT data, Berger & Bouwman (2009): http://faculty.weatherhead.case.edu/bouwman/data.html
On-Balance Sheet Liquidity Creation (LC) per capita ($/capita)	Total on-balance sheet liquidity creation of all banks in the state, normalized by the state's population.	CATFAT data, Berger & Bouwman (2009): http://faculty.weatherhead.case.edu/bouwman/data.html
Off-Balance Sheet Liquidity Creation (LC) per capita ($/capita)	Total off-balance sheet liquidity creation of all banks in the state, normalized by the state's population.	CATFAT data, Berger & Bouwman (2009): http://faculty.weatherhead.case.edu/bouwman/data.html
Total Assets (TA) per capita (Thousands, $/capita)	All assets held by banks in the state, normalized by the state's population.	Call Report Data
Gross Total Assets (GTA) per capita (Thousands, $/capita)	All gross total assets held by banks in the state, normalized by the state's population.	Call Report Data
Control Variables:	**Definition**	**Source**
State Inc. Tax (Percentage)	Top marginal rate of the state's income tax.	NBER: http://users.nber.org/~taxsim/state-rates/maxrate.html
State Minimum Wage ($/hour)	Minimum wage mandated by state law. If there are no minimum wage laws in the state, then minimum wage equals the Federal minimum wage.	Tax Policy Center: http://www.taxpolicycenter.org/taxfacts/content/PDF/state_min_wage.pdf
State Expenditures per capita ($/capita)	Total spending by the state's government normalized by the state's population.	U.S. Census: http://www.census.gov/govs/local/
Regional GDP per capita ($/capita)	Total GDP of all bordering states,[a] normalized by the population of all bordering states.	BEA
Governor Dummies	*Rep. Governor Dummy* takes a value of one if the state has a Republican governor. *Dem. Governor Dummy* takes a value of one if the state has a Democratic governor. *Indep. Governor Dummy* takes a value of one if the state has a governor who belongs to a third party. We exclude Indep. Governor Dummy to avoid collinearity.	National Governor's Association: http://www.nga.org/cms/home.html
Legislature Dummies	*Rep. Legislature* takes a value of one if both houses of the state's legislature are controlled by Republicans. *Dem. Legislature* takes a value of one if both houses of the state's legislature are controlled by Democrats. *Split Legislature* takes a value of one if the control of the houses of the state's government is divided between the two parties.[b] We exclude Split Legislature to avoid collinearity.	National Conference of State Legislatures (NCSL): http://www.ncsl.org/research/about-state-legislatures/partisan-composition.aspx
Federal Funds Rate (Percentage)	The interest rate charged by an institution when lending overnight funds to another institution. This variable is used only when year fixed effects are not included.	Federal Reserve
TED Spread (Percentage)	The difference between interest rates on short-term US debt and interbank loan interest rates. This variable is used only when year fixed effects are not included.	Bloomberg
State Fixed Effects	Takes a value of one if the observation corresponds to the state.	
Year Fixed Effects	Takes a value of one if the observation corresponds to the year.	
Instrument:	**Definition**	**Source**
Bank Equity per capita (Thousands, $/capita)	Total bank book equity in the state, normalized by the state's population.	Call Report Data
Bank Equity per capita – Large (Thousands, $/capita)	Total bank book equity in the state for banks with greater than $1 billion in gross total assets, normalized by the state's population.	Call Report Data
Bank Equity per capita – Small (Thousands, $/capita)	Total bank book equity in the state for banks with less than or equal to $1 billion in gross total assets, normalized by the state's population.	Call Report Data
Rice-Strahan Index (*RSI*)	Index that represents the level of interstate branching restrictions for a given state and year. The values range from 0 (least restrictive) to 4 (most restrictive)	Rice and Strahan (2010)

(*continued on next page*)

Table 1
(*continued*)

Panel B: Summary Statistics

	Mean	Std. Dev.	Count	Min	Max
GDP per capita ($)	39,089.95	9979.41	1350	20,339.51	86,781.63
LC per capita ($)	12.01	9.47	1350	2.50	61.81
Small Bank LC per capita ($)	3.85	3.41	1350	0.68	27.83
Large Bank LC per capita ($)	7.60	6.62	1350	0	44.82
LC per capita (Single State, $)	7.73	8.55	1350	0.97	54.89
Small Bank LC per capita (Single State, $)	3.62	3.35	1350	0.63	27.72
Large Bank LC per capita (Single State, $)	3.32	4.00	1350	0	23.13
On-Balance Sheet LC per capita	5.89	2.16	1350	0.71	15.06
Off-Balance Sheet LC per capita	6.12	8.91	1350	0.25	58.16
Total Assets per capita (Thousands, $)	21.83	11.11	1350	9.61	102.83
GTA per capita (Thousands, $)	28.54	11.31	1350	15.49	106.08
State Inc. Tax (Percentage)	5.19	3.08	1350	0	13.50
State Min. Wage ($/hour)	6.05	1.04	1350	1.98	8.65
State Exp. per capita ($)	4727.42	1911.18	1350	1705.34	17,270.06
Regional GDP per capita ($)	39,806.31	7888.58	1350	24,953.96	64,162.27
Rep. Governor Dummy	0.4785	0.4997	1350	0	1
Dem. Governor Dummy	0.4896	0.5000	1350	0	1
Indep. Governor Dummy	0.0319	0.1757	1350	0	1
Rep. Legislature Dummy	0.2748	0.4466	1350	0	1
Dem. Legislature Dummy	0.4637	0.4989	1350	0	1
Split Legislature Dummy	0.2607	0.4392	1350	0	1
Federal Funds Rate (Percentage)	4.58	2.63	1350	0.12	8.76
TED Spread (Percentage)	0.68	0.42	1250	0.17	1.76
Bank Equity per capita (Thousands, $)	1.88	1.10	1350	0.46	8.65
Bank Equity per capita – Large (Thousands, $)	0.59	0.37	1350	0.04	1.58
Bank Equity per capita – Small (Thousands, $)	1.28	1.14	1350	0	8.46
RSI	2.93	1.45	1350	0	4

Panel C: Correlations of Key Variables

	GDP per Capita	*LC per Capita*	*Small Bank LC per Capita*	*Large Bank LC per Capita*	*On-Balance Sheet LC per Capita*	*Off-Balance Sheet LC per Capita*
GDP per Capita	1.000					
LC per Capita	0.365	1.000				
Small Bank LC per Capita	0.003	0.426	1.000			
Large Bank LC per Capita	0.462	0.824	0.057	1.000		
On-Balance Sheet LC per Capita	0.190	0.165	−0.200	0.331	1.000	
Off-Balance Sheet LC per Capita	0.327	0.932	0.384	0.745	0.087	1.000

[a] We classify Alaska's bordering states as: Hawaii, Oregon, Washington, and California. We classify Hawaii's bordering states as: Alaska, Oregon, Washington, and California.
[b] Nebraska's state legislature is unicameral and non-partisan. We classify their legislature as "split."

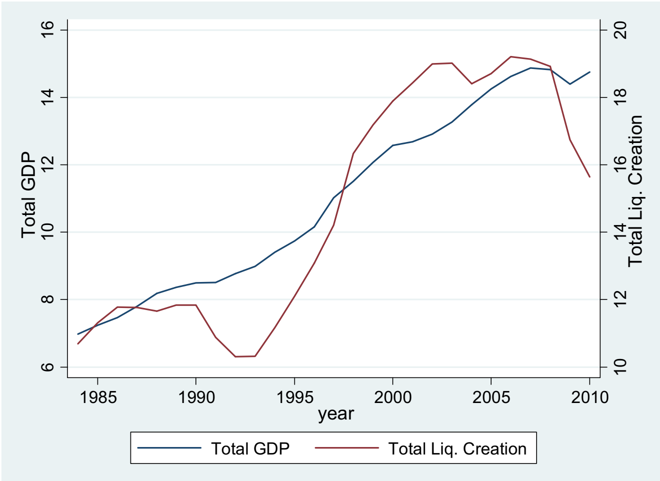

Fig. 1. Total GDP (in trillions) vs. Total Liquidity Creation (in billions) over time. This figure plots the total GDP and total Liquidity Creation over the 1984–2010 sample period. These measures are not normalized by population, but are rather reported as the sum of the GDP and liquidity creation of all states in the United States. GDP and Liquidity Creation have been divided by 1 billion for scaling purposes.

effect of *LC per capita* on *GDP per capita*. In a robustness check, we find that the results are robust to including single-state banks only.

We also adjust the data to account for a reporting anomaly in the SoD dataset. Some banks wish to take advantage of relaxed banking regulations in Delaware and South Dakota. As such, they list more deposits in these two states than their actual holdings in these states. To account for this, we make two adjustments. First, we eliminate banks in these two states which report 100% of their deposits in one banking office within the state but do not report their headquarters in the same state. Second, we winsorize the data by year at the 5% level to control for extreme values. Within our sample, the mean value of *LC per capita* is $12.01, with a standard deviation of $9.47. As noted below, our results are also robust to the exclusion of data from Delaware and South Dakota.

Fig. 1 displays the time series of total *GDP* and *LC* at the national level over the sample period. We report total *GDP* and total *LC* here, rather than normalizing by population, so as to not underweight states with larger populations.[7] Generally, we find that the two variables move together, declining only during the recent subprime financial crisis of the late 2000s. This figure provides us with a very preliminary indication that bank *LC* is related to economic output.

The correlations shown in Table 1 Panel C confirm the positive relation between the state *GDP* and *LC*, both normalized by population. *GDP per capita* and *LC per capita* have a very strong 0.365 correlation. The relation is stronger for *Large Bank LC per capita* than *Small Bank LC per capita* and stronger for *Off-balance sheet LC per capita* than *On-balance sheet LC per capita*. Of course, these correlations only give a general idea of the bivariate relations and account for only one determinant at a time, and do not control for other factors in a rigorous fashion as occurs in our regression analyses below.

We collect several additional bank-level variables. We collect *TA* and *GTA* from annual Call Reports, and test them as alternatives to *LC* as generators of state *GDP*. We also collect *Bank Equity* for all banks and for small and large banks separately from the Call Reports to instrument for *LC* and *small bank LC* and *large bank LC*, respectively. We convert each of these variables from the bank level variable to the state level, following the same procedure used for *LC*. Following this, all of these variables are normalized by state population and winsorized at the 5% level.

Finally, we collect a number of state-level political variables because state taxes, minimum wage legislation, government spending, and regulation may affect state *GDP per capita*. We collect the top marginal rate of each state's *Income Tax*, its *Minimum Wage*, and its *Government Expenditures per capita* for each year in the sample. If a state has no minimum wage law, we instead use the Federal minimum wage, since this essentially acts as the state's minimum. In our sample, the average top marginal level *of State Income Tax* is 5.19%; the average *State Minimum Wage* is $6.05; and the average *State Expenditures per capita* are $4727.42. We also collect data on the political parties which control the state's government. We calculate separate dummy variables indicating whether Democrats, Republicans, or Independents control each state's governorship and whether Democrats, Republicans, or neither controls the legislature. Over our sample period, we find that 47.85% of state-year observations have Republican-controlled governorships, while 48.96% have Democrat-controlled governorships and 3.19% have third party-controlled governorships. State legislatures are controlled by Republicans 27.48% of the time, and by Democrats 46.37% of the time. State legislatures are split between the two parties 26.07% of the time.[8] All regressions also include *State Fixed Effects* to control for other unspecified differences across the states that are persistent over time.

We also calculate *Regional GDP per capita* for each state and year to further control for economic conditions. *Regional GDP* is calculated by summing the *GDP* of all states sharing a border with a given state. We then divide this total by the combined populations of all bordering states.[9] Over our sample, the average *Regional GDP per capita* is $39,806.31, close to the average state level *GDP per capita*.[10]

In our main specifications, we also include *Time Fixed Effects* to control for changes in the aggregate banking environment. In alternative specifications, we drop *Time Fixed Effects* and instead include the *Federal Funds Rate* and the *TED Spread*, which control for the aggregate banking environment in an alternative way. The *Federal Funds Rate* is the interest rate at which banks lend to each other, and is targeted by the Federal Reserve as its primary monetary policy tool. The *TED Spread* is the difference between the three-month LIBOR and the 3-month U.S. T-bill rate, and traditionally acts as an indicator of credit risk in the banking system (e.g., Cornett et al., 2011).

3. Main results

Table 2 presents our first set of regression results. All independent variables are lagged one year to mitigate potential endogeneity concerns, as contemporaneous *GDP* cannot cause the lagged independent variables. We examine the effect of lagged *LC per capita* on *GDP per capita* for all banks using ordinary least squares (OLS). Regression (1) includes only *State Fixed Effects* and *Time Fixed Effects* as control variables. Regression (2) adds lagged *State Income Tax*, lagged *State Minimum Wage*, and lagged *State Government Expenses per capita*, while regression (3) adds lagged *Regional GDP per capita*. Regression (4) is our full model, which

[7] This is effectively the same as weighting the individual states by their populations.

[8] Nebraska's state legislature is unicameral and non-partisan. We classify their legislature as "split."

[9] We classify Alaska's bordering states as: Hawaii, Oregon, Washington, and California. We classify Hawaii's bordering states as: Alaska, Oregon, Washington, and California.

[10] This variable is potentially endogenous because it may also be affected by the state's GDP per capita. However, as shown in the Tables below, the results are robust to exclusion of this variable.

Table 2
The effects of lagged bank liquidity creation on state gross domestic product (GDP). This table presents Ordinary Least Squares (OLS) regression results. The dependent variable is state-level *GDP per capita*. The key independent variable, *LC per Capita*, is liquidity creation (CATFAT) normalized by state population. The sample period is 1984–2010, and t-statistics based on standard errors clustered at the state level are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) *GDP/Capita*	(2) *GDP/Capita*	(3) *GDP/Capita*	(4) *GDP/Capita*	(5) *GDP/Capita*
LC per Capita$_{t-1}$	75.76**	106.8***	106.9***	105.0***	101.3***
	(2.463)	(3.848)	(3.799)	(3.966)	(4.831)
State Inc. Tax$_{t-1}$		230.9	269.2	285.6	347.5*
		(0.940)	(1.238)	(1.354)	(1.683)
State Min. Wage$_{t-1}$		1012***	987.1***	969.0***	722.9*
		(2.927)	(2.882)	(2.812)	(1.976)
State Gvt. Exp. per capita$_{t-1}$		2.517***	2.279**	2.253***	1.898**
		(3.104)	(2.633)	(2.770)	(2.395)
Regional GDP per capita$_{t-1}$			0.515***	0.506***	0.588***
			(3.718)	(3.783)	(6.084)
Third Party Governor Dummy$_{t-1}$				−1596***	−1526***
				(−2.752)	(−2.946)
Dem. Governor Dummy$_{t-1}$				420.9	339.1
				(1.123)	(0.885)
Split Legislature$_{t-1}$				712.2	453.5
				(1.005)	(0.699)
Dem. Legislature$_{t-1}$				−184.9	−336.9
				(−0.263)	(−0.501)
Federal Funds Rate$_{t-1}$					251.7**
					(2.060)
TED Spread$_{t-1}$					−633.6**
					(−2.266)
State FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	NO
Observations	1300	1300	1300	1300	1200
Adj. R-squared	0.914	0.927	0.932	0.933	0.930

also includes lagged state-level political control variables. Regression (5) is a robustness check, which replaces *Time Fixed Effects* with two variables measuring the aggregate banking environment: lagged *Federal Funds Rate* and lagged *TED Spread*. In all regressions, standard errors are clustered at the state level.

Across all specifications, the coefficient on lagged *LC per capita* is economically and statistically significant and positively related to *GDP per capita*. Using the coefficient from the full model in column (4), 105.0, we find that a one standard deviation increase in *LC per capita* is associated with an economically significant 2.57% increase in *GDP per capita*, evaluated at the sample mean level of $39,089.95.[11] The measured effect is similar across the other specifications.[12]

Table 3 presents the results of our "horse races" between *LC per capita* and the two normalized measures of assets, *TA per capita and GTA per capita*. Regressions (1) and (2) include lagged *TA per capita* and *GTA per capita*, respectively, with control variables, but exclude lagged *LC per capita*. Regressions (3) and (4) run "horse races" between the lagged *LC per capita* and lagged *TA per capita* and lagged *GTA per capita*, respectively, inclusive of all the control variables. In regressions (1) and (2), we find that both *TA per capita* and *GTA per capita* are positively related to *GDP per capita*, but only the coefficient on *TA per capita* is statistically significant, and it is only significant at the 10% level, as opposed to the 1% level for *LC per capita* in the earlier tables. We further find in regressions (3) and (4) that lagged *LC per capita* outperforms the traditional measures of bank output in terms of forecasting *GDP per capita*. Neither lagged *TA per capita* nor lagged *GTA per capita* have statistically significant coefficients when *LC per capita* is included. Additionally, because their t-statistics are less than one, both variables reduce the model's Adjusted R^2, meaning that their inclusion reduces the model's goodness of fit. In contrast, the coefficients on lagged *LC per capita* remain statistically significant and positive, while maintaining magnitudes similar to the previous regressions. A robustness check below suggests that the main reason for these results may be the inclusion of off-balance sheet activities in the *LC* measure, which are excluded by *TA* and *GTA*.

Table 4 presents results which examine the effect of *LC per capita* on *GDP per capita* by bank size class. We split our sample of banks using a cutoff of 1 billion dollars in GTA. Banks less than or equal to $1 billion in assets are generally considered to be community banks (DeYoung et al., 2004) and $1 billion is the traditional dividing line between small and large banks throughout much of the empirical banking literature (e.g., Carter and McNulty, 2005; Berger and Black, 2011). We repeat the analysis from Table 2, but substitute the two size-based *LC per capita* measures for total *LC per capita*. We report only specifications that include all the control variables in this table. Regression (1) is our full specification with *Time Fixed Effects*, while regression (2) replaces *Time Fixed Effects* with the *Federal Funds Rate* and the *TED Spread*.

[11] We calculate economic impact by multiplying the standard deviation of lagged *LC* ($9.56) by its coefficient from the regression (105.0), and dividing by the sample mean of *GDP per capita* ($39,089.95). We follow a similar methodology throughout the paper.

[12] With respect to the control variables, we also find that in all regressions, the coefficient on lagged State Income Tax is not significantly different from zero, while the coefficients on lagged State Minimum Wage, lagged State Government Expenditures per capita, and lagged Regional GDP per capita are all positive and significantly different from zero. We find that the coefficient on the Democratic Party Governor Dummy is not statistically different from zero. Additionally, we find that the coefficient on the Third Party Governor Dummy is negative and statistically significant, suggesting that relative to a Republican governor, a third party governor is associated with lower state GDP per capita. Further, we find that the State Legislature Dummy Variables are not statistically different from zero. These results are also robust to the exclusion of Time Fixed Effects and the inclusion of the lagged Federal Funds Rate and lagged TED Spread in regression (5). All variables maintain their signs and levels of significance from regression (4). Turning to the State Fixed Effects (not shown), the effects for Wyoming, Texas, Illinois, and Connecticut are appreciably larger than the omitted state, Alabama, while West Virginia, Mississippi, and Maine have fixed effects which suggest that their GDP per capita is much lower than Alabama. Examining the Time Fixed Effects (not shown), the crisis years, especially 2008 and 2009, have especially low GDP per capita relative to other years.

Table 3
"Horse Races" between Bank Liquidity Creation and both Total Assets and Gross Total Assets. This table presents Ordinary Least Squares (OLS) regression results. The dependent variable is state-level *GDP per capita*. We compare the effects of *TA per capita* and *GTA per capita* on *GDP per capita* to the effect of *LC per capita* on *GDP per capita.* The sample period is 1984–2010, and t-statistics based on standard errors clustered at the state level are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) *GDP/Capita*	(2) *GDP/Capita*	(3) *GDP/Capita*	(4) *GDP/Capita*
LC per Capita$_{t-1}$			103.7***	109.7***
			(3.620)	(3.673)
TA per Capita $_{t-1}$	40.55*		3.615	
	(1.725)		(0.143)	
GTA per Capita$_{t-1}$		29.20		−9.922
		(1.287)		(−0.397)
State Inc. Tax$_{t-1}$	228.5	228.8	284.9	287.9
	(1.066)	(1.054)	(1.361)	(1.394)
State Min. Wage$_{t-1}$	844.4**	845.2**	969.8***	964.7***
	(2.427)	(2.446)	(2.829)	(2.841)
State Gvt. Exp. per capita$_{t-1}$	2.101**	2.087**	2.254***	2.254***
	(2.500)	(2.464)	(2.778)	(2.764)
Regional GDP per capita$_{t-1}$	0.475***	0.484***	0.504***	0.510***
	(3.569)	(3.602)	(3.787)	(3.819)
Third Party Governor Dummy$_{t-1}$	−1982***	−1993***	−1602***	−1570**
	(−3.015)	(−3.023)	(−2.699)	(−2.609)
Dem. Governor Dummy$_{t-1}$	381.7	381.8	420.9	420.8
	(0.964)	(0.958)	(1.122)	(1.127)
Split Legislature$_{t-1}$	905.0	901.5	715.0	704.1
	(1.209)	(1.194)	(1.007)	(0.977)
Dem. Legislature$_{t-1}$	1.814	22.62	−187.1	−182.4
	(0.00260)	(0.0325)	(−0.267)	(−0.259)
State FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	1300	1300	1300	1300
Adj. R-squared	0.930	0.929	0.933	0.933

In both regressions, we find that the coefficients on *LC per capita* by both small and large banks are positive and statistically significant. Using the coefficient from regression (1) on small bank *LC*, 383.4, a one standard deviation shift in *LC* by small banks is associated with a 9.37% increase in *GDP per capita* over the sample mean level. For a similar increase, using the coefficient on large bank *LC*, 96.05, *GDP per capita* increases by 2.55% over the sample mean. These results may shed light on why banks are important to economic output. The banking literature generally suggests that small banks often provide relationship loans and commitments to small businesses that cannot be replicated by capital markets, and thus are better able to relieve small business financial constraints (e.g., Berger et al., 2005; Berger et al., 2017). In contrast, large banks provide transactional credit to larger companies that are less bank dependent because they more often have outside capital market alternatives such as public debt and equity. Consistent with this, our data suggest that small bank *LC* may be more important to economic growth than large bank *LC* on a per-dollar basis. This is not the case on an outright basis, since large banks produce so many more dollars of *LC.* The coefficients on small bank *LC per capita* and large bank *LC per capita* are statistically different from each other at the 10% level in both regressions. The respective F-statistics for these tests are 3.41 and 3.12, with corresponding p-values of 0.0708 and 0.0838, and are shown near the bottom of the table. Finally, in both regressions, we find that the control variables behave in a manner consistent with earlier results.

The potentially endogenous nature of our key exogenous variable, *LC per capita*, is also a concern. For example, banks may expand into or grow more in states with higher economic growth, and/or move out of or shrink in states with poor economic growth. Accordingly, we re-estimate our model using a two-stage least squares (2SLS) approach. For completeness, we try different instruments. We use *Bank Equity per capita*, and the Rice-Strahan Index (*RSI*), which measures the restrictiveness of interstate branching regulations for the state in a particular year from 1994 until 2010.

The theories are split on the causal effects of our first instrument, equity, on bank liquidity creation. Some suggest that more bank capital may impede liquidity creation by making the bank less fragile (e.g., Diamond and Rajan, 2000, 2001). Fragile capital structures encourage banks to commit to monitoring their borrowers and off-balance sheet counterparties, and additional equity capital makes it harder for less-fragile banks to commit to monitoring, which in turn hampers their abilities to create liquidity. Capital may also reduce liquidity creation because it "crowds out" deposits, which are an important source of liquidity creation (e.g., Gorton and Winton, 2017).

An alternative view is that higher capital improves banks' ability to absorb risk and hence their ability to create liquidity. Liquidity creation makes banks less liquid, exposing them to liquidity risk, raising the likelihood and severity of losses associated with having to dispose of illiquid assets or miss out on lending opportunities to meet customers' liquidity demands (Allen and Santomero, 1997; Allen and Gale, 2004). Capital absorbs risk and expands banks' risk-bearing capacity (e.g., Bhattacharya and Thakor, 1993; Repullo, 2004; Von Thadden, 2004; Coval and Thakor, 2005), so higher capital ratios may allow banks to create more liquidity. Donaldson et al., (2015) also show formally that higher capital can lead to more liquidity creation.

There is also evidence on the effects of capital on lending, a key component of liquidity creation. For example, studies of the banking crisis in the US in the early 1990s (also known as the "credit crunch") generally find that more capital is associated with higher lending and higher capital requirements are associated with reduced lending, suggesting that buffers over the regulatory minimums are needed for increased lending (e.g., Berger and Udell, 1994; Hancock et al., 1995; Peek and Rosengren, 1995a,b;

Table 4
The effects of bank liquidity creation on GDP by bank size. This table presents Ordinary Least Squares (OLS) regression results. The dependent variable is state-level *GDP per capita*. The key independent variables, *Small Bank LC per Capita* and *Large Bank LC per Capita*, are liquidity creation (CATFAT) for small and large banks, normalized by state population. The sample is split by bank size. Small banks are banks which have less than or equal to $1 billion in gross total assets. The sample period is 1984–2010, and t-statistics based on standard errors clustered at the state level are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) *GDP/Capita*	(2) *GDP/Capita*
Small Bank LC per Capita$_{t-1}$	383.4**	360.7**
	(2.308)	(2.311)
Large Bank LC per Capita$_{t-1}$	96.05***	93.25***
	(3.374)	(3.784)
State Inc. Tax$_{t-1}$	288.5	354.1*
	(1.332)	(1.692)
State Min. Wage$_{t-1}$	976.5***	724.6**
	(3.010)	(2.083)
State Gvt. Exp. per capita$_{t-1}$	2.144***	1.827**
	(2.795)	(2.378)
Regional GDP per capita$_{t-1}$	0.508***	0.596***
	(3.657)	(6.280)
Third Party Governor Dummy$_{t-1}$	−1320**	−1263**
	(−2.415)	(−2.395)
Dem. Governor Dummy$_{t-1}$	441.7	355.7
	(1.166)	(0.926)
Split. Legislature$_{t-1}$	723.2	459.5
	(1.026)	(0.712)
Dem. Legislature$_{t-1}$	−46.16	−229.3
	(−0.0648)	(−0.338)
Federal Funds Rate$_{t-1}$		240.9**
		(2.041)
TED Spread$_{t-1}$		−646.0**
		(−2.300)
Small-Large t-Statistic	1.85	1.77
Small-Large *p*-value	0.0708	0.0838
State FE	YES	YES
Year FE	YES	NO
Observations	1300	1200
Adj. R-squared	0.934	0.931

Shrieves and Dahl, 1995; Thakor, 1996). Studies of other time periods and other nations seem to confirm these results, although the effects are often smaller (e.g., Peek and Rosengren, 2000; Calomiris and Wilson, 2004; Driscoll, 2004; Francis and Osborne, 2012; Berrospide and Edge, 2010; Aiyar et al., 2012; Jiménez et al., 2013).

Additionally, Berger and Bouwman (2009) find a positive relation between bank capital and liquidity creation for large banks and a negative relation for small banks using U.S. data from 1993–2003. At least part of this difference between small and large banks appears to be due to off-balance sheet activities. When they exclude off-balance sheet activities, the positive relation between capital and liquidity creation for large banks becomes statistically insignificant. Evidence from other countries generally find a negative relation for small banks and an insignificant effect for large banks, possibly because large banks in the other countries often do not have significant off-balance sheet activities (e.g., Fungacova et al., 2010; Fungacova and Weill, 2012; Lei and Song, 2013; Distinguin et al., 2013; Horváth et al., 2014).

In our 2SLS analysis, we acknowledge the possible differences in the effects of *Bank Equity* between small and large banks, and include both *Small Bank Equity* and *Large Bank Equity* separately in some of the estimations as instruments for Lagged *Small Bank LC* and Lagged *Large Bank LC*.

Our other instrument is the Rice-Strahan Index, *RSI*, which measures the restrictiveness of the state's interstate branching regulations from 1994 to 2010. As discussed in Rice and Strahan (2010), the Riegle–Neal Interstate Banking and Branching Efficiency Act of 1994, which opened up interstate branching for the first time since 1927, allowed individual states to continue to impose some restrictions on such branching. The index ranges from zero to four, and is the sum of four dummies for these restrictions: the minimum age of the institution for acquisition, allowance of *de novo* interstate branching, allowance of interstate branching by acquisition of a single branch or portions of an institution, and statewide deposit cap on branch acquisitions. Since the index data from Rice and Strahan (2010) are only available for the period 1994–2005, we update these data using the 2002–2010 Profiles of State-Chartered Banking (PSCB) provided by the Conference of State Bank Supervisors (CSBS). When we use *RSI*, we restrict the regressions to cover the data only since 1994 because there would be no variation in *RSI* prior to that time, since all interstate branching was essentially entirely banned (i.e., *RSI* would equal four for all of the earlier observations). Another limitation in using *RSI* is that we are not able to include time fixed effects because they are too highly related to the index – states simply do not change their restrictions much over time. We acknowledge that *RSI* may not be an ideal instrument. It may not be perfectly exogenous because state legislatures sometimes act on the behest of their states' banking industry (Kroszner and Strahan, QJE 1999). However, we do not believe that industry lobbying for this type of regulation is strongly related to industry liquidity creation.

We believe that our instruments satisfy the exclusion restriction. Bank capital and deregulation should affect economic growth almost exclusively through bank lending, off-balance sheet activities, deposits, and other banking activities that are all elements of bank liquidity creation. Thus, there is little way for bank capital or deregulation to affect economic growth outside of liquidity creation.

Table 5 presents the results of our 2SLS model. Panel A presents the first-stage results. Regressions in columns (1) and (2) examine all banks together and use *Bank Equity per capita* as the instrument. Year Fixed effects are included as controls in column (1), while the model in column (2) replaces these with our aggregate banking environment controls: *Federal Funds Rate* and *TED Spread*. Regressions (3a), (3b), (4a), and (4b) report results in which *LC per capita* is divided between small and large banks. Regressions (3a) and (3b) include *Time Fixed Effects*, while regressions (4a) and (4b) substitute the aggregate banking environment controls. *Small Bank Equity* and *Large Bank Equity* are the instruments. Regressions (5) and (6) report results using *RSI*, without and with the aggregate banking environment controls, respectively. As noted, we cannot include time fixed effects with *RSI*. The Panel A results indicate that *Equity per capita* positively predicts *LC per capita*, and *Small Bank Equity per capita* and *Large Bank Equity per capita* similarly positively predict *LC per capita* for their size classes. *RSI* negatively predicts *LC per capita* as expected, given that *RSI* is increasing in regulatory restrictiveness.

Panel B presents the second-stage results. The columns correspond to those in Panel A. Columns (1) and (2) of Panel B use *Bank Equity per capita* as the instrument, columns (3) and (4) split the sample by size and use *Small Bank Equity per capita* and *Large Bank Equity per capita* as the instruments, and columns (5) and (6) use *RSI* as the instrument.

We find in regressions (1) and (2) of Panel B that the coefficient on lagged *LC per capita* is positive and economically and statistically significant, and similar to the OLS findings. The coefficient of 116.7 in column (1) suggests that a one standard deviation increase in lagged bank *LC per capita* is related to a 2.85% increase in *GDP per capita*, consistent with our earlier results. The coefficient in column (2), 106.1, suggests a similar 2.60% increase in *GDP per capita*.

Table 5
The Effects of Bank Liquidity Creation on GDP in a 2SLS setting. This table presents two-stage least squares (2SLS) results. Panel A shows the first-stage results and Panel B reports the second-stage results. Columns in Panel A correspond to the second-stage regressions found in Panel B. Regressions (3) and (4) in Panel B have two instruments, and thus two first stages, which are presented in Panel A, columns (3a), (3b), (4a), and (4b). The dependent variable is state-level GDP per capita, and the instruments are bank *equity per capita* and the Rice–Strahan Index (*RSI*). The key independent variable, liquidity creation per capita, is liquidity creation (CATFAT) normalized by state population. The sample is split by bank size. Small banks are banks which have $1 billion in total assets or less. The sample period is 1984–2010 for regressions (1)–(4) and 1994–2010 for regressions (5) and (6), and z-statistics based on standard errors clustered at the state level are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A – First-Stage Results

	(1) *LC/Capita*	(2) *LC/Capita*	(3a) *Small Bank LC/Capita*	(3b) *Large Bank LC/Capita*	(4a) *Small Bank LC/Capita*	(4b) *Large Bank LC/Capita*	(5) *LC/Capita*	(6) *LC/Capita*
Lagged *Equity/Capita*	4.75***	3.95***						
	(5.93)	(5.12)						
Lagged *Small Bank Equity/Capita*			5.30***	3.57	5.02***	3.07		
			(5.26)	(1.46)	(5.31)	(1.15)		
Lagged *Large Bank Equity/Capita*			0.02	3.28***	−0.02	2.76***		
			(0.20)	(8.38)	(−0.29)	(6.80)		
Lagged *RSI*							−0.966***	−0.962**
							(−4.11)	(−2.02)
Control Variables	YES	YES	YES	YES	YES	YES	YES	YES
Agg. Banking Environment Controls	NO	YES	NO	YES	NO	YES	NO	YES
State FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	NO	YES	NO	YES	NO	NO	NO
Observations	1300	1200	1300	1300	1200	1200	850	850
R-squared	0.686	0.667	0.692	0.771	0.685	0.742	0.736	0.736

Panel B – Second-Stage Results

	(1) *GDP/Capita*	(2) *GDP/Capita*	(3) *GDP/Capita*	(4) *GDP/Capita*	(5) *GDP/Capita*	(6) *GDP/Capita*
Lagged *LC/Capita*	116.7***	106.1**			1089***	1066**
	(2.887)	(2.070)			(4.339)	(2.180)
Lagged *Small Bank LC/Capita*			724.1***	734.1**		
			(6.151)	(2.143)		
Lagged *Large Bank LC/Capita*			111.7***	114.6*		
			(3.017)	(1.710)		
Instrument(s)	*Equity/capita*	*Equity/capita*	*Small Bank Equity/capita, Large Bank Equity/capita*	*Small Bank Equity/capita, Large Bank Equity/capita*	*RSI*	*RSI*
Control Variables	YES	YES	YES	YES	YES	YES
Aggregate Banking Environment Controls	NO	YES	NO	YES	NO	YES
State FE	YES	YES	YES	YES	YES	YES
Year FE	YES	NO	YES	NO	NO	NO
Observations	1300	1200	1300	1200	850	850
R-squared	0.937	0.934	0.936	0.932	0.545	0.565

Table 6
The effects of lagged log bank liquidity creation on log state gross domestic product (GDP). This table presents Ordinary Least Squares (OLS) regression results. The dependent variable is the natural logarithm of state-level *GDP per capita*. The key independent variable, ln(*LC per Capita)*, is the natural logarithm of liquidity creation (CATFAT) normalized by state population. The sample period is 1984–2010, and t-statistics based on standard errors clustered at the state level are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) *ln(GDP/Capita)*	(2) *ln(GDP/Capita)*	(3) *ln(GDP/Capita)*	(4) *ln(GDP/Capita)*	(5) *ln(GDP/Capita)*	(6) *ln(GDP/Capita)*	(7) *ln(GDP/Capita)*	(8) *ln(GDP/Capita)*
ln(LC per Capita)$_{t-1}$	0.0470***	0.0511***	0.0476***	0.0461***	0.0453***	0.0460***	0.0481***	
	(3.099)	(3.942)	(4.061)	(4.252)	(5.418)	(4.236)	(4.241)	
ln(Small Bank LC per Capita)$_{t-1}$								0.0310***
								(4.08)
ln(Large Bank LC per Capita)$_{t-1}$								0.0221**
								(2.41)
TA per Capita $_{t-1}$						2.38e-05		
						(0.0500)		
GTA per Capita$_{t-1}$							−0.000215	
							(−0.477)	
State Inc. Tax$_{t-1}$		−0.000166	0.00216	0.00220	0.00396	0.00219	0.00226	0.00269
		(−0.0588)	(0.781)	(0.838)	(1.353)	(0.840)	(0.878)	(1.03)
State Min. Wage$_{t-1}$		0.0164**	0.0165***	0.0158**	0.00970	0.0158**	0.0157**	0.0149**
		(2.561)	(2.756)	(2.627)	(1.486)	(2.631)	(2.644)	(2.54)
ln(State Gvt. Exp. per capita)$_{t-1}$		0.268**	0.264**	0.259**	0.210***	0.259**	0.258**	0.249**
		(2.326)	(2.432)	(2.465)	(2.928)	(2.459)	(2.450)	(2.54)
ln(Regional GDP per capita)$_{t-1}$			0.591***	0.558***	0.586***	0.558***	0.559***	0.543***
			(4.698)	(4.484)	(6.834)	(4.495)	(4.508)	(4.78)
Third Party Governor Dummy$_{t-1}$				−0.0295	−0.0252	−0.0295	−0.0286	−0.0292
				(−1.543)	(−1.500)	(−1.548)	(−1.518)	(−1.61)
Dem. Governor Dummy$_{t-1}$				0.00891	0.00759	0.00891	0.00892	0.00926
				(1.246)	(1.050)	(1.241)	(1.250)	(1.28)
Split Legislature$_{t-1}$				0.0128	0.00819	0.0128	0.0127	0.0143
				(0.997)	(0.643)	(0.995)	(0.976)	(1.05)
Dem. Legislature$_{t-1}$				0.00531	−0.000440	0.00527	0.00555	0.0085
				(0.384)	(−0.0342)	(0.386)	(0.403)	(0.60)
Federal Funds Rate$_{t-1}$					0.00424**			
					(2.118)			
TED Spread$_{t-1}$					−0.0151***			
					(−2.797)			
State FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	NO	YES	YES	YES
Observations	1300	1300	1300	1300	1200	1300	1300	1300
Adj. R-squared	0.947	0.954	0.958	0.959	0.954	0.959	0.959	0.935

Table 7
On- and off-balance sheet liquidity creation. This table presents Ordinary Least Squares (OLS) regression results. The dependent variable is state-level *GDP per capita*. The key independent variables are *On-Balance Sheet LC per Capita* and *Off-Balance Sheet LC per Capita* (CATFAT-CATNONFAT and CATNONFAT), normalized by state population. The sample period is 1984–2010, and t-statistics based on standard errors clustered at the state level are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) *GDP/Capita*	(2) *GDP/Capita*	(3) *GDP/Capita*	(4) *GDP/Capita*	(5) *GDP/Capita*	(6) *GDP/Capita*	(7) *GDP/Capita*
On-Balance Sheet LC per Capita$_{t-1}$	20.25	42.08	107.8	71.90	86.85		
	(0.106)	(0.265)	(0.754)	(0.520)	(0.684)		
Off-Balance Sheet LC per Capita$_{t-1}$	80.70***	112.5***	106.9***	107.9***	102.6***		
	(2.857)	(4.621)	(4.329)	(4.659)	(5.496)		
Small Bank On-Balance Sheet LC per Capita$_{t-1}$						894.3**	981.45**
						(2.127)	(2.21)
Small Bank Off-Balance Sheet LC per Capita$_{t-1}$						175.1*	148.16
						(1.689)	(1.54)
Large Bank On-Balance Sheet LC per Capita$_{t-1}$						−162.1	−146.19
						(−1.282)	(−1.21)
Large Bank Off-Balance Sheet LC per Capita$_{t-1}$						136.9***	137.74***
						(4.135)	(31.59)
State Inc. Tax$_{t-1}$		226.6	269.3	282.9	343.6	273.6	336.48
		(0.938)	(1.209)	(1.332)	(1.567)	(1.409)	(1.69)
State Min. Wage$_{t-1}$		982.0***	987.5***	954.0***	717.7*	891.5***	706.01**
		(2.793)	(2.862)	(2.709)	(1.938)	(2.940)	(2.23)
State Gvt. Exp. per capita$_{t-1}$		2.545***	2.279***	2.271***	1.908**	2.168***	1.90***
		(3.187)	(2.687)	(2.867)	(2.482)	(3.200)	(2.69)
Regional GDP per capita$_{t-1}$			0.515***	0.499***	0.587***	0.467***	0.598***
			(3.768)	(3.793)	(6.146)	(3.403)	(6.77)
Third Party Governor Dummy$_{t-1}$				−1659***	−1556***	−1535**	−1333.53**
				(−2.823)	(−2.945)	(−2.537)	(−2.12)
Dem. Governor Dummy$_{t-1}$				423.6	340.6	339.0	226.89
				(1.121)	(0.885)	(0.916)	(0.63)
Split Legislature$_{t-1}$				711.6	451.9	787.5	519.40
				(0.995)	(0.688)	(1.072)	(0.77)
Dem. Legislature$_{t-1}$				−200.5	−346.3	199.7	−60.11
				(−0.283)	(−0.505)	(0.265)	(−0.08)
Federal Funds Rate$_{t-1}$					251.7**		247.57**
					(2.055)		(2.23)
TED Spread$_{t-1}$					−622.9**		−696.49***
					(−2.652)		(−3.17)
State FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	NO	YES	NO
Observations	1300	1300	1300	1300	1200	1300	1200
Adj. R-squared	0.914	0.927	0.932	0.933	0.930	0.936	0.936

Both regressions (3) and (4) show that the coefficients on small and large bank *LC per capita* are economically and statistically significant and positive. The coefficients on lagged *LC per capita* for small and large banks are 724.1 and 111.7, respectively in regression (3). The 2SLS coefficients are larger than the OLS coefficients, a common finding in the literature (e.g., Levitt, 1996; Berger and Bouwman, 2009). Using these coefficients, we estimate that a one standard deviation increase in *small bank* or *large bank LC per capita* is related to 17.71% and 2.73% increases over mean GDP levels, respectively, which are statistically different from each other at the 10% level. In all regressions, we estimate a Wald test for a weak instrument. In all specifications, the Wald statistic is larger than the critical value at the 10% level, 24.58, meaning we are able to reject the null hypothesis of a weak instrument.[13]

Finally, in regressions (5) and (6), the coefficients on *LC per capita* are economically and statistically significant and positive, although they are much larger in magnitude than in the main findings. We are again able to reject the null hypothesis of a weak instrument using the Wald test. The much greater magnitude for the coefficients on *LC per capita* may be due to the measurement issues discussed above – that we are restricted to data starting in 1994 and we are unable to include time fixed effects.[14]

We also estimate our OLS regressions using an alternative functional form, substituting natural logarithms of *GDP per capita* and *LC per Capita* for their levels. Table 6 reports the results of these regressions. We find that our results are robust to this alternative specification. We further find that our 2SLS results are also robust to the use of natural logarithms for these key variables (not shown).

Additionally, Berger and Bouwman (2009) develop both the CATFAT and CATNONFAT measures of *LC*, the first of which we use in our main regressions. CATFAT captures both on- and off-balance sheet *LC*, while CATNONFAT includes on-balance sheet *LC* only. Here, we use CATNONFAT for on-balance sheet *LC* and calculate (CATFAT – CATNONFAT) to measure off-balance sheet *LC*. In Table 7, we first replicate the five regressions of Table 2, but replace our *LC per capita* measure with *on-balance sheet LC per capita* and *off-balance sheet LC per capita*. We find that while both measures consistently have positive coefficients, only *off-balance sheet LC per capita* is statistically and economically significant. This result is

[13] We also instrument for *LC per Capita* using a combination of *Bank Equity per capita*, the Rice-Strahan Index for bank deregulation, and dummy variables to represent Inter- and Intra-state banking deregulation. The Rice-Strahan Index represents the combination of several state-level bank regulatory powers (e.g. branching restrictions) to estimate the strength of bank regulation in each state (Rice and Strahan, 2010)This specification takes advantage of changes in the regulatory environment, which would affect bank liquidity creation but not state-level GDP. Our results are robust to this alternative instrumentation. However, the model with all four instruments is overidentified.

[14] Our 2SLS results are also robust to the use of natural logarithms for the key variables (not shown), i.e., the results are similar to those in Table 6.

Table 8
Test of reverse causality. This table presents Ordinary Least Squares (OLS) regression results. The dependent variable is state-level *LC per Capita*. The key independent variable, *GDP per capita*, is Gross Domestic Product (GDP) normalized by state population. We also include lagged *LC per Capita* as a control variable, following the methodology of Granger (1969). The sample period is 1984–2010, and t-statistics based on standard errors clustered at the state level are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Lag Length (n):	(1) *LC/Capita* One Year	(2) *LC/Capita* Two Years	(3) *LC/Capita* Three Years	(4) *LC/Capita* Four Years
GDP per Capita $_{t-n}$	35.51	23.45	10.90	−30.13
	(0.889)	(0.279)	(0.104)	(−0.303)
LC per Capita$_{t-n}$	0.866***	0.711***	0.564***	0.401***
	(39.32)	(17.38)	(10.25)	(5.547)
State Inc. Tax$_{t-1}$	−0.0930	−0.234	−0.406	−0.565
	(−1.112)	(−1.150)	(−1.252)	(−1.206)
State Min. Wage$_{t-1}$	−0.163	−0.524	−0.878*	−1.221**
	(−0.952)	(−1.641)	(−2.007)	(−2.214)
State Gvt. Exp. per capita$_{t-1}$	−0.000315	−0.000489	−0.000556	−0.000577
	(−1.528)	(−1.559)	(−1.067)	(−0.807)
Regional GDP per capita$_{t-1}$	−0.000133	−0.000213	−0.000337	−0.000397
	(−1.279)	(−1.090)	(−1.315)	(−1.522)
Third Party Governor Dummy$_{t-1}$	−1.311***	−2.821***	−3.911***	−4.412***
	(−2.926)	(−3.008)	(−2.976)	(−2.789)
Dem. Governor Dummy$_{t-1}$	−0.241	−0.458	−0.516	−0.499
	(−1.008)	(−0.932)	(−0.782)	(−0.693)
Split Legislature$_{t-1}$	0.632	1.279*	1.625*	1.901
	(1.517)	(1.687)	(1.687)	(1.661)
Dem. Legislature$_{t-1}$	0.588	1.180	1.661	2.115
	(1.426)	(1.429)	(1.453)	(1.519)
State FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Aggregate Banking Environment Controls	NO	NO	NO	NO
Observations	1300	1250	1200	1150
Adjusted R-squared	0.909	0.816	0.749	0.697

consistent with the finding in Driscoll (2004) of no statistically significant effect of bank lending on state output. As discussed above, off-balance sheet guarantees like loan commitments and standby letters of credit, which make up most of *off-balance sheet LC*, allow customers to expand their economic activities because they are able to plan their investments and other expenditures (e.g., Boot et al., 1993) and act as back-ups for some capital market financing, such as commercial paper and municipal revenue bonds. Similarly, derivatives, allowing firms to grow by hedging market prices (e.g., Stulz, 2003). Detrended off-balance sheet liquidity creation has also been found to better predict future financial crises better than on-balance sheet liquidity creation (Berger and Bouwman, 2017). This result may help explain why *LC per capita* beat *TA per capita* and *GTA per capita* in the “horse races” above – *TA* and *GTA* exclude off-balance sheet activities.

Columns (6) and (7) of Table 7 show regressions with small bank and large bank *on-balance sheet LC per capita* and *off-balance sheet LC per capita*, with time fixed effects and the aggregate banking environment variables, respectively. The results show that for small banks, *on-balance sheet LC per capita* matters more and for large banks, *off-balance sheet LC per capita* matters more. This is likely because small banks tend to specialize in on-balance sheet activities and typically serve small businesses without significant outside financing options. In contrast, large banks generate most of their *LC* off the balance sheet and more often serve large businesses that have outside financing options, making *on-balance sheet LC* less important. Thus, while *LC* by both sizes of banks contribute significantly to economic growth, the primary mechanism behind these results differ – small banks contribute to economic growth primarily through *on-balance sheet LC*, while large banks add to economic growth chiefly through *off-balance sheet LC*. The reason why *off-balance sheet LC per capita* empirically dominates for the full sample is that large banks create so much more *LC* than small banks.

To further assuage endogeneity concerns, we test reverse causality, following the methodology of Granger (1969). Note that Granger causality addresses predictability, and not economic causality. To this point in our analysis, we have studied the effect of lagged *LC per capita* on *GDP per capita*. Here, we run regressions of *LC per capita* on *GDP per capita* and *LC per capita*, both lagged one, two, three, or four years, and the control variables used in the full specification above. Table 8 presents the results. Across the four regressions, we do not find any evidence that *GDP per capita* Granger-causes *LC per capita*.

4. Financial crises, dynamics, and other robustness checks

We also investigate the effects of bank *LC per capita* during financial crises. Financial crises are often periods in which liquidity provided both by banks and by capital markets decline, so liquidity creation may be especially important during these times. The recent subprime crisis results may be particularly interesting, given that others find this crisis is related to a liquidity shock (e.g., Cornett et al., 2011; Chodorow-Reich, 2014; Acharya and Mora, 2015; Gorton and Muir, 2015).

To do this, we replicate Table 2, but include interaction terms in which lagged *LC per capita* is multiplied by a dummy variable indicating whether a given year is a crisis year. We examine five distinct crisis periods, following Berger and Bouwman (2013).[15] The crises include the 1987 stock market crash, the 1990–1992

[15] Berger and Bouwman (2013) classify crises by quarters. Since we use yearly data, the quarters defined as crisis quarters in Berger and Bouwman (2013) do not line up perfectly with our annual data. Accordingly, we classify a year as a “crisis year” if any quarter within the year is part of a crisis.

Table 9
The effects of bank liquidity creation on GDP during financial crises. This table presents Ordinary Least Squares (OLS) regression results. The dependent variable is state-level GDP per capita. The key independent variable, *LC per Capita*, is liquidity creation (CATFAT) normalized by state population. We also include variables which interact *LC per Capita* with dummy variables capturing various banking and market financial crises. The sample period is 1984–2010, and t-statistics based on standard errors clustered at the state level are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) *GDP/Capita*	(2) *GDP/Capita*	(3) *GDP/Capita*	(4) *GDP/Capita*	(5) *GDP/Capita*
LC per Capita$_{t-1}$	67.07**	96.91***	98.86***	96.91***	113.8***
	(2.379)	(3.724)	(3.742)	(3.898)	(4.819)
*LC per Capita$_{t-1}$ * 1987 Crisis Dummy*	−192.1**	−109.7	−64.83	−70.56	−69.68
	(−2.114)	(−1.198)	(−0.704)	(−0.821)	(−1.257)
*LC per Capita$_{t-1}$ * 1990–1992 Crisis Dummy*	−195.2***	−185.4***	−158.4**	−162.4**	−130.3***
	(−3.271)	(−2.749)	(−2.445)	(−2.612)	(−3.816)
*LC per Capita $_{t-1}$ * 1998 Crisis Dummy*	50.11	23.59	28.05	24.85	−13.13
	(1.657)	(0.773)	(1.056)	(0.920)	(−0.739)
*LC per Capita $_{t-1}$ * 2000–2002 Crisis Dummy*	37.50*	33.58	25.11	24.19	−51.15***
	(1.781)	(1.515)	(1.189)	(1.142)	(−3.437)
*LC per Capita $_{t-1}$ * 2007–2009 Crisis Dummy*	29.39	57.60*	45.26	51.15*	8.281
	(0.741)	(1.818)	(1.404)	(1.724)	(0.466)
State Inc. Tax$_{t-1}$		196.6	238.2	254.0	278.2
		(0.837)	(1.119)	(1.241)	(1.339)
State Min. Wage$_{t-1}$		987.1***	967.5***	950.6***	788.1**
		(2.813)	(2.775)	(2.706)	(2.069)
State Gvt. Exp. per capita$_{t-1}$		2.542***	2.309***	2.289***	1.830**
		(3.177)	(2.703)	(2.857)	(2.309)
Regional GDP per capita$_{t-1}$			0.494***	0.485***	0.576***
			(3.630)	(3.688)	(6.175)
Third Party Governor Dummy$_{t-1}$				−1684**	−1578***
				(−2.625)	(−2.940)
Dem. Governor Dummy$_{t-1}$				422.4	338.1
				(1.160)	(0.893)
Split Legislature$_{t-1}$				686.1	519.6
				(1.001)	(0.798)
Dem. Legislature$_{t-1}$				−238.8	−262.4
				(−0.341)	(−0.387)
Federal Funds Rate$_{t-1}$					322.5**
					(2.569)
TED Spread$_{t-1}$					−924.2***
					(−3.526)
State FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	NO
Observations	1300	1300	1300	1300	1200
Adj. R-squared	0.915	0.928	0.932	0.934	0.932

credit crunch, the 1998 Long Term Capital Management (LTCM) episode and Russian debt crisis, the 2000–2002 dot-com bubble bursting and September 11 terrorist attacks, and the 2007–2009 subprime lending crisis.

Table 9 presents our crisis regression results. Across all specifications, the coefficients on lagged *LC per capita* remain positive and statistically significant with economic magnitudes similar to our main results, suggesting that our findings hold during normal times. The interaction term for each crisis measures the deviation from the normal times effect for that crisis and the sum of the coefficient on *LC per capita* plus the coefficient on the interaction term with the dummy for each crisis measures the estimated effect for that crisis. The coefficients on the crisis interaction terms are generally different from one another, with the first two generally negative and the last three generally positive, suggesting that there is no uniform crisis effect. The total effects for the first two crises are generally close to zero or negative, while the last three suggest stronger effects during these crises than during normal times, but the differences are often not statistically significant. Thus, *LC per capita* appears to have statistically and economically significant effects on *GDP per capita* during normal times and may be accentuated during the last three crises, but was not effective during the first two crises.

We next analyze the dynamics of the relation by including two-, three-, and four-year lagged *LC per capita* variables along with the one-year lagged value. We estimate regressions which include each lagged value separately, and finally a regression which includes all four lags. These results are reported in Table 10. Using one lag at a time in regressions (1)–(4) with the Year fixed effects, and (6)–(9) with the aggregate banking environment variables, we find that the coefficients on one-, two-, three-, and four-year lagged *LC per capita* are independently positive and statistically significant. When all lagged *LC* variables are combined in regressions (5) and (10), we find that only the coefficients on the one-year lagged *LC per capita* are positive and statistically significant, suggesting that the effects of *LC* are relatively short-lived. The positive effects of the longer lags in regressions (1)–(4) and (6)–(9) likely reflect high collinearity with the first lag, given that the correlations with the first lag are all over 71%. These results suggest that most of the effects of *LC per capita* on *GDP per capita* occur during the first year.

We run a number of additional robustness tests. We first investigate whether our results are driven by our method of allocating *LC* proportionally based on the deposits in branches of multistate banks. We drop all multistate banks from our sample and repeat our analysis for only single-state banks. Table 11 presents the outcome of these tests. We find that these results do not differ from our earlier findings that (1) *LC* is positive related to *GDP*, (2) *LC* outperforms *TA per capita* and *GTA per capita* in “horse races,” (3) that *Small Bank LC per Capita* has a stronger effect per dollar

Table 10

The dynamic effects of bank liquidity creation on GDP. This table presents Ordinary Least Squares (OLS) regression results. The dependent variable is state-level *GDP per Capita*. The key independent variable, *LC per Capita*, is liquidity creation (CATFAT) normalized by state population. We also include the two-, three-, and four- year lagged *LC per Capita*. The sample is split by bank size. Small banks are banks which have less than or equal to $1 billion in gross total assets. The sample period is 1984–2010, and t-statistics based on standard errors clustered at the state level are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) GDP/Capita	(2) GDP/Capita	(3) GDP/Capita	(4) GDP/Capita	(5) GDP/Capita	(6) GDP/Capita	(7) GDP/Capita	(8) GDP/Capita	(9) GDP/Capita	(10) GDP/Capita
LC per Capita$_{t-1}$	105.0***				80.06**	101.3***				91.32***
	(3.966)				(2.102)	(4.831)				(2.870)
LC per Capita$_{t-2}$		88.68***			30.83		89.95***			24.98
		(3.542)			(1.587)		(4.211)			(1.332)
LC per Capita$_{t-3}$			75.00***		−15.42			71.72***		−21.29*
			(2.814)		(−1.145)			(3.164)		(−1.872)
LC per Capita$_{t-4}$				58.62**	3.258				54.42**	2.707
				(2.204)	(0.113)				(2.237)	(0.0991)
State Inc. Tax$_{t-1}$	285.6	290.8	293.2	276.1	327.5	347.5*	342.7*	327.7*	325.4	359.2
	(1.354)	(1.427)	(1.414)	(1.188)	(1.306)	(1.683)	(1.725)	(1.696)	(1.519)	(1.563)
State Min. Wage$_{t-1}$	969.0***	913.6**	874.7**	812.2*	911.6**	722.9*	686.8*	661.7*	603.2	674.7
	(2.812)	(2.368)	(2.098)	(1.765)	(2.015)	(1.976)	(1.862)	(1.784)	(1.484)	(1.676)
State Gvt. Exp. per capita$_{t-1}$	2.253***	1.799**	1.829*	1.716*	1.739*	1.898**	1.864**	1.846**	1.751**	1.809**
	(2.770)	(2.316)	(1.985)	(1.771)	(1.813)	(2.395)	(2.348)	(2.306)	(2.112)	(2.191)
Regional GDP per capita$_{t-1}$	0.506***	0.509***	0.515***	0.519***	0.553***	0.588***	0.595***	0.606***	0.630***	0.602***
	(3.783)	(3.575)	(3.544)	(3.590)	(3.922)	(6.084)	(6.171)	(6.281)	(6.330)	(5.926)
Third Party Governor Dummy$_{t-1}$	−1596***	−1532***	−1614***	−1531**	−1184**	−1526***	−1650***	−1763***	−1667***	−1379***
	(−2.752)	(−2.839)	(−2.688)	(−2.508)	(−2.074)	(−2.946)	(−3.009)	(−3.040)	(−2.925)	(−2.744)
Dem. Governor Dummy$_{t-1}$	420.9	351.0	322.5	286.0	310.6	339.1	299.8	279.4	239.8	302.0
	(1.123)	(0.891)	(0.783)	(0.664)	(0.757)	(0.885)	(0.764)	(0.700)	(0.569)	(0.753)
Split Legislature$_{t-1}$	712.2	659.9	692.1	645.9	521.2	453.5	483.2	488.2	411.5	382.8
	(1.005)	(1.023)	(1.030)	(1.041)	(0.879)	(0.699)	(0.733)	(0.727)	(0.673)	(0.652)
Dem. Legislature$_{t-1}$	−184.9	−112.2	−64.07	−65.64	−215.9	−336.9	−353.4	−361.8	−406.4	−370.1
	(−0.263)	(−0.162)	(−0.0909)	(−0.0930)	(−0.320)	(−0.501)	(−0.513)	(−0.516)	(−0.590)	(−0.571)
Federal Funds Rate$_{t-1}$						251.7**	248.3**	249.7**	243.4*	236.2*
						(2.060)	(2.041)	(2.030)	(1.868)	(1.829)
TED Spread$_{t-1}$						−633.6**	−642.5**	−680.4**	−706.1**	−617.4**
						(−2.266)	(−2.294)	(−2.445)	(−2.441)	(−2.132)
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO
Observations	1300	1250	1200	1150	1150	1200	1200	1200	1150	1150
Adj. R-squared	0.933	0.936	0.932	0.931	0.933	0.930	0.929	0.928	0.926	0.929

Table 11

The effects of bank liquidity creation on GDP for single-state banks. This table presents Ordinary Least Squares (OLS) regression results. The dependent variable is the natural logarithm of state-level *GDP per capita*. The key independent variable, *LC per Capita*, is liquidity creation (CATFAT) normalized by state population. We omit all multistate banks. The sample period is 1984–2010, and t-statistics based on standard errors clustered at the state level are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1) *GDP/Capita*	(2) *GDP/Capita*	(3) *GDP/Capita*	(4) *GDP/Capita*	(5) *GDP/Capita*	(6) *GDP/Capita*	(7) *GDP/Capita*	(7) *GDP/Capita*	(8) *GDP/Capita*	(9) *GDP/Capita*	(10) *GDP/Capita*
LC per Capita$_{t-1}$	42.85*	79.77***	81.97***	79.39***	77.73***	98.67***	113.8***				
	(1.696)	(3.321)	(3.436)	(3.551)	(3.852)	(2.999)	(3.420)				
Small Bank LC per Capita$_{t-1}$								380.4**	354.6**		
								(2.215)	(2.379)		
Large Bank LC per Capita$_{t-1}$								41.39	44.85		
								(0.859)	(0.922)		
TA per Capita $_{t-1}$						−51.71					
						(−1.288)					
GTA per Capita$_{t-1}$							−72.44**				
							(−2.324)				
On-Balance Sheet LC per Capita$_{t-1}$										−93.46	−84.25
										(−0.925)	(−0.854)
Off-Balance Sheet LC per Capita$_{t-1}$										97.55***	93.92***
										(4.360)	(5.075)
State Inc. Tax$_{t-1}$		232.4	272.7	286.2	349.9*	272.5	259.8	274.3	337.7	253.9	288.5
		(0.938)	(1.256)	(1.345)	(1.699)	(1.305)	(1.314)	(1.289)	(1.653)	(1.255)	(1.359)
State Min. Wage$_{t-1}$		959.1***	936.3***	914.8**	693.3*	884.1**	859.7**	888.1**	657.8*	857.6**	633.9
		(2.746)	(2.703)	(2.615)	(1.856)	(2.590)	(2.541)	(2.668)	(1.842)	(2.434)	(1.659)
State Gvt. Exp. per capita$_{t-1}$		2.530***	2.294**	2.267**	1.891**	2.297***	2.339***	2.108**	1.799**	2.329***	1.949**
		(2.991)	(2.555)	(2.678)	(2.316)	(2.695)	(2.764)	(2.645)	(2.282)	(2.756)	(2.419)
Regional GDP per capita$_{t-1}$			0.523***	0.511***	0.640***	0.524***	0.522***	0.513***	0.649***	0.489***	0.607***
			(3.772)	(3.853)	(6.939)	(3.921)	(3.921)	(3.695)	(7.188)	(3.812)	(6.990)
Third Party Governor Dummy$_{t-1}$				−1732***	−1616***	−1729***	−1669**	−1570***	−1461***	−1970***	−1883***
				(−3.130)	(−3.300)	(−2.934)	(−2.607)	(−2.819)	(−2.782)	(−3.037)	(−3.351)
Dem. Governor Dummy$_{t-1}$				385.7	296.8	368.6	345.9	384.5	295.3	370.2	286.7
				(0.995)	(0.746)	(0.973)	(0.944)	(0.988)	(0.750)	(0.971)	(0.734)
Split Legislature$_{t-1}$				762.3	447.3	773.3	780.3	791.7	472.7	753.2	452.8
				(1.033)	(0.663)	(1.030)	(1.036)	(1.079)	(0.702)	(1.010)	(0.666)
Dem. Legislature$_{t-1}$				−126.9	−383.6	−165.6	−197.5	43.16	−236.0	−183.4	−403.1
				(−0.177)	(−0.551)	(−0.228)	(−0.271)	(0.0595)	(−0.338)	(−0.258)	(−0.582)
Fed Funds Rate$_{t-1}$					244.4*				225.4*		245.9*
					(1.965)				(1.888)		(1.971)
TED Spread$_{t-1}$					−627.5**				−640.6**		−535.2**
					(−2.302)						(−2.117)
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	NO
Observations	1300	1300	1300	1300	1200	1300	1300	1300	1300	1300	1200
Adjusted R-squared	0.912	0.925	0.930	0.931	0.928	0.932	0.932	0.931	0.928	0.932	0.929

Table 12
State-industry-level regression results. This table presents a state-industry-level analysis in an OLS setting. The dependent variables are the state-level *GDP per Capita* for individual industries. We present the coefficients and t-statistics for *LC per Capita*. We include but do not show all of the controls from Table 2, including lagged state income tax, state minimum wage, state government expenditures, regional GDP, political dummy variables and state and year fixed effects. Data are from the BEA using their 1997–2010 NAICS industry classifications. All t-statistics are based on standard errors clustered at the state level. Industries with statistically significant coefficients are listed in bold type.

Industry	Coefficient on LC/Capita	t-Statistic	Estimated economic impact of one standard deviation increase in state-level LC/Capita
Mining	**46.646**	**2.007**	**17.77%**
Manufacturing	**24.974**	**3.186**	**1.16%**
Finance, insurance, and real estate	**16.348**	**3.120**	**0.52%**
Professional & business services	**8.504**	**1.743**	**0.49%**
Construction	**8.503**	**1.827**	**1.19%**
Information	**6.573**	**2.215**	**0.85%**
Transportation & warehousing	**5.008**	**1.983**	**1.08%**
Retail trade	**3.715**	**2.065**	**0.36%**
Government	3.670	1.003	–
Arts, Entertainment & Recreation	**3.394**	**1.444**	**0.44%**
Agriculture, forestry, fishing, & hunting	3.134	0.674	–
Utilities	**1.201**	**1.571**	**0.44%**
Wholesale trade	0.257	0.080	–
Other services, except government	−0.060	−0.090	–
Educational services & health care	**−3.466**	**−1.754**	**−0.90%**

than *Large Bank LC per Capita*, and (4) that *On-Balance Sheet LC*, in aggregate, is not a determinant of growth in the real economy while *Off-Balance Sheet LC* is.

We conduct six more robustness checks that we do not show in the tables. First, we test for a quadratic relation between *LC per capita* and *GDP per capita*. We find that a squared *LC per capita* term is negative, but not statistically significant. Second, we try including lagged *GDP per capita* on the right-hand-side of the *GDP per capita* regressions and find that the main results continue to hold. Third, we try regressing the annual change in *GDP per capita* on the change in *LC per capita* plus the control variables, and find that a similar relation holds. Fourth, we replicate results using standard errors clustered by both state and year, and find our results to be robust. Fifth, we estimate regressions for subsamples of states based on their prior economic conditions. We split our sample each year using the Federal Reserve Bank of Philadelphia's Coincident Index[16] and (separately) GDP growth in the previous year. Regardless of the subsample, we find that *LC per capita* is statistically significant and economically meaningful. However, we find that the economic magnitude of *LC per capita*'s effect on *GDP per capita* is greater for states with an above-median Coincident Index or above-median GDP growth in the previous year. Sixth, we repeat our analysis omitting Delaware and South Dakota because of the reporting irregularities described above and find that our results continue to hold.

5. Industry-level results

We finally study the effect of state-level *LC per Capita* on state-industry-level *GDP per capita*. As discussed above, we hypothesize that the main transmission mechanism through which bank *LC* affects *GDP* is through increased output of firms in bank-dependent industries. Industries with better access to capital markets are less likely to be affected by bank *LC*. This is suggested by results in Rajan and Zingales (1998), who find that firms in manufacturing-based industries which are more dependent on external financing grow faster in countries with developed financial systems.

We obtain GDP data by industry at the state level from the BEA. The industries are based on the BEA's North American Industry Classification System (NAICS) from 1997–2010. We do not use identical industry classifications to those of Rajan and Zingales (1998), as they limit their analysis to manufacturing-based industries, whereas we include all industries in our sample. We are unable to include the data before 1997, as they are based on the Standard Industry Classification (SIC) system, which is not consistent with NAICS classifications.[17]

Table 12 presents the results of our industry-level study. We run the regressions for each industry and present only the coefficients and t-statistics for *LC per capita*. We include but do not show all of the controls from our full specification in Table 2, as well as state and year fixed effects. The dependent variable in each regression is the state-industry-level *GDP per capita*. Our findings show that the coefficient on *LC per capita* is positively related to *GDP per capita* for all industries except health care and "other services," suggesting that the effects of *LC* on real economic growth are widespread. However, this relation is not statistically significant for all industries. We find that output in bank-dependent industries like mining, construction, and manufacturing is strongly influenced by bank liquidity creation. Alternatively, we find that the *GDP per capita* of industries which are less bank-dependent, such as the government and health care, are not positively influenced by *LC per capita.* Our state-industry-level results give us more confidence in our main result that *LC* is positively related to real economic growth.

6. Conclusion

This paper studies the relation between bank liquidity creation (*LC*) and economic output (*GDP*). We find that state *LC per capita* is positively related to real economic output in terms of state *GDP per capita*, and that the results are both statistically and economically significant. Moreover, we find that small bank *LC* generates more *GDP* per dollar than large bank *LC*, but large bank *LC* matters more overall because large banks provide much more *LC* than small banks. We also find that for small banks, *on-balance sheet LC per capita* matters more and for large banks, *off-balance sheet LC per capita* matters more. Thus, while *LC* by both sizes of banks con-

[16] This index combines four state-level economic indicators – nonfarm payroll employment, average hours worked in manufacturing, the unemployment rate, and wage and salary disbursements deflated by the consumer price index – into a single statistic.

[17] This discontinuity is not only due to differing industry classifications, but also due to the fact that NAICS-based statistics are calculated using U.S. GDP while the SIC-based statistics are calculated based on U.S. Gross Domestic Income (GDI). There are also unlisted differences in "source data and different estimation methodologies." As a result, the BEA cautions against combining the two data series.

tribute significantly to economic growth, the primary mechanism behind these results differ – *on-balance sheet LC* by small banks and *off-balance sheet LC* by large banks. We also study this relation during normal times and financial crises, and find mixed results. We also study the dynamics of the relation, and find that the effects of *LC per capita* are strongest in the first year. Finally, we find that the *LC*-output relation is strongest in bank-dependent industries, consistent with the hypothesized transmission mechanism.

Our paper also sheds light on the use of *LC* as a measure of bank output. When compared to traditional measures of bank output, total assets (*TA*) and gross total assets (*GTA*), we find that *LC* is a statistically and economically significant determinant of *GDP per capita*, while *TA per capita* and *GTA per capita* are not, suggesting that *LC* may be a superior measure of bank output. This may be because *LC* takes into account off-balance sheet activities, liabilities, and capital, as well as assets, and/or because it weights different assets differently.

This study also has important policy implications. Policymakers might want to encourage liquidity creation within a robust banking sector, as this may lead to higher levels of economic output. However, there may be an optimal point for liquidity creation. From a microprudential perspective, excessive liquidity creation may cause liquidity risk within individual institutions. From a macroprudential perspective, excessive liquidity creation may also cause result in asset bubbles that burst and cause financial crises (Acharya and Naqvi, 2012; Berger and Bouwman, 2017). Thus, policymakers face a trade-off between economic growth on the one hand and individual institution and financial system stability on the other hand. Current regulations may discourage liquidity creation. The Basel III Accord includes liquidity ratios which discourage banks from creating liquidity, as banks are required to hold more liquid assets such as marketable securities and are discouraged from holding illiquid loans and liquid deposits (e.g., Grind et al., 2014). However, the Basel III ratios are generally not very highly correlated with the *LC/GTA* ratio, so that Basel III liquidity requirements may not have a very large effect on bank liquidity creation (Berger and Bouwman, 2016). Further, higher required bank capital ratios may either encourage or discourage liquidity creation within banks depending upon which of the theoretical concepts empirically dominates, which is not clear from the literature.

This paper also has implications for future research. While we find that bank liquidity creation impacts economic growth – primarily through *on-balance sheet LC* for small banks and primarily through *off-balance sheet LC* for large banks – more research is needed on the underlying mechanisms or channels through which it occurs. Finally, more research on the effects of bank capital ratios on liquidity creation is needed to clarify which of the theoretical effects dominate under different circumstances.

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