TECHNICAL EFFICIENCY IN BANK LIQUIDITY CREATION

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Motivation

- Banks create liquidity by financing illiquid assets such as loans with liquid liabilities such as demand deposits.

- Creating liquidity, banks offer a liquidity on demand service to investors and depositors, which benefits to the economy.

- Comprehensive measure of liquidity transformation using all assets, liabilities, and off-balance sheet activities (Berger & Bouwman, 2009):
  - Classifies all assets, liabilities, and off-balance sheet activities as liquid, semi-liquid, or illiquid
  - Weights the elements: illiquid assets or liquid liabilities (½); liquid assets or illiquid liabilities (- ½)
  - Sums the elements classified and weighted

- Studies of factors associated with higher levels of liquidity creation:
  - Size, multibank holding membership, merging (Berger & Bouwman, 2009)
  - Bank value (Cowan & Salotti, 2015), competition (Horvath et al. 2015), regulatory policies and intervention (Berger et al., 2015)
CONTRIBUTION

- Banks produce most liquidity when originating the most illiquid loans and collecting the most liquid liabilities.

- This ability is determined by technology, organization, business model i.e. specialization or diversification.

- Liquidity creation is the result of a production process: the ability of each bank to make the best use of its productive resources (financial and physical capital, and labor).

- Contribution:
  - An optimal bank liquidity creation benchmark: the efficient frontier in bank liquidity creation
  - Factors associated with most efficient bank liquidity production
HYPOTHESES

- Relationship between size and efficiency in producing liquidity
  - Larger size is associated with higher liquidity creation (Berger & Bouwman, 2009).
  - Scale economies and risk diversification affect productivity in the banking sector and increase with bank size (Hughes & Mester, 1998; Hughes et al., 2001).

- Hypothesis 1: Larger banks are expected to be more efficient in creating liquidity.
HYPOTHESES

- Relationship between bank business model and efficiency in producing liquidity

- Bank diversification stems from a mix of traditional (deposit taking, lending, payment services) and nontraditional activities (e.g. asset management, insurance, nonfinancial business) (Apergis, 2014).
  - Traditional banking relies on the relationship oriented model: associating the highest value added liabilities (core deposits) to the highest value added loans (relationship loans) (Song & Thakor, 2007).
  - Nontraditional banking does not participate to the core intermediation function of banks.

- Hypothesis 2: Traditional banking would be more efficient than nontraditional banking.
HYPOTHESES

- Bank business model and activity mix are related to bank size.
  - Larger banks are more engaged in nontraditional banking (Stiroh & Rumble, 2006), rely more on the use of hard information to perform transactional lending (Berger & Udell, 2002).
  - Smaller banks have an advantage in terms of lending and traditional banking, rely more on soft information to perform relationship lending.

- We expect a stronger effect of traditional banking activities on efficiency than the size effect of scale economies.

- Hypothesis 3: The largest banks are expected to be less efficient because of nontraditional banking activities.
METHODOLOGY

- Technical efficiency in bank liquidity creation is estimated with a production (value added) approach: overall liquidity production is viewed as an output, consistently with Berger & Bouwman’s measure.

- Stochastic Frontier Approach (Aigner et al. 1977; Meeusen & van den Broeck, 1977) and Battese & Coelli (1995) model for panel data:

\[
\ln(Y_{it}) = \beta_0 + \sum_{j=1}^{4} \beta_j x_{jit} + \sum_{j=1}^{4} \sum_{k=1}^{4} \beta_{jk} x_{jit} x_{kit} + V_{it} + U_{it} \tag{1}
\]

- Output: the logarithm of liquidity creation of bank i at period t
- Inputs: financial capital (ln(total equity)), labour capital (ln(total expenses in salaries and employees benefits)), physical capital (ln(expenses of premises and fixed assets)), output quality (ln(nonperforming loans))
**METHODODOLOGY**

Technical inefficiency term $U_{it}$ defined as:

$$U_{it} = \delta_0 + \sum_{j=1}^{14} \delta_j z_{jit} + W_{it}$$  \hspace{1cm} (2)

Where:

- $z_1$: size of the bank $i$ (ln(total assets))
- $z_2$: dummy variable of bank holding company membership
- $z_3$ to $z_5$: proxies of diversification between traditional and nontraditional banking activities, respectively the diversification of activities, assets, and loans;
- $z_6$ to $z_{14}$: variables assessing the interaction between dummies of bank size class and diversification of banking activities
METHODOLOGY

- Effect of activity diversification on technical efficiency in creating liquidity

- The more involved in nontraditional banking a bank, the more diverse its sources of non-interest income.

- Herfindahl-Hirschman Index (HHI) of non-interest income categories (Schmidt & Walter, 2009; Stiroh, 2004):

\[
HHI_{Activity_{i,t}} = \left( \frac{FID}{NON} \right)_{i,t}^2 + \left( \frac{SRV}{NON} \right)_{i,t}^2 + \left( \frac{TRADE}{NON} \right)_{i,t}^2 + \left( \frac{S&I}{NON} \right)_{i,t}^2 + \left( \frac{VENT}{NON} \right)_{i,t}^2 + \left( \frac{SERV}{NON} \right)_{i,t}^2 + \left( \frac{SEC}{NON} \right)_{i,t}^2 + \left( \frac{GAINS}{NON} \right)_{i,t}^2 + \left( \frac{OTH}{NON} \right)_{i,t}^2
\]

- High value of HHI: concentration of fee sources, activity specialization, traditional banking
- Low value of HHI: activity diversification, non-traditional banking
METHODOLOGY

- Effect of asset diversification on technical efficiency in creating liquidity
  - Traditional banking focus on lending
  - Nontraditional banking engage in non-lending activities

- Herfindahl-Hirschman Index (HHI) of asset categories:

\[
HHI_{Asset_{i,t}} = \left( \frac{CASH}{ASSETS} \right)_{i,t}^2 + \left( \frac{SECU}{ASSETS} \right)_{i,t}^2 + \left( \frac{LOANS}{ASSETS} \right)_{i,t}^2 + \left( \frac{FIX}{ASSETS} \right)_{i,t}^2 + \left( \frac{OTH}{ASSETS} \right)_{i,t}^2
\]

- High value of HHI: asset concentration, traditional banking
- Low value of HHI: asset diversification, nontraditional banking
Methodology

- Effect of loan diversification on technical efficiency in creating liquidity

- Traditional banking includes making loans to different sectors (C&I, real estate agriculture, financial institutions, individual) (Deng et al., 2007).

- Diversification of the loan portfolio may benefit in terms of economies of scope as banks acquire informations on various clients and sectors.

- Herfindahl-Hirschman Index (HHI) of loan categories (Deng et al., 2007; Estes, 2014):

\[
HHI_{\text{Loans}_{it}} = \left(1 - \frac{RE}{\text{LOANS}}_{i,t}\right)^2 + \left(\frac{\text{CONST}}{\text{LOANS}}_{i,t}\right)^2 + \left(\frac{\text{FARM}}{\text{LOANS}}_{i,t}\right)^2 + \left(\frac{\text{MULTI}}{\text{LOANS}}_{i,t}\right)^2 + \left(\frac{\text{CRE}}{\text{LOANS}}_{i,t}\right)^2 + \left(\frac{\text{AG}}{\text{LOANS}}_{i,t}\right)^2 + \left(\frac{\text{CI}}{\text{LOANS}}_{i,t}\right)^2 + \left(\frac{\text{CONS}}{\text{LOANS}}_{i,t}\right)^2 + \left(\frac{\text{OTH}}{\text{LOANS}}_{i,t}\right)^2
\]

- High value of HHI: concentration loan portfolio, nontraditional banking
- Low value of HHI: loan portfolio diversification, traditional banking
METHODODOLOGY

Data
- Call reports (FDIC): quarterly balance sheet and income statement data
- Berger & Bouwman’s liquidity creation measure
- Period from 1999 to 2014
- 103,583 observations and 7,113 banks

Results:
- Technical efficiency scores of bank i at time t
- Determinants of technical efficiency
RESULTS

- Evolution of average technical efficiency scores in creating overall liquidity, by bank size.
RESULTS

- Evolution of average technical efficiency scores in creating on-balance sheet liquidity, by bank size
RESULTS

- Evolution of average technical efficiency scores in creating off-balance sheet liquidity, by bank size
RESULTS

- Estimation of the technical inefficiency effects

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<tr>
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<th>Coefficient</th>
<th>Standard Error</th>
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<tr>
<td>Intercept</td>
<td>10.880</td>
<td>(21.97)**</td>
</tr>
<tr>
<td>Ln (total assets)</td>
<td>0.095</td>
<td>(27.21)**</td>
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<tr>
<td>BHC dummy</td>
<td>0.098</td>
<td>(8.91)**</td>
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<tr>
<td>HHI_activity</td>
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<tr>
<td>HHI_asset</td>
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<tr>
<td>HHI_loan</td>
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<td>(63.95)**</td>
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<tr>
<td>Vsigma</td>
<td>-3.052</td>
<td>(267.26)**</td>
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<tr>
<td>Intercept</td>
<td>9.308</td>
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<tr>
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<td>Medium dummy * HHI_activity</td>
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<td>(11.29)**</td>
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<td>Large dummy * HHI_activity</td>
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<td>(3.87)**</td>
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<td>Small dummy * HHI_asset</td>
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<td>(25.21)**</td>
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<td>Medium dummy * HHI_asset</td>
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<tr>
<td>Vsigma</td>
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CONCLUSION

- Size matters for efficiency in liquidity creation in a nonlinear shape.
  - Medium banks are most correlated to the efficient frontier of overall liquidity creation.
  - Small banks – experienced in processing soft information and relationship lending – are closer to the efficient frontier of the on-balance sheet liquidity creation.
  - Large banks – relying on hard information and transaction lending are more correlated to the efficient frontier of the off-balance sheet liquidity creation.

- Effect of global financial conditions on efficiency in producing liquidity
  - Small banks are more resilient to the 2007-2008 financial crisis.
  - Large banks are the most affected.

- Policy implications
  - Regulation affects the choice of activity mix by banks (DeYoung et al. 2004)
  - Relationship between activity mix and efficiency in liquidity creation
  - Help understand the consequences of regulation in terms of welfare of the economy