United States Department of Agriculture

Linking Public Data Sources to Create Localized Official Statistics

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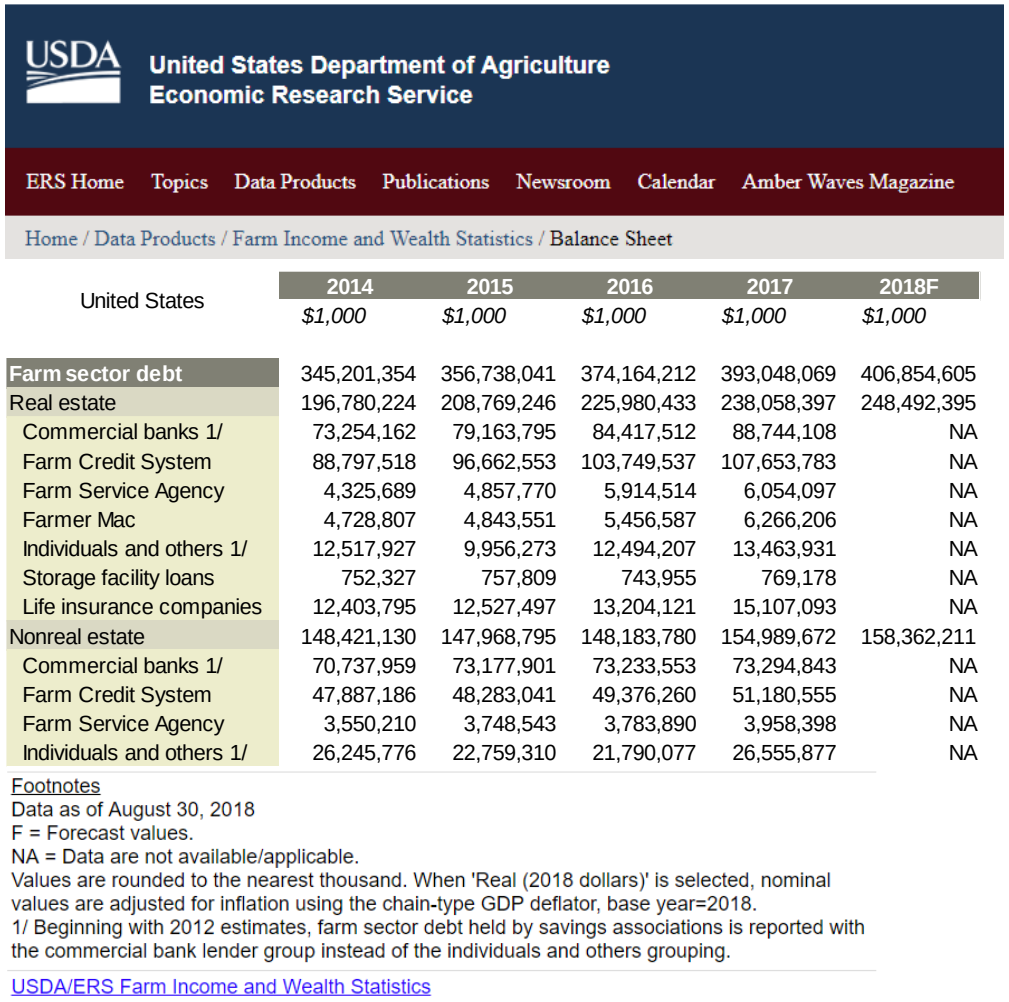
Economic Research Service
October 24, 2018

The Findings and Conclusions in This Preliminary Presentation Have Not Been Formally Disseminated by the U. S. Department of Agriculture and Should Not Be Construed to Represent Any Agency Determination or Policy. This research was supported by the intramural research program of the U.S. Department of Agriculture, Economic Research Service.

Motivation



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Home / Data Products / Farm Income and Wealth Statistics / Balance Sheet

United States	2014	2015	2016	2017	2018F
	$1,000	*$1,000*	*$1,000*	*$1,000*	*$1,000*
Farm sector debt	345,201,354	356,738,041	374,164,212	393,048,069	406,854,605
Real estate	196,780,224	208,769,246	225,980,433	238,058,397	248,492,395
Commercial banks 1/	73,254,162	79,163,795	84,417,512	88,744,108	NA
Farm Credit System	88,797,518	96,662,553	103,749,537	107,653,783	NA
Farm Service Agency	4,325,689	4,857,770	5,914,514	6,054,097	NA
Farmer Mac	4,728,807	4,843,551	5,456,587	6,266,206	NA
Individuals and others 1/	12,517,927	9,956,273	12,494,207	13,463,931	NA
Storage facility loans	752,327	757,809	743,955	769,178	NA
Life insurance companies	12,403,795	12,527,497	13,204,121	15,107,093	NA
Nonreal estate	148,421,130	147,968,795	148,183,780	154,989,672	158,362,211
Commercial banks 1/	70,737,959	73,177,901	73,233,553	73,294,843	NA
Farm Credit System	47,887,186	48,283,041	49,376,260	51,180,555	NA
Farm Service Agency	3,550,210	3,748,543	3,783,890	3,958,398	NA
Individuals and others 1/	26,245,776	22,759,310	21,790,077	26,555,877	NA

Footnotes
Data as of August 30, 2018
F = Forecast values.
NA = Data are not available/applicable.
Values are rounded to the nearest thousand. When 'Real (2018 dollars)' is selected, nominal values are adjusted for inflation using the chain-type GDP deflator, base year=2018.
1/ Beginning with 2012 estimates, farm sector debt held by savings associations is reported with the commercial bank lender group instead of the individuals and others grouping.

USDA/ERS Farm Income and Wealth Statistics

The Economic Research Service produces national balance sheets as part of our Farm Income and Wealth Statistics data products

Objective: find a method to procure state-level estimates through better use of existing reports and new disaggregation methods of administrative data

Focus: 85% of loan volumes held by Commercial/Savings Banks, the Farm Service Agency and the Farm Credit System

Challenges for Top Institutional Lenders

Institution	Issue
Farm Service Agency	State-level data exists, but not in readily available format
Commercial/Savings Banks	Data is aggregated by bank, not by state. State-level data can be imputed with regulatory sources
Farm Credit System	Data is aggregated by bank, not by state. Limited regulatory information. State values must be estimated using other means (e.g. surveys)

Data Sources

Commercial/Savings Banks

Call Report Data: 1976 – 2018

- Federal Reserve Bank of Chicago; Federal Financial Institutions Examination Council

Summary of Deposits: 1994 - 2018

- Federal Deposit Insurance Corporation

Community Reinvestment Act: 1997 – 2018

- Federal Financial Institutions Examination Council

Home Mortgage Disclosure Act: 1999 – 2016

- Federal Financial Institutions Examination Council

Farm Service Agency

Monthly Management Summary Reports: 2003 – 2018

- Farm Service Agency

Farm Credit System

Call Report Data: 2005 – 2018

- Farm Credit Administration

Other Sources

Census of Agriculture: 1992 – 2012

- USDA National Agricultural Statistical Service

Accessing State-Level Information From PDFs

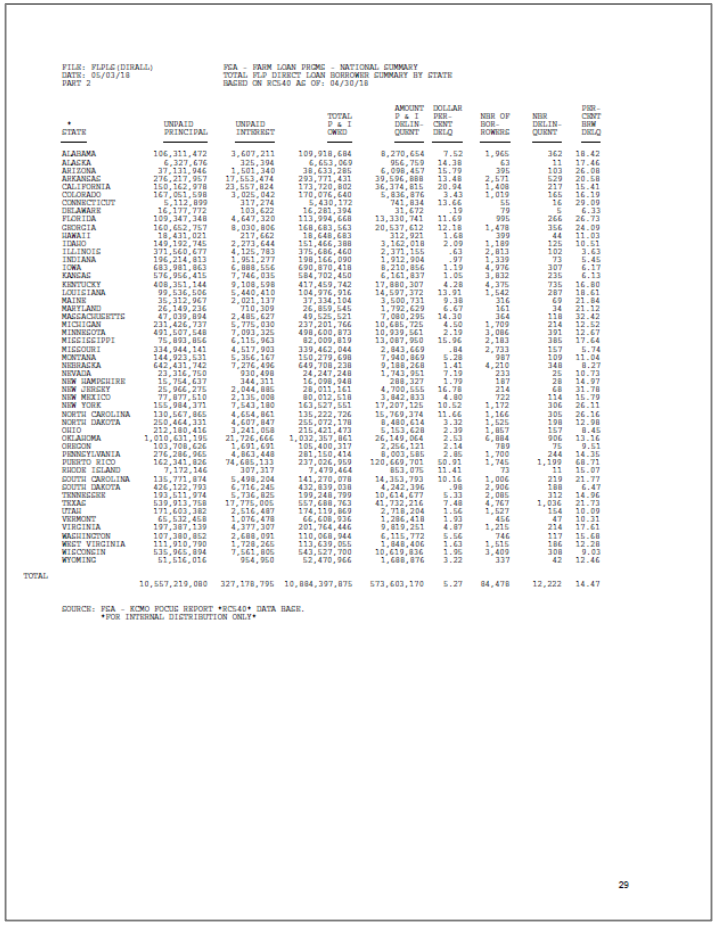
Using R to Scrape PDFs from the Farm Service Agency

Objective: Read in data frame of tabular data in PDF of loan data for states

Tabular data in FSA PDFs were accessed by

- Transforming the PDFs into a data frame containing lines of text
- Indexing start and end of table using regular expressions
- Coercing fixed width data into columns

Sample PDF



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PART 2

FSA - FARM LOAN PRGMS - NATIONAL SUMMARY
TOTAL FLP DIRECT LOAN BORROWER SUMMARY BY STATE
BASED ON RCS40 AS OF: 04/30/18

* STATE	UNPAID PRINCIPAL	UNPAID INTEREST	TOTAL P & I OWED	AMOUNT P & I DELIN-QUENT	DOLLAR PER-CENT DELQ	NBR OF BOR-ROWERS	NBR DELIN-QUENT	PER-CENT NBR DELQ
ALABAMA	106,311,472	3,607,211	109,918,684	8,270,654	7.52	1,965	362	18.42
ALASKA	6,327,676	326,394	6,653,069	956,759	14.38	63	11	17.46
ARIZONA	37,131,946	1,501,340	38,633,285	6,098,457	15.79	395	103	26.08
ARKANSAS	276,217,957	17,553,474	293,771,431	39,596,888	13.48	2,573	529	20.56
CALIFORNIA	150,162,978	23,557,824	173,720,802	36,374,815	20.94	1,408	217	15.41
COLORADO	167,051,598	3,025,042	170,076,640	5,836,876	3.43	1,019	165	16.19
CONNECTICUT	5,112,899	317,274	5,430,172	741,834	13.66	55	16	29.09
DELAWARE	16,177,772	103,622	16,281,394	31,672	.19	79	5	6.33
FLORIDA	109,347,348	4,647,320	113,994,668	13,330,741	11.69	995	266	26.73
GEORGIA	160,652,757	8,030,806	168,683,563	20,537,612	12.18	1,478	356	24.09
HAWAII	18,433,021	217,662	18,648,683	312,921	1.68	399	44	11.03
IDAHO	149,192,745	2,273,644	151,466,388	3,162,018	2.09	1,189	125	10.51
ILLINOIS	373,560,677	4,125,783	375,686,460	2,371,155	.63	2,813	102	3.63
INDIANA	196,214,813	1,951,277	198,166,090	1,912,904	.97	1,339	73	5.45
IOWA	683,981,863	6,888,556	690,870,418	8,210,856	1.19	4,976	307	6.17
KANSAS	576,956,415	7,746,035	584,702,450	6,161,837	1.05	3,832	235	6.13
KENTUCKY	408,351,144	9,108,598	417,459,742	17,880,307	4.28	4,375	735	16.80
LOUISIANA	99,536,506	5,440,410	104,976,916	14,597,372	13.91	1,542	287	18.61
MAINE	36,312,967	2,021,137	37,334,104	3,500,731	9.38	316	69	21.84
MARYLAND	96,149,236	710,309	26,859,545	1,792,629	6.67	161	34	21.12
MASSACHUSETTS	47,039,894	2,485,627	49,525,521	7,080,295	14.30	364	118	32.42
MICHIGAN	233,426,737	5,775,030	237,201,766	10,680,726	4.50	1,709	214	12.52
MINNESOTA	491,607,548	7,093,326	498,600,873	10,939,561	2.19	3,086	391	12.67
MISSISSIPPI	75,893,856	6,115,963	82,009,819	13,087,950	15.96	2,183	385	17.64
MISSOURI	334,944,141	4,517,903	339,462,044	2,843,669	.84	2,733	157	5.74
MONTANA	144,923,531	5,356,167	150,279,698	7,940,869	5.28	987	109	11.04
NEBRASKA	642,431,742	7,276,496	649,708,238	9,188,268	1.41	4,210	348	8.27
NEVADA	23,316,750	930,498	24,247,248	1,743,951	7.19	233	25	10.73
NEW HAMPSHIRE	15,764,637	344,311	16,098,948	288,327	1.79	187	28	14.97
NEW JERSEY	25,966,275	2,044,886	28,011,161	4,709,555	16.78	214	68	31.78
NEW MEXICO	77,877,510	2,135,008	80,012,518	3,842,833	4.80	722	114	15.79
NEW YORK	155,984,371	7,543,180	163,527,551	17,207,325	10.52	1,172	306	26.11
NORTH CAROLINA	130,567,865	4,654,863	135,222,726	15,769,374	11.66	1,166	305	26.16
NORTH DAKOTA	250,464,335	4,607,947	255,072,178	8,480,414	3.32	1,525	198	12.98
OHIO	212,180,436	3,241,958	215,421,473	5,163,628	2.39	1,857	157	8.45
OKLAHOMA	1,010,631,195	21,726,666	1,032,357,861	26,149,064	2.53	6,884	906	13.16
OREGON	103,708,626	1,691,691	105,400,317	2,256,121	2.14	789	75	9.51
PENNSYLVANIA	276,286,965	4,863,448	281,150,414	8,003,585	2.85	1,700	244	14.35
PUERTO RICO	162,541,826	74,665,133	237,206,959	120,669,701	50.87	1,749	1,199	68.71
RHODE ISLAND	7,172,146	307,317	7,479,464	863,075	11.41	73	11	15.07
SOUTH CAROLINA	136,771,874	5,498,204	141,270,078	14,353,793	10.16	1,006	219	21.77
SOUTH DAKOTA	426,122,793	6,716,145	432,839,038	4,242,396	.98	2,906	188	6.47
TENNESSEE	193,511,974	5,736,825	199,248,799	10,614,677	5.33	2,085	312	14.96
TEXAS	539,913,758	17,775,005	557,688,763	41,732,216	7.48	4,767	1,034	21.73
UTAH	171,603,382	2,516,487	174,119,869	2,718,204	1.56	1,627	154	10.09
VERMONT	65,532,458	1,076,478	66,608,936	1,286,418	1.93	456	47	10.31
VIRGINIA	197,387,139	4,377,307	201,764,446	9,819,261	4.87	1,216	214	17.61
WASHINGTON	107,380,852	2,688,091	110,068,944	6,115,772	5.56	746	117	15.68
WEST VIRGINIA	111,910,790	1,728,266	113,639,056	1,848,406	1.63	1,515	186	12.28
WISCONSIN	535,965,894	7,561,905	543,527,799	10,619,836	1.95	3,409	308	9.03
WYOMING	51,516,016	954,960	52,470,966	1,688,876	3.22	337	42	12.46
TOTAL	10,557,219,080	327,178,795	10,884,397,875	573,603,170	5.27	84,478	12,222	14.47

SOURCE: FSA - KCMO FOCUS REPORT *RCS40* DATA BASE.
FOR INTERNAL DISTRIBUTION ONLY

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Using R to Scrape PDFs from the Farm Service Agency

Packages used:
Pdftools ← PDF to text
Stringr ← string manipulation

Full script had to account for quirks, such as

- Changes to table over time
- "West Virginia"

Example – PDF Scrape

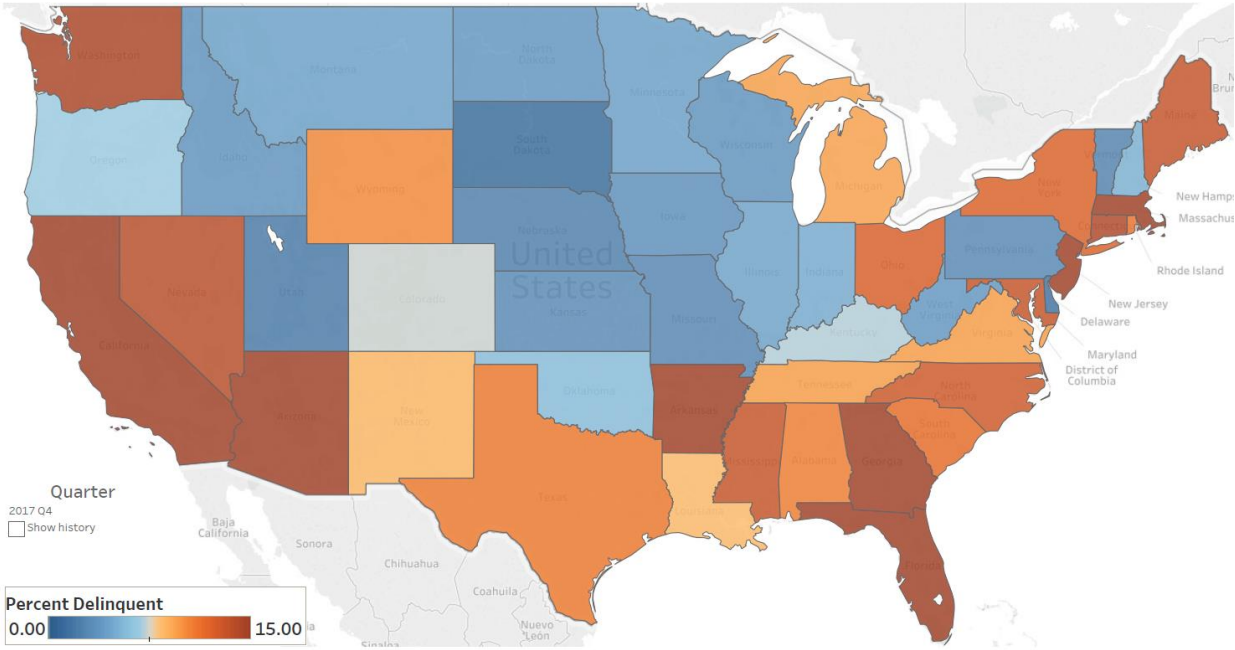
```
#Example: Pulling table of state data from PDF
#Convert PDF into textfile
textfile <- pdf_text(filepath)

#Creating new row in dataframe for each space
flatfile <- strsplit(textfile,"\n")

#Searching for page containing table of interest TableName
for(i in 1:length(flatfile)){

  #Identifying start of table TableName
  if(grepl(sprintf(TableName),flatfile[[i]][3])){

    #Looping through rows of interest using regular expressions
    for(j in grep("ALABAMA",flatfile[[i]]):grep("WYOMING",flatfile[[i]])){

      #Converting each each row into a vector
      vector <- unlist(strsplit(str_replace(gsub("\\s+",
                " ", str_trim(tolower(flatfile[[i]][j]))), "B", "b")," ")))

      #Binding each  row to a new dataframe, outfile
      outfile <- rbind(outfile,vector,deparse.level = 0,stringsAsFactors=FALSE)
    }
  }
}
```


Using R to Scrape PDFs from the Farm Service Agency

Benefits of this approach:

- Parameterized code allows for automatic quarterly updates
- Additional variables or tables can be extracted with minimal code changes
- No need for intermediate tables for data visualizations

Delinquency Rates for FSA Production Loans – Q2 2018



Disaggregating Bank-Level Data with Regulatory Information

Using R to Disaggregate Commercial Bank Call Report Data

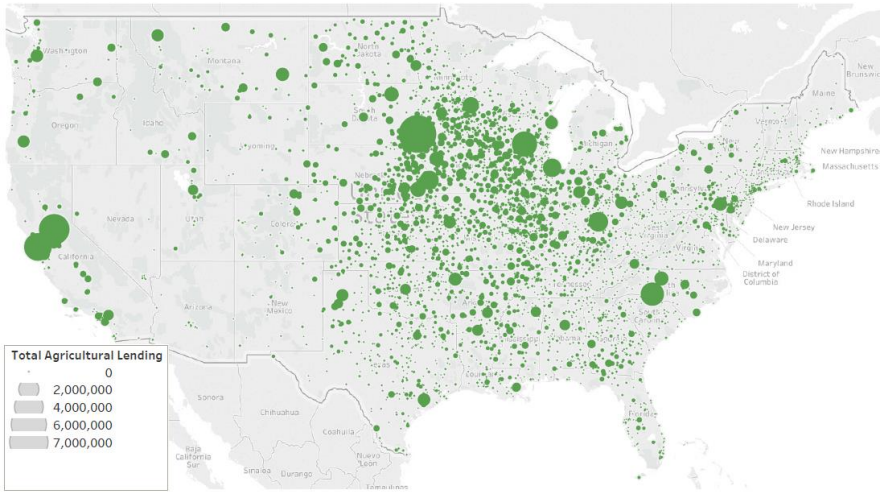
Call reports list information by headquarters, not where loans occur

Solution: disaggregate call reports information into counties using regulatory information that captures bank presence by county and re-aggregate at the state level

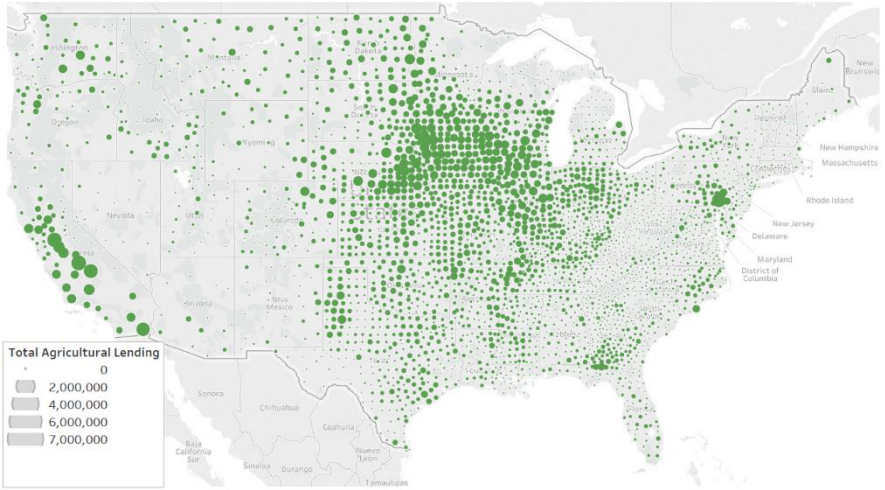
Overarching Process:

1) Read in data
2) Cleaning and imputation
3) Assigning county shares
4) Many-to-one merges
5) Calculation of county shares
6) Re-aggregation and upload

Original Data – Loan Volume by Institution



Disaggregated Data – Loan Volume by County



Accessing Call Report/Regulatory Information

Most sources used are contained in zip files that have URLs that can be used for direct access

Packages used:
RCurl ← url access
SASxport ← read xport files

Section Process

- Download zip file to temporary directory
- Identify index using regular expressions
- Merge pulled schedules
- Delete temporary files

Significant cleaning, but uses simple methods

Example – Zip File Extract

```
#Example - reading in call report data from multiple schedules
#Adding file.exists helps avoid failures
if(file.exists(call_report_url))){

  #Create a temporary directory and download the full zipfile
  td <- tempdir()
  tf = tempfile(tmpdir=td, fileext=".zip")
  download.file(call_report_url,tf,mode="wb")

  #Find the index number for the name of the first schedule and read in the data
  fname = unzip(tf, list=TRUE)$Name[grepl("SCHEDULE A",unzip(tf, list=TRUE)$Name)]
  unzip(tf, files=fname, exdir=td, overwrite=TRUE)
  fpath = file.path(td, fname)
  sched_a = read.xport(fpath)

  #Repeat the process for the second schedule
  fname = unzip(tf, list=TRUE)$Name[grepl("SCHEDULE B",unzip(tf, list=TRUE)$Name)]
  unzip(tf, files=fname, exdir=td, overwrite=TRUE)
  fpath = file.path(td, fname)
  sched_b = read.xport(fpath)

  #Combine schedules
  all_schedules <- Reduce(function(x, y) merge(x, y, all=TRUE), list(sched_a,sched_b))

  #Delete all files in temporary directory
  do.call(file.remove, list(list.files(td, full.names = TRUE)))
}
```


Assigning County Proportions

Merging call report data with regulatory data allows us to proxy for an institution's regional lending

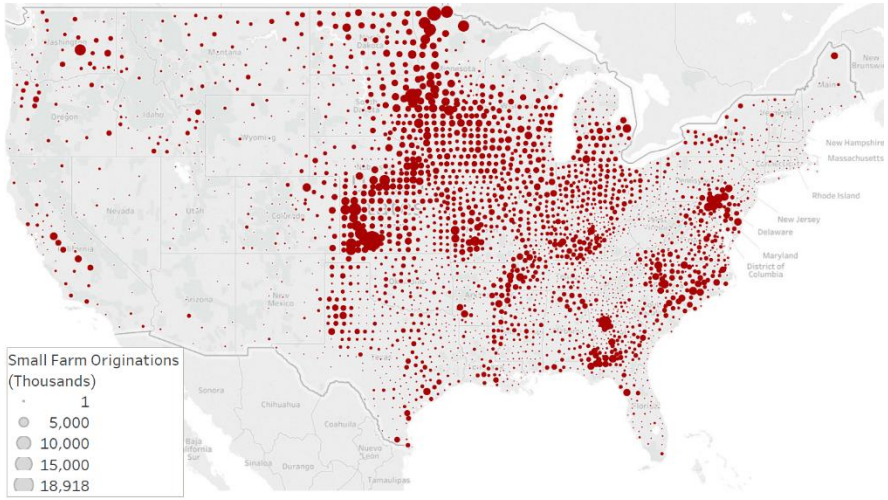
One source will contain aggregated information you are attempting to disaggregate, and the other(s) contain disaggregated information that can be used to proxy for regional dispersion

Section Process

- Add column to regulatory table containing sum by group
- Merge in call report data (many to one)
- Multiply across for county share

Largest Lender: Call Report Information

Largest Lender: Regulatory Information



Assigning County Proportions

Packages used:
Rodbc ← SQL server connection

Challenge: often requires strong assumptions, in-depth knowledge and significant cleaning before merge

Note: many-to-one merges can result in tables that are too large for individual machines to hold in memory

Example – Assigning County Shares with Share of Total

```
#Example - using regulatory information to assign shares
#need to create sum of volume by unit_id and add as column
df$unit_sum <- ave(df$volume, df$unit_id, FUN=sum)
#Divide volume (county level) by this total for share
df$county_share <- df$volume / df$unit_sum
#checking to see if shares by unit add to 1
df$check <- ave(df$county_share, df$unit_id, FUN=sum)
#If correctly disaggregated, table should only include 1s
table(df$check)
#merge in call report information where reg info exists
df_with_cr <- merge(df,call_reports,by="unit_id",all.x=TRUE,all.y=FALSE)
#county-level volumes
df_with_cr$loan_volume_share <- df_with_cr$county_share * df_with_cr$loan_volume
#Saving database out to SQL - where dbhandle is database handle
sqlSave(dbhandle, df_with_cr, "disagg_call_reports", fast=TRUE,append=TRUE,
        rownames=FALSE)
```

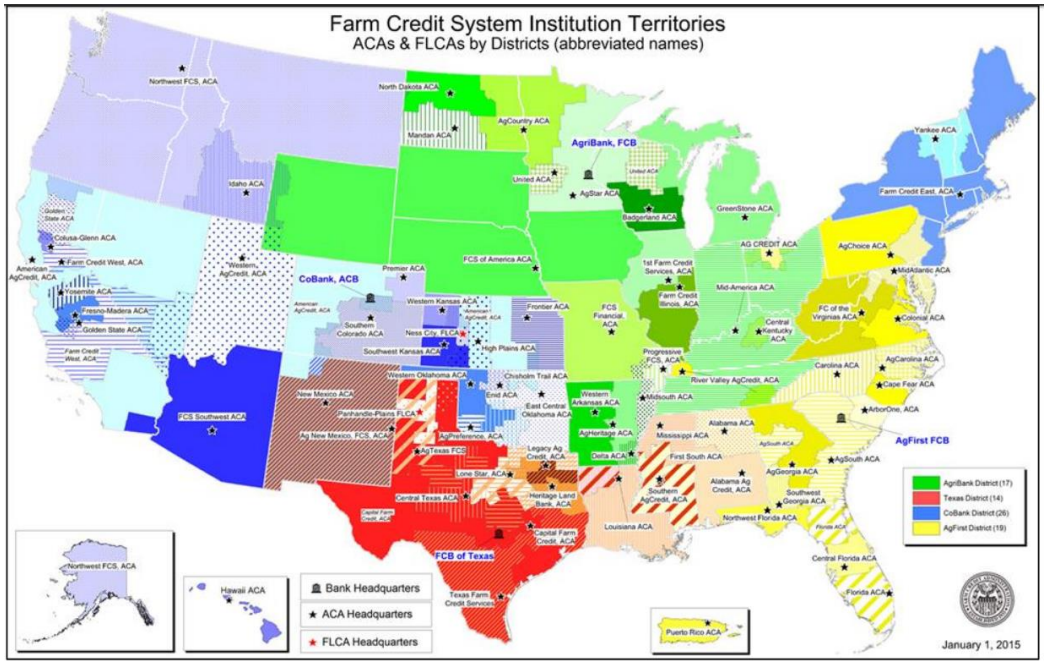

Refining Administrative Data with Surveys

Combining Administrative Data with Surveys

Similarities to commercial bank data:
1) Data reported at the institution level
2) Same importation method

Differences:
1) Limited regulatory information

Overarching Process:
1) Read in data
2) Survey analysis
3) Assign state shares



Using R to Disaggregate Commercial Bank Call Report Data

Packages used:
survey ← survey analysis

Useful specifically when survey total is less reliable than what is reported in administrative data, but produces valid proportions by group

Important to know survey limitations to know what mitigating factors to use (e.g. moving averages)

Example – Assigning State Share using Survey Share

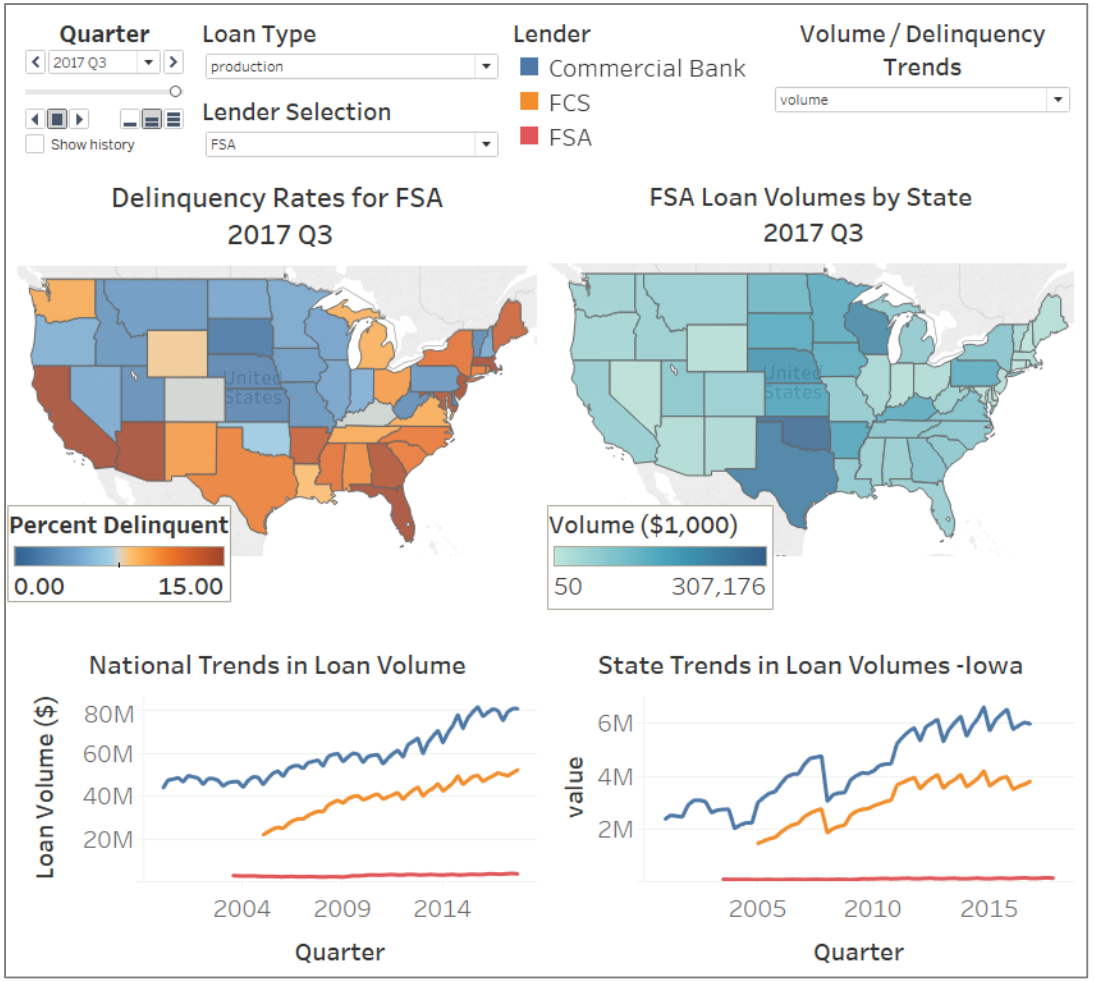
```
### Creating state shares based on national total
# read in survey data
data <- read.csv(surveypath,header=T)
# create survey design
survey.design <- svydesign(id=~id,data=data,weights = ~weights)
# summing debt by state
state_debt <- svyby(~debt,~state,survey.design,svytotal)
# finding share of debt by state
state_debt$debt_share <- state_debt$debt / sum(state_debt$debt)
# applying state share of debt to administrative total
state_debt$admin_share <- state_debt$debt_share * national_total
```


Combining All Methods

Potential Use Cases

- Extension of ERS data products
- Creation of new ERS visualizations
- Use for broader research purposes

Example: Dashboard Mockup



Contact Information

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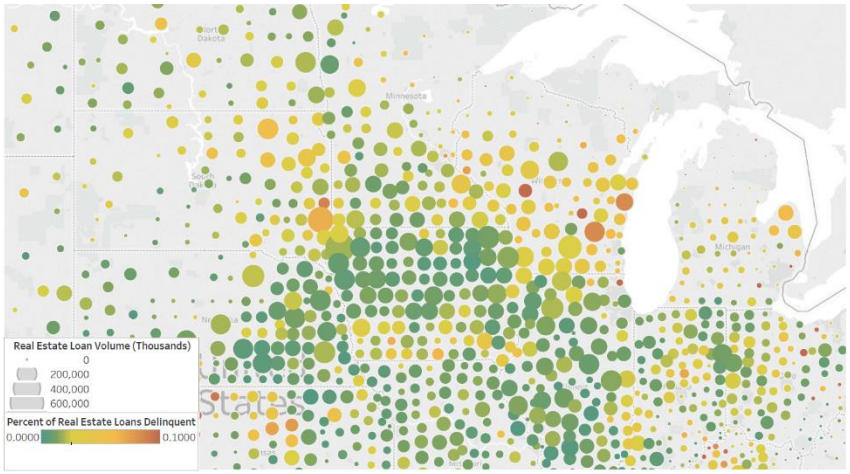
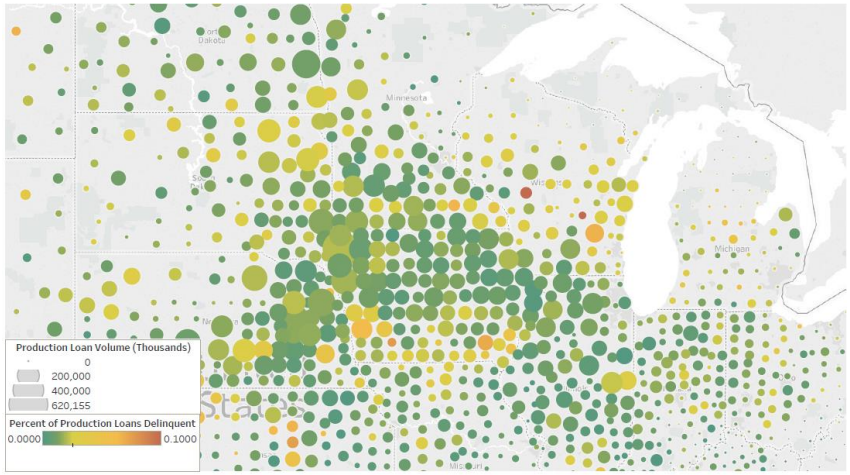
Extensions: Financial Stress Factors

Real Estate Loan Delinquency Rate by County, Q2 2018



Production Loan Delinquency Rate by County, Q2 2018

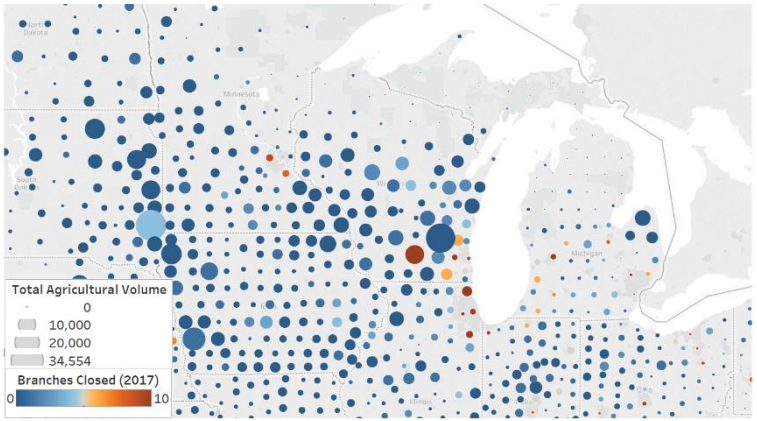


Disaggregation methods can be extended to other schedules to look at regional financial stress, including:

- Delinquent loan volumes
- Loans in nonaccrual status
- Charge-offs

Extensions: Bank Branch Closures

Number of Closed Branches by County, 2017

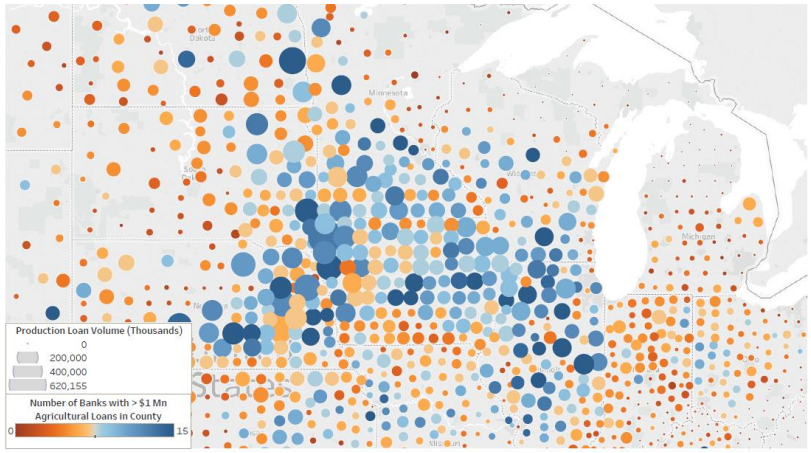


Subsequent research will pair county-level loan volumes and delinquencies with the bank branch closures from the FDIC's Reports of Structure Changes

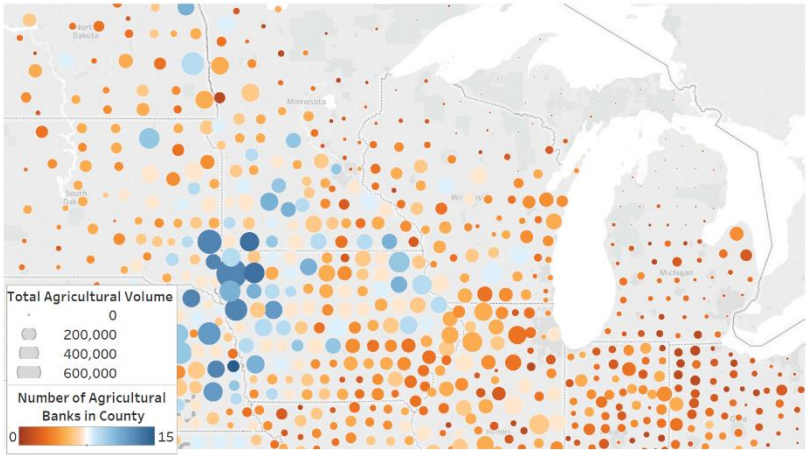
Primary aim is to understand the relationship between agricultural loan performance and bank branch closures

Extensions: Competition in Lending

Number of Banks with > $1Mn Loans in County



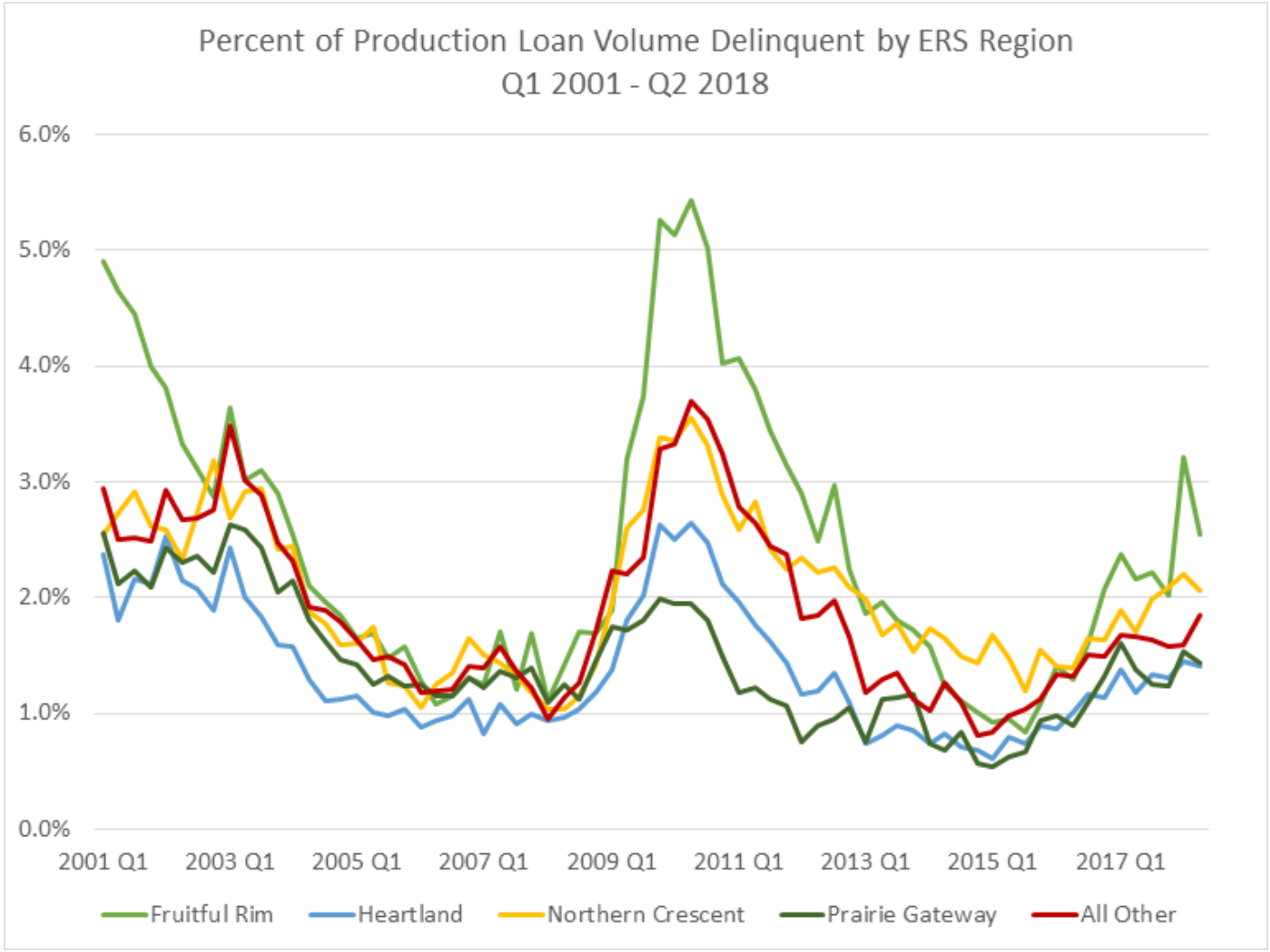
Number of FDIC-designated Ag. Banks in County



Can be used to check the robustness of agricultural credit markets across counties

- Number of institutions with x in agricultural lending
- Number of agricultural-focused lending institutions

Appendix: Production Loan Delinquencies by ERS Production Region



Appendix: Real Estate Loan Delinquencies by ERS Production Region