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Climate variability and bank lending in the Southeast USA

Denis Nadolnyak[a], Valentina Hartarska[b]*

[a]Assistant Professor, Auburn University, 209B Comer Hall, Auburn, Al 36849, USA
[b] Associate Professor, Auburn University, 210 Comer Hall, Auburn, Al 36849, USA

Abstract

Abstract
In this paper, we investigate the possibility that agricultural loan portfolios of banks serving agricultural producers in the southeastern U.S. are affected by inter-annual climate fluctuations. The main finding is that La Nina years are associated with on average three times lower charge-offs and more and larger loans, in banks focusing on agricultural lending in this region. The results suggest that ENSO impact on the agricultural lending is relatively small perhaps because farmers utilize well existing insurance mechanisms and take advantage of government disaster relief payments.

Keywords: Climate variability; ENSO; banking; catastrophic events;

1. Introduction

In the U.S., commercial banks are one of several sources of external funds available to qualified farmers. Typically, commercial banks doing business with agricultural producers, processors, and cooperatives are relatively small and lend to businesses located within a 2-3 hours drive from the bank (Kilkenny, 2010). Since emerging climate research shows that long term climate variability measured by El Niño Southern Oscillation (ENSO) events affects producers in the Southeastern USA, we study how such events affect agricultural banks in this region.

There is emerging literature studying how financial markets are affected by catastrophic risk events many of which are caused by climate extremes. The basic conclusion is that commercial banks and their clients are affected by these events in the absence of adequate insurance markets. For example, Garmaise and Moskowitz (2009) show that insurance market imperfections can restrict provision of bank credit and prevent positive net present value projects

* Denis Nadolnyak. Tel.: +1-334-844-5620; fax: +1-334-844-5639.
E-mail address: nadolda@auburn.edu.

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from being undertaken. This can limit market participation of less wealthy investors and hamper neighbourhood revitalization in disadvantaged areas. These authors provide supportive empirical evidence from extreme events such as hurricanes and an earthquakes. Kau and Keenan (1999) develop an option-pricing methodology to calculate probability distributions for improving credit risk evaluations for lenders who cannot find insurance or cannot rely on governments to cover catastrophic events. Collier, Katchova, and Skees (2010) find that in Peru, El Niño events (catastrophic flooding) affected financial institutions serving the poor. In particular, the one bank they study restructured four percent more of their portfolio after an El Niño event struck, but there was no impact on the proportion of delinquent loans. Evidence from Banco ProCredit in Ecuador shows that the demand for credit increases after a volcanic eruption but the probability of receiving microloan does not change for existing clients, while it decreases for new clients, suggesting that microcredit in rural Equador has an insurance function (Bergyz and Schraderx, 2009). Ewing, Hein and Kruse, (2005) examine community bank performance in several tornado-prone and hurricane-prone areas in the USA. Just as agricultural banks, community banks tend to be less diversified geographically and may be more vulnerable to local economic shocks as these banks serve local small business customers. Ewing, Hein and Kruse (2005) findings suggest regional differences (i.e., banks' performance in Miami MSA Florida was different from that of banks serving Fort Worth and Wilmington MSAs in Oklahoma) and these (positive post-event) differences depend on the severity of the event, which again suggests a role for complementary insurance markets.

In the Southeast USA, draughts and floods caused by ENSO events affect agricultural producers whose risk management options include farm supports and crop insurance (Nadolnyak, Vedenov, and Novak, 2008). Impacts of climate variability on agricultural banks are expected through possible changes in repayment patterns including charge offs, delinquencies, defaults, and loan restructuring. Understanding if and how much agricultural portfolios in bank in the Southeast are affected by climate variability measured by the ENSO event index would be suggestive of the degree to which the financing needs of farmers are met by existing financial markets and government support mechanisms and if these weather related risks are sufficiently diversified through the financial system.

2. Measuring the impact of climate variability on agriculture in the Southeast USA

The Centre for Ocean-Atmospheric Prediction Studies classifies ENSO data as belonging to one of three phases based on an index derived from observed sea surface temperatures (SST) anomalies: El Niño - warm SST anomalies in the Pacific, La Niña – El Viejo or cool SST anomalies, and neutral. In North America, El Niño creates warmer-than-average winters in the upper Midwest states and the Northwest, reducing snowfall. Central and southern California, northwest Mexico, and the Southwestern U.S. become significantly wetter. The northern Gulf of Mexico states and Southeast states are wetter and cooler than average during the El Niño phase of the oscillation (Climate Prediction Center temperature rankings). La Niña, causes mostly the opposite effects of El Niño. The impact on the southeastern states is significantly more pronounced in the winter than in the warm season, and below-average precipitation (causing droughts but preventing floods) is expected in the winter and summer months.

The economic impact of ENSO in the Southeast is pronounced in agriculture because it is mostly rain fed and vulnerable to volatility in precipitation, solar radiation, and temperatures that affect crop growth both directly and indirectly through their impacts on soil moisture, creating (un)favourable conditions for disease, etc. For this region, the impacts of inter-annual climate variability (ENSO phases) on crop yields have been documented and are used by agricultural extension services (agclimate.org). These impacts differ among crops, but generally neutral years result in better yields, El Niño years result in uniformly lower yields, whereas La Niña years are beneficial for some crops (corn, peanuts) and may be harmful for others (cotton). The negative impact of El Niño is due to freezes and/or floods early in the season. La Niña may have negative impact due to lack of rainfall and higher temperatures in the summer season, while the higher amount of solar radiation promotes plant growth.

Detailed analysis of the impact of ENSO on yields of various crops in the region has been done for several crops (Martinez, et al., 2009; Baigorria, et al., 2008). Given the complexity of plant growth processes, agronomic analysis on the aggregate scale and for particular crops is not feasible. Thus, the best strategy is to resort to uniform ENSO classification. Aggregate impacts of ENSO on production risk (*as opposed to production level*) have also been analyzed. For example, ENSO events were found to be positively associated with agricultural disaster payments in county level analysis (Nadolnyak and Hartarska, 2009). In particular, El Niño years with higher precipitation and freeze frequency were associated with substantially more disaster payments, whereas La Niña had much smaller effect due to droughts and heat. ENSO events were also found to affect production risk at more moderate levels in crop insurance analysis: the downward volatility of corn, cotton, and peanut yields in the southeast has been consistently higher in El Niño years suggesting that conditioning insurance premiums on ENSO would increase producer welfare (Nadolnyak and Vedenov, 2008).

To match the semi-annual bank data, dummies are created to classify years according to the indexes measuring sea surface temperatures (SST) in the Pacific with regard to their impact on climate in the southeastern U.S. The index most relevant to the region, according to regional climate research, is Nino 3.4 reflecting SSTs (3-month running mean of spatially averaged SST anomalies) between 5°North-5°South latitude and 170-120°West longitude. Monthly Nino 3.4 index data are used to classify years according to their observed impacts on the local climate. Generally, an ENSO year of October through September is classified as El Niño (La Niña) if the index values are 0.5°C or greater (-0.5°C or smaller) for 6 consecutive months. However, El Niño and La Niña impact the South-eastern climate at different times. To make classification more relevant, climatologists and agronomists in the Southeastern U.S. classify a crop year as El Niño if the index is 0.5 or higher for 6 consecutive months before February because the impact occurs mostly in the winter and early spring. La Niña classification is given if the index value is -0.5 or lower for 6 consecutive months before July because the impact of low SSTs is felt mostly in the summer. This classification is different from the one describing the global impacts of ENSO but it is much more relevant for agriculture in the Southeastern U.S. According to this methodology, years 2003, 2005 and 2007 are classified as El Niño and 2006 & 2008 as La Niña, while 2001, 2002, and 2004 are classified as neutral years.

3. Bank data description

All commercial banks operating in the Southeastern states with the highest regional impact of ENSO events - Alabama, Florida, Georgia, Mississippi, and South Carolina - are included in the initial dataset compiled from non-archived call reports for the period 2001-2008. The variables of interest include performance indicators on agricultural loans & loans to farmers as well as the performance of loans and leases secured by farmland, broken out by their size.

There are many definitions of what is an agricultural bank. The standard definition by the Federal Deposit Insurance Corporation is a bank with a ratio of agricultural to total loans of no less than 25 percent. In the dataset we assembled such a strict definition would have resulted in only 100 semi-annual observations or 14 banks – one in Alabama, five in Georgia, and eight in Mississippi. This is the first indicator that there is not a significant concentration in agricultural lending in the region, which would suggest that impact of ENSO events on the overall loan portfolio would be small and that both banks and their bank clients may be sufficiently diversified.

In the Southeastern states in the sample, 56 percent of the observations are from banks with non negative agricultural portfolio. Banks with substantial agricultural loan portfolio (bigger than $1 million) have an asset base of $7,821,758 on average with over 8,300 semiannual observations. When the data are analyzed by state, Florida has 68 banks with agricultural loan portfolio bigger than $1 million but none of Florida-based banks has a ratio of agricultural to total loans bigger than the 25 percent as in the FDIC definition for agricultural bank. If we lower the ratio to 10%, Florida had 3 banks with this ratio, AL had 11 banks, MS had 21, NC had none, and GA had 28 banks in December 2008. Thus to form the final dataset for analysis we employ an approach similar to that in Settlege, Preckler and Settlege (2009), and more in line with the Federal Reserve System definition of agricultural bank, which defined as agricultural any bank that has a ratio of agricultural to total loans greater than the mean for all banks.

For the study period, there were 360 banks offering agricultural loans of which about 337 with agricultural loan portfolio larger than $1million dollars. The empirical strategy was to create a sample of banks with more focus of agricultural lending than the average bank that lends to the sector in this region. The population of banks analyzed consists of all banks in the states Alabama, Florida, Georgia, Mississippi, and South Carolina with non-zero agricultural loans and average value of the ratio of agricultural to total loans larger than the mean of 2.7. There are

242 banks or 2,186 semi-annual observations from banks with any agricultural loans. The ratio of agricultural to total loans for this group is 8.8 and they have total assets of $129,354,100 on average, ranging from $6.5 million to $2.2 billion with banks lending on average of $6 million in agricultural loans annually, with a range from only $87,000 to $76 million.

Table 1. Mean differences per bank by ENSO event,

	Banks with nonzero agricultural portfolio and a ratio of agricultural to total loans ratio bigger than the mean for that group			Banks with agricultural portfolio bigger than one million and a ratio of agricultural to total loans bigger than the mean for that group		
	Neutral	El Niño	La Niña	Neutral	El Niño	La Niña
Percentage of banks reporting most of their portfolio consists of loans < 100K	37	33	27***	37	33	27***
$'000 charge offs (ytd) on loans& leases secured by farmland	9.4	8.4	3.12***	9.41	8.34	3.12**
$'000 charge offs (ytd)on loans for agricultural production & other loans to farmers	17.9	29.8*	24.4			
$'000 recoveries (ytd) on loans & leases secured by farmland	2.5	3.7	2.9	2.48	3.7	2.92
$'000 recoveries (ytd) loans for agricultural production and other loans to farmers	4.9	5.7	4.4			
$'000 real estate loans secured by farmland	5,854	7,298***	9,344***	5,854	7,298	9,344*
Number of loans less than $100,000 secured by farmland	20.4	25.2*	36.6***	20.4	25.2	36.6***
Number of loans outstanding in 100,000-250,00 range secured by farmland	6.22	9.17***	14.21***	6.2	9.2	14.2***
Number of loans outstanding in 100,000-250,00 range secured by farmland	3.21	5.07***	7.68***	3.2	5.1**	7.7***
$ value of loans less than $100,000 secured by farmland	638	819**	1,221***	638	819	1,222***
$ value of loans in $100,000-250,000 range secured by farmland	790	1,161***	1,825***	790	1,161	1,825***
$ value of loans in $250,000-500,000 range secured by farmland	938	1,460***	2,323***	938	1,460***	2,323***
Delinquency 1-3m on loans secured by farmland	53	43.6	42.4	66.23	57.26	78.7
Delinquency 1-3m on loans secured by farmland	66.2	57.3	78.7	18.9	12.2**	19.5
Delinquency >3 months on loans secured by farmland	18.9	12.2	19.5			

*** the mean difference is statistically significant at the 1 percent level
** the mean difference is statistically significant at the 5 percent level
* the mean difference is statistically significant at the 5 percent level

For those 337 banks providing agricultural loans larger than $1 million, the average value of the ratio of agricultural to total loans is 5.1%. The banks with a ratio above this average constitutes an additional subsample we analyze that consists of 143 banks or $1,133 annual observations with 5 years of data per bank on average. For this subgroup, the mean ratio of agricultural to total loans is 13.3% and the average size of total assets is $8,572,667.

4. Results

Differences in means analysis are presented in Table 1 and they show that ENSO events have some impact on the number and value of loans that banks give but minimal impact on the loan portfolio performance of banks with above average agricultural lending in the South-eastern Region. The cleanest results are those loans secured by farmland because these are most likely to be loans to farmers in crop production, which is more vulnerable to climate variability.

The results show that fewer banks are likely to define themselves as serving mostly small agricultural producers in a La Niña (27%) year compared to neutral year (37%) suggesting shift away from small and to larger production units. For loans secured by farmland charge-offs are three times lower in a La Niña year ($3,100 on average per bank) compared to a neutral year ($9,400). This charged off value is relatively small economically but statistically significant nevertheless. The mean difference between an El Niño and a Neutral year for loans secured by land and leases to farmers is not statistically significant. However, the differences between charge offs on all agricultural loans and loans to farmers is statistically significant and in an El Niño year banks charged off $29,000 compared to $17,900 charged off in a neutral year.

The results show a statistically significant increase in lending in terms of both numbers of loans disbursed and their values during non-neutral years. This is valid for all categories of loans: less than $100,000, $100,000-$250,000, $250,000-500,000. Banks might have lent more in both types of non-neutral years but for different reasons. During a La Niña year, the weather is beneficial to many crops and farmers may need to buy more inputs to take advantage of better weather conditions and produce at a higher level. This is illustrated in the smaller loans category for less than $100,000, where on average banks funded 80% more small loans (36.6) in La Niña years compared to Neutral years (20.4). In the next two categories of bank loan size, banks lend during La Niña years more than double the rate in Neutral year. Unlike La Niña year the difference in funding in El Niño year is statistically significant only at the 10 percent level and is much smaller at 24% higher or 5 more loans on average in the first category. Although statistically significant at the 1 percent level this difference is less than 50 % increase. Additional borrowing in El Niño that is likely to cause damage to crops grown in the Southeast and might have forced farmers to manage their business risk during these years. This result may also be due to loan restructuring.

The rate of delinquency on loans delinquent between 30 and 90 days and on loans delinquent for more than 90 days is not statistically different across the ENSO event. The last three columns of Table 1 also summarise the comparison means for the portfolio of banks with agricultural loans larger than one million and a ratio of agricultural to total loans of 5.1 percent. It confirms previous results in that fewer banks would report themselves as having agricultural loan portfolio mostly to small farmer in La Niña year and that the charge offs in La Niña year are three time smaller than those during a Neutral year. The difference for this group is that banks lent more in only La Niña compared to Neutral year in all small loan categories but lent more only in the $250,000-500,000 loans in the El Niño year. The results also show that defector default (delinquent loans >90 days) on loans secured by farmland is smaller in El Nino. Since we expect more losses then, the result may be due to more loans needing to be restructured. This result is also consistent with Ewing, Hein and Kruse (2005) who find improvement in portfolio performance after a severe event.

The results above are also confirmed by standard econometric analysis, such as fixed effects and censored variable regression. The impacts of inter-annual climate variability on banks serving agricultural producers are weaker than the impacts on agricultural production which suggests that only a small part of agricultural production risk is transmitted to financial institutions. This may be in part due to efficient financial management practices of both the banks and the producers and to the production supports that mitigate the climate risks. Future research may improve the results by (1) using continuous measure of the seasonal ENSO signal in the region and (2) by narrowing the geographical areas served by the banks in the sample and analyzing a particular bank's performance by climate measures most relevant for the crops grown in that area it serves.

5. Conclusion

In this paper, we explored the possibility that agricultural loan portfolios of banks serving agricultural producers were affected by inter-annual climate fluctuations. We find that La Niña years are associated with more and larger loans and, on average, three times lower charge-offs in banks focusing on agricultural lending in the Southeastern USA. Viewed through the prism of the emerging literature on bank lending and catastrophic risk events, these findings seem to suggest that ENSO events impact may be relatively small because farmers utilize well existing insurance mechanisms and take advantage of government disaster relief payments.

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