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Financing Constraints and Access to Credit in a Postcrisis Environment: Evidence from New Farmers in Alabama

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We use survey data to study the degree to which new farming operations in Alabama were financially constrained after the 2008 financial crisis. Next, we control for farmers' self-selection out of the credit market and identify which farmers were able to secure loans during the period of 2009–2010. The results show that new farmers that started any part of their operation after 2005 were financially constrained but no evidence that their financing constraints were affected by the crisis. As expected, we find that lending was collateral-driven, although lenders also considered farmers' profitability and cash flows.

Key Words: financing constraints, access to credit, financial crisis, beginning farmers

JEL Classifications: G31, Q12, Q14

Financial market crises translate into limited access to credit with negative consequences for many agricultural producers. We study how the 2008 crisis affected agricultural producers' access to credit. Agricultural banks were less affected because they are small compared with nonagricultural banks. Because previous financial crises have affected agricultural lenders significantly, this time they were in a better position to manage risks (Briggeman, Gunderson, and Gloy, 2009; Ellinger, 2009). Nationwide, agricultural sector profitability peaked in 2008 but has decreased since. Consequently, although the share of problem loans of agricultural lenders remains less than Fifty percent of that of nonagricultural banks, delinquencies have been increasing (Briggeman, 2011; Ellinger, 2011). Increased delinquency rates typically lead to elevated collateral requirements with a potential to worsen access to credit for agricultural producers, especially among more vulnerable groups (Briggeman and Zakrzewicz, 2009).

This article sets out to determine the impact of the financial crisis on access to credit for new farming operations and to determine which farmers got credit in the postcrisis environment. The existence and magnitude of credit constraints for agricultural producers are nonnegligible. Nationwide, Briggeman, Gunderson, and Gloy (2009) estimate that the value of production is 3% lower in credit-constrained farm sole proprietorships compared with those that are not credit-constrained. Credit constraints have also been found in agricultural

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cooperatives and have been shown to affect land values (Chaddad, Cook, and Heckelei, 2005; Mishra, Moss, and Erickson, 2008).

If the financial crisis has affected farmers' ability to borrow, then new operations should be most affected, because they typically lack capital, experience, or both. Even with the introduction of special support programs, beginning farmers continue to face production and financing challenges and remain disadvantaged relative to the general farmer populations.[1] Previous studies have found that new operations are financially constrained and that, for younger (and high debt) farmers, the financial constraints are affected by the business cycle (Barry, Bierlen, and Sotomayor, 2000; Bierlen and Featherstone, 1998). This group is most vulnerable because banks elevate collateral requirement when delinquencies are on the rise and new farmers typically have less assets to offer as collateral. Moreover, even when lenders make lending decisions based not on collateral, but on projected performance, younger farmers are still at a disadvantage because they have lower return on assets compared with more established operations (Mishra, Moss, and Erickson, 2009).

Even before the financial crisis, farmers in Alabama, especially small sole proprietors, were financially constrained and used off farm spousal income to invest on the farm (Hartarska and Mai, 2008). In this article, we use survey data collected in the fall of 2010 from new operations in Alabama to study the degree to which new operations were financially constrained during the post-crisis period and to identify the factors affecting access to credit in the 2009–2010 period.

The remainder of the article is organized as follows. Section 2 presents the conceptual framework and empirical specifications. Section 3 briefly describes the data. Section 4 summarizes the results. Conclusions are offered in Section 5.

[1] An overview of the state of beginning farmers and ranchers is presented in recent special issue of *Choices* 26,2(2009).

Analytical Framework and Empirical Specifications

The analysis consists of first establishing if new operators have financing (or liquidity) constraints and whether these constraints have became more severe in the post-crisis period. Next, we identify the factors affecting farmers' ability to obtain credit to gain insights into possible ways to alleviate existing financing constraints.

The first part of the analysis is based on the literature on asymmetric information in credit markets. According to this literature, in the presence of high transaction costs and asymmetric information, loans are either rationed or available at a premium (Jensen and Meckling, 1976; Stiglitz and Weiss, 1981). In such circumstances, external and internal finance are no longer substitutes and investment in firms facing high asymmetric information costs such as most new farming operators is constrained by the availability of internal funds (Myers and Majluf, 1984). Because financial constraints do not affect all farmers uniformly, the extent of effective financing constraints that different operators face provides information on the ability of the financial system to cater to their financial needs in that time period.

Financial constraints are important in farming because farming is capital-intensive and, although farmers do not like debt, many operations, especially the newer ones, have limited ability to undertake profitable investment with only own funds. The lack of equity markets and seasonality of cash flows makes access to loans crucial and the ability of credit markets to alleviate financing constraints very important. Moreover, limited diversification opportunity and supply shocks lead to large variations in farmers' net worth and profitability further restricting their investment.

The financing constraints approach pioneered by Fazzari, Hubbard, and Petersen (1988) tests for differences in sensitivity of investment to internal funds in firms with different levels of asymmetric information costs by comparing subsamples defined according to priors that characterize constrained and unconstrained firms (e.g., new and established

farms). For each subsample, a reduced-form investment equation is estimated where investment is modeled as a function of internal funds and investment opportunities determined from a variety of theoretical perspectives (Hubbard, 1998). A statistically significant difference in investment sensitivity to internal funds between subsamples indicates that one group is more credit-constrained. Recently, Carreira and Silva (2010) provided an extensive review of the vast empirical literature on the subject. In particular, they argue that numerous studies find that younger firms are more financially constrained than established firms.

We first estimate a reduced-form (change in) investment equation for the 2008–2010 period for two groups of Alabama operators: the new (started any part of their operation between 2000 and 2004) and the newest (started after 2005). In this framework, we test for differences in financing constraints before and after the crisis of 2008 for each group. Following Hartarska and Nadolnyak (2008), investment is modeled as a function of operators' investment opportunity and internally generated funds (typically defined as revenues minus expenses) to which we add change in liquidity since 2008 as well as farm and operator controls.[2] The estimated model is of the form:

$$\begin{aligned}\Delta\, Investment_i = {} & \beta_0 + \beta_1 Inv\ Opportunity_i \\ & + \beta_2\ Cash\ Flow_i \\ & + \beta_3\ Change\ in\ Liquidity \\ & \quad since\ 2008_i \\ & + \Sigma\beta_K Controls_i + e_i\end{aligned} \tag{1}$$

where Δ *Investment* is the percentage change in the value of fixed assets, *Inv Opportunity* is a measure of investment opportunity proxied by the change in the return-on-assets ratio (ROA), *Cash Flow* is the cash flow measure that proxies for available internal liquidity, *Change in Liquidity since* 2008 is a dummy that measures the impact of the 2008 crisis on liquidity and takes the value of one if, after 2008, operators kept larger proportion of cash and liquid assets compared with before 2008.[3]

Investment in farms differs from that in nonfarm firms because, for farmers who own their land, the land is the largest part of fixed investments. Some operators may not be landowners, and landowners may not be working on their farms. The dependent variable measuring change in fixed assets may contain possible measurement error because the survey did not collect data on land ownership and increase (or decrease) in land value may drive changes in the value of fixed assets. Furthermore, when farmers cannot obtain a loan to invest in fixed assets, they could lease the land, and there will be no change in investment, but we argue that even if this is true, it will be a dependent variable measurement error that does not lead to biased coefficient estimates.[4]

We also note that the majority of farm operators in Alabama are in livestock production (cow and calf) or poultry with these groups representing 68% of all farm sales. For such operations, land is a less important capital asset compared with land in row crop-producing operations. In our sample, row crop producers are only 4%. Thus, we include farm operation types as explanatory variables. We also capture variation in land assets size by including farm assets classes measured at the time the operation was started. We also control for spatial land value differences by including the average county-level price of land. During the study period, there were no recorded drops in the price of agricultural land values, so possible bias is likely one-sided, increase in the value. Because the possible measurement error is in

[2] Advantages and disadvantages of this approach are discussed in Hubbard (1998). Empirical findings and specification issues are discussed in Carreira and Silva (2010). Theoretical justifications are further offered by Cleary, Povel, and Raith (2007).

[3] Change in capital assets rather than the more typical investment level scaled by capital stock is the dependent variable because it was not possible to ask farmers about the value of their investment and their capital (or we would not have had sufficient number of returned surveys to conduct this analysis). For Alabama, for example, there are 149 observations from farms in the 2009 Agricultural Resource Management Survey data and only seven started any part of their operation since 2005.

[4] See Cameron and Trivedi (2005), p. 913.

the left hand side variable, it will be swept away in the error term.

In this class of models, proper measurement of investment opportunities and cash flow (liquidity) are important. Without investment opportunities, operators would not invest even if they had cash. Cash flow (liquidity, net worth) and investment opportunity effects must be clearly separated to ensure that the *Cash Flow* variable of interest here captures the effect of internally generated funds only. We measure available liquidity by asking farmers what percentage of their revenue they keep in liquid assets.

In the literature, investment opportunity is a measure of the expected value of future profits or discounted value of income from one extra dollar of investment. In large firms, this is typically the average *q,* which, under certain conditions, serves as a proxy for marginal *q* (see Hayashi, 1982, for a detailed description of average, marginal, and fundamental *q*). Applications of the *q* approach to large agricultural producers have included various measures of the fundamental *q,* e.g. Bierlen and Featherstone (1998). In small firms/farms, investment opportunity is measured by (previous year) employment growth, sales growth, or indicators of current profitability such as ROA (see Carreira and Silva, 2010). We measure investment opportunity with three categories for a change in ROA: increase, decrease, and no-change as the base.[5]

Empirical evidence shows that farmers' off-farm investment is affected by entrepreneurial and operation characteristics (Mishra and Morehart, 2001). Because money is fungible within the household, these factors may also affect farm investment. We include controls for entrepreneurial experience and experience in farming before starting this operation, whether the operator or the spouse work off farm to capture possible access to external funds, the age of the operation to capture experience, and gender of the entrepreneur to capture differences in preferences for investment. We also include the proportion of income coming from farming to control for hobby farming as well as the proportion of sales coming from various types of farming, e.g. livestock (largest group and serving as the base), poultry, specialty crops, government payments, and others.

Although panel data would be preferable, such data are too costly to collect, especially given the relatively small population of new operators in Alabama and the difficulty of soliciting financial information and also because of large expected attrition resulting from a high percentage of failure of new enterprises. Instead, farmers were asked to provide information on changes in the key variables during the period of 2008–2010, which partially compensates for the lack of panel data. Nevertheless, we interpret the results cautiously and argue that they are valid for the state of Alabama and the study period.

We next determine which farmers were able to overcome their financing constraints and secure loans. To answer this question, we estimate a probit model where the dependent variable takes the value of one if the farmer received a loan. Because some operators may self-select out of the market if they believed they would not be approved even if they applied, we need to control for farmers' self-selection. Thus, we use a Heckman probit model as described by Van de Ven and Van Pragg (1981). The unobserved relationship is

$$(2) \qquad y_j^* = x_j\beta + u_{1j}$$

where y_j* is the credit received by operators and x includes variables affecting banks' decisions to lend. However, instead of y_j*, we only observe a binary outcome (received or did not receive loans), which is captured by a probit equation

$$(3) \qquad y_j^{probit} = \left(y_j^* > 0\right)$$

The dependent variable for operator *j* is observed only if we observe a loan application from that operator. Thus, the selection equation (applied or did not apply for a loan) is

[5] Thijssen (1996) shows that investment and financing decisions are independent, and farmers' capital investment decisions are consistent with static expectations suggesting a simple investment opportunity measure is appropriate.

$$y_j^{select} = z_j\gamma + u_{2j} > 0 \tag{4}$$

where

$$u_1 \sim N(0;1)$$
$$u_2 \sim N(0;1)$$
$$\text{corr}(u_1;u_2) = \rho$$

and the log likelihood for this model is

$$\begin{aligned} LnL = & \sum_{\substack{j\in S \\ y_j \neq \mathbf{0}}} w_j ln\{\mathbf{\Phi_2}(x_j\beta, z_j\gamma, \rho)\} \\ & + \sum_{\substack{j\in S \\ y_j \neq \mathbf{0}}} w_j\, ln\{\mathbf{\Phi_2}(-x_j\,\beta, z_j\gamma, -\rho)\} \\ & + \sum_{j\neq S} w_j\, ln\{1 - \Phi(z_j\,\gamma, -\rho)\} \end{aligned} \tag{5}$$

where S is the set of observations for which y_j is observed, $\mathbf{\Phi_2}(.)$ is the cumulative bivariate normal distribution function (with mean [zero 0]'0), $\Phi(.)$ is the standard cumulative normal, and w_j is an optional weight for observation j.[6]

The explanatory variables in Equation 3 include factors affecting the decision to extend a loan by a lender. This decision is based on evaluation of project profitability, collateral, and borrower creditworthiness. To achieve identification in Equation 4, we need at least one instrument in z_j in addition to the explanatory variables in Equation 3; otherwise, identification would be only by functional form. Such an instrument needs to affect the choice to apply or not to apply for credit (Equation 4) but not lenders' decisions to lend (Equation 3). Because farmers who do not believe they can get a credit are less likely to apply, we use self-evaluation for access to credit as an instrument that likely will affect their decision to apply for a loan but should not affect a lender's decision to grant the loan. In particular, we use two instruments: z_1 is a variable measuring farmers' perceived lack of access to credit from banks and financial institutions and z_2 is a variable measuring farmers' perceived lack of access to credit from the Farm Credit System institutions.

The existence and value of collateral is likely the main determinant for loan approval (Klinefelter and Penson, 2005). Collateral is needed because lenders do not have perfect knowledge of borrower credibility and investment projects. To decrease information asymmetry, in addition to requiring collateral to guard against default, lenders collect information about borrowers and their projects. Boucher, Carter, and Guirkinger (2008) show that asymmetric information can result not only in typical quantity rationing, but also in "risk rationing" whereby farmers are able to borrow but only under high-collateral contracts, which lowers their expected well-being. Therefore, farmers' ability to offer collateral will affect their chances to get loans. Because we could not ask farmers about the value of collateral they can potentially offer for a loan, we asked if farmers considered their availability of collateral an obstacle to obtaining loans and use this variable in the main probit Equation 3.

To control for possible land price effects, we include county-level land values. We also include farm age to control for availability and quality of financial statements and a growth dummy to proxy for farm profitability because agricultural lenders are increasingly using cash flow rather than collateral-based lending (Klinefelter and Penson, 2005). The growth dummy takes the value of one if the enterprise grew (experienced employment growth) and zero otherwise. We also control for operators' income diversification and creditworthiness by including the percentage of income coming from farming and whether the operator works off the farm because banks also use such information in lending decisions (Berger and Udell, 1998).

To properly identify the effect of credit constraints on investment, variables that affect credit but not investment should be included in the credit supply Equation 3. In our model, this variable is the growth dummy. The assumption is that change in ROA used in the investment Equation 1 captures investment opportunities, whereas the dummy variable used in Equation 4 provides information only on whether growing firms were funded or not.

Data

The data come from a survey of new farmers in Alabama conducted by the Alabama National

[6] This model is estimated with the heckprobit command in Stata.

Agricultural Statistical Service (NASS) in October 2010. The survey was designed to collect unique financial, business, and demographic information from new operators in the state.

New operators were defined as farmers in Alabama who began any part of their operation since 2005 based on the 2007 Agricultural Census data.[7] This classification encompasses farms that started a new operation, e.g. an existing cow-calf production that started a small feedlot. Questionnaires were sent to all farmers comprising the population of 1,639 with one reminder letter sent 2 weeks after the first questionnaire and follow-up phone calls made by NASS personnel.[8] The result was 393 returned questionnaires, which represents an effective response rate of 25.9%.

Although the questionnaires were sent only to operators identified by the NASS as ones that began to operate any part of their operation in 2005 or later, 140 of the respondents indicated 1 year before 2005 as a year they started their operation.[9] However, over 100 of these indicated 1 year after 2000 and thus fit the definition for new farmers by the Farm Credit Administration for 10 years or less in farming. We use this data feature to our advantage to study if there are financing constraints for the two groups of new farmers. The "newest" operator group includes those who started their operation in 2005 or later, which was the original target of the survey, whereas the "new" operator group includes those operators who, in the survey, indicated that they started any part of their operation between 2000 and 2004. The resulting sample with all variables needed for the analysis consists of 305 observations.[10]

Because, during the survey, a number of farmers called and indicated they had problems accessing loans, we expected that most credit constrained farmers would return the questionnaire. Comparison of the survey respondents by sales categories described in our survey is presented in Table 1, panels A and B. The table shows that farmers who responded match surprisingly closely the general population of farmers in Alabama. In particular, roughly half of farmers in Alabama (58%) and in our sample (48%) had sales less than $5,000. The rest of the categories match relatively closely except for the categories with sales between $10,000 and 25,000 ($100,000–250,000) being underrepresented (overrepresented) in the survey. The overrepresentation could be the result of the fact that these are the farmers with a new operation or because these were the most credit-constrained new operations, or perhaps both. The majority of farms in Alabama are in livestock and poultry (58%) and, in our sample, these farmers are somewhat overrepresented at 68% of the sample, whereas those in row crops are underrepresented (4% vs. 14% in Alabama). We note these differences when describing our variable choice and possible biases.

Investment, measured by the change in the value of fixed assets, has both positive

[7] To reach the target population of new farmers, it was only possible to use data from the 2007 Agricultural Census because the NASS list sampling frame does not keep any control data that correspond to date of operation inception. There is simply no reasonable way to identify and survey the population of farmers based on their inception day.

[8] The Census question was "In what year did the operator begin to operate any part of this operation?" The population was identified as all farmers who entered 2005 or later; imputed records were excluded and only the first operator from the operation cell (k0930) was used (operators 2 or 3 were ignored); inactive records were removed. Only operators with total value of products sold, who met the minimum threshold of $1,500 were part of the net population of 1,639.

[9] The NASS identifies three reasons why the actual operation start-up date differs from the target after 2005. Specifically, these are: 1) incorrect information provided to the 2007 Census from which the sample was targeted; 2) a different person (senior operator, other partner, spouse) completed the AU survey vs. the Census; and 3) misinterpretation of the question. Some respondents might have interpreted this question as when anyone in the family began the current farm operation as opposed to the year the target (intended respondent) began operating the farm.

[10] The resulting "new" farmers group likely misses possible operations that were started between 2002 and 2005 because they were not explicitly targeted by the NASS and thus may mischaracterize actual financing constraints or access to loans for Alabama farms expanding or starting their operations during this period. Thus, we interpret with caution the results relevant to the group of "new" farmers.

Table 1. Comparison between Farmers in the State and in the Sample

Panel A. Percentage of Farms with Sales in a Category			
	Alabama Farms (%)	Sample Since 2005 (%)	Full Sample (%)
Row crop	14	4	4
Livestock	48	52	55
Poultry	10	16	13
Fruit, vegetable, and horticulture	8	8	8
Government agricultural payment	3	8	7
Other	18	13	14
Total	128		
Panel B. Percentage Farms by Sales Category			
	Alabama Farms (%)	Sample Since 2005	Full Sample
Less than $5,000	58	45	48
$5,000–$9,999	12	10	13
$10,000–$24,999	13	8	7
$25,000–$49,999	5	5	4
$50,000–$99,999	3	5	4
$100,000–$249,999	2	13	10
$250,000–$499,999	3	2	2
$500,000–$999,999	2	0	0
$1,000,000 or more	3	0	1
No sales		11	12
Total	100	99	101

Source: 2007 Census of Agriculture, authors' calculations.

(investment) and negative (disinvestment) values. The question we use to construct this variable first defines fixed assets as land, buildings, machinery, vehicles, equipment, and breeding livestock and then asks by what percent has the net value of all fixed capital assets changed from 2008–2010 to measure the value of investment as percentage of fixed assets.[11]

Because land is part of a fixed investment, there is a concern that measured increases in investment may be the result of change in land prices even if there was no real investment change. To alleviate measurement errors as discussed in the Methods section, we include the county-level price of land from the 2007 Census of Agriculture to reflect possible differences in the value of the assets. Second, we add the value of assets at the beginning of operation to control for the size of beginning asset values. This variable also corrects for the overall scale effects. Because the largest group of farmers in Alabama consists of livestock (calf and cow) and poultry producers, ownership of land would cause some measurement error but, for Alabama, the measurement error is likely smaller compared with what it may be for a major crop-producing region. Furthermore, because potential measurement errors are in the dependent variable, we expect valid coefficient estimates with likely high standard errors. Although it is possible that some Alabama farmers leased rather than bought land, we were unable to measure the use of leasing by operators. Although the average disinvestment of the newest operations is 1%, whereas that of new ones is 2%, this difference is not statistically significant as shown in Table 2, which contains summary statistics of all variables.

The cash flow variable is measured by the percentage of revenue minus costs kept in liquid assets. Table 2 shows only few statistically

[11] The specific question was "Capital assets are land, buildings, machinery, vehicles, equipment, and breeding livestock. From 2008 to 2010, by what percent did the net value of all your capital assets change?"

Table 2. Summary Statistics

Panel A. Variables in Investment Equation 1

	Newest	Newest	New	New
	Mean	Standard Deviation	Mean	Standard Deviation
Investment				
Investment (% change in net fixed assets)	–1.0	15.3	–2.0	13.9
Cash flow (% liquid net revenue)	10.3	23.9	11.9	26.8
Keep extra liquidity (share 2008)	0.22	0.42	0.21	0.41
ROA increase (share)	0.10*	0.30	0.05	0.22
ROA decrease (share)	0.53	0.50	0.58	0.50
Female (share)	0.14	0.35	0.15	0.35
Experience in farming (in years)	8.5***	12.5	13.5	13.7
Experience in business (years)	13.0	14.4	10.5	14.3
Income from Farming (%)	17**	29	9	21
Work off farm (share)	0.70	0.46	0.61	0.49
Spouse works off farm (share)	0.48	0.50	0.43	0.50
Operator age (years)	52	13	54	12
Operation age (years)	4*	1	15	12
Education				
Graduated high school (share)	0.23	0.42	0.26	0.44
Some college/(share)	0.30	0.46	0.37	0.48
College graduate (share)	0.19	0.40	0.21	0.41
Some graduate school (share)	0.04	0.21	0.03	0.16
Masters degree or higher (share)	0.16**	0.37	0.09	0.28
Gross sales in 2009				
Row crop (sales, % of total)	4	19	5	20
Poultry (sales, % of total)	15***	34	4	19
Specialty crops (sales,% of total)	7	24	9	27
Government payments (sales % of total)	8	26	5	20
Have income only from government payment (%)	13	32	15	32
Livestock (sales % of total)	51**	47	62	45
Operators race				
White (share)				
Black (share)	0.07*	0.25	0.13	0.34
Other (share)	0.04	0.19	0.03	0.16
Beginning assets (shares)				
$5,000–$9,999	0.05***	0.23	0.21	0.41
$10,000–$24,999	0.10	0.31	0.12	0.33
$25,000–$49,999	0.11	0.32	0.13	0.34
$50,000–$99,999	0.08	0.27	0.11	0.32
$100,000–$249,999	0.21	0.41	0.19	0.39
$250,000–$499,999	0.13***	0.33	0.02	0.13
$500,000–$999,999	0.11***	0.32	0.03	0.16
$1,000,000 or more	0.05**	0.23	0.01	0.09
County land value (in 2007 $)	2,543	644	2,540	647
Number of observations (Equation 1)	201		104	

Table 2. Continued

Panel B. Variables in the Credit Supply with Selection Equations (3&4)

	Newest Farmers		New Farmers	
	Mean	Standard Deviation	Mean	Standard Deviation
Credit				
Got loans (share)	0.26	0.44	0.19	0.39
Applied for loans (share)	0.38**	0.49	0.25	0.44
No access to FCS loans (share)	0.21	0.41	0.24	0.43
No access to FI loans (share)	0.06	0.23	0.08	0.27
Dummy if operation grew	0.30	0.46	0.44	0.50
Collateral				
Not an obstacle (share)				
Minor obstacle (share)	0.21	0.41	0.24	0.43
Somewhat obstacle (share)	0.27**	0.45	0.17	0.37
Major obstacle (share)	0.11	0.31	0.15	0.35
Number of observations (Equation 3)	208		93	

Statistically significant difference in means *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
ROA, return-on-assets ratio.

significant differences between the two groups in the sample. To explore if there is a possible effect on investment of liquidity that farmers kept, we asked "Compared to years prior to the 2008 financial crisis, do you now keep larger amount of cash and liquid assets (bank accounts, CDs etc)?" The results do not show statistically significant difference across the two groups with only 22% in each group reporting they kept higher levels of liquidity after the crisis.

Opportunity cost of capital is measured by three dummy variables. The first takes the value of one if operations' ROA has increased in the 2008–2010 period and zero otherwise, and the second dummy that takes the value of one if ROA has decreased during the period and zero otherwise. A third dummy takes the value of one if ROA has not changed and is the omitted dummy variable serving as a base for comparison. Table 2 shows that increase in ROA was 10% among the newest operators, which is double the 5% increase in ROA among the new operations, and this difference is statistically significant at the 10% level.

Among the control variables, we find few statistically significant differences across the groups. The newest farmers have fewer years of previous experience in farming (8.5 vs. 13.5 years) and higher proportion of their income coming from farming (17% vs. 9%). Statistically significant differences indicate that, compared with the group of new operators, more farmers in the newest group have a Master's degree or higher (16% vs. 9%), fewer have sales from livestock production (51% vs. 62%), and fewer are black (7% vs. 13%). Fewer of the newest operators inherited the farm (14% vs. 24%) and more purchased it (19% vs. 12%). Most interestingly, although only 5% of the operators in the new group had beginning assets of $250,000 or more, 29% of the newest operations fall within this range of beginning assets. It is possible that many of the newest entrants in farming bought land to diversify their assets in unstable financial markets. However, because a much higher percentage of this group's income comes from farming, it is possible that the high returns to farming in the past few years had attracted new entrants.

Summary statistics for the variables in the credit offer Equation 4 are also presented in Table 2. There is a statistically significant difference between percentage of credit applications by the new and by the newest farmers (25% vs. 38%, respectively).

To evaluate how collateral requirements affected access to loans, we asked farmers if collateral requirements were an obstacle to obtaining loans.[12] The answer choices were "no obstacle," which we use as a base, whereas the obstacles were classified as minor, moderate, and major. We find statistically significant difference between the two groups only in the moderate category: 27% vs. 17% for the newest and the new farmers, respectively.

The instruments for the loan application Equation 4 come from two questions regarding farmers' perceived access to credit. We created a dummy variable equal to one if farmers stated that they do not have access to loans from the Farm Credit System (z_1) and from Banks and Financial Institutions (z_2).[13] As Table 2 shows, there is no statistically significant difference in access to credit between the new and the newest group.

Results and Discussion

Liquidity Constraints

Table 3 presents the results from the regression of investment sensitivity to cash flow and investment opportunity. It contains three models with three samples, the first with operators who started any part of their operations after 2005 (the newest group), the second with those who started between 2000 and 2005 (the new group), and the last regression uses all observations. The overall fit of these models explains from one-fourth to one-third of the variation in the data.

The results indicate that, as expected, investment opportunity affects investment by new farming operations in all specifications. Compared with farmers with a no change in their ROA, investment in operations with increasing ROA is higher by 12% and that in operations with decreasing ROA is lower by 6%. These results are the same for both groups of farmers.

We find that investment in the group of newest operators depends on internal cash flows (liquidity) with 10% higher liquidity associated with approximately 1% higher investment. This relationship is not statistically significant for the subsample of farmers who started their operation before 2005. We observe that the standard error is relatively small (although not small enough to make it statistically significant) and this may be attributable to a possible measurement error in the dependent variable, which would inflate the standard error.[14] Nevertheless, lack of statistical significance for this group is in line with Bierlen and Featherstone (1998) who found liquidity constraints in only young operators (although their group of young does not necessarily correspond to our "newest" farmers). It is also in line with the empirical literature on liquidity constraints, which shows that newest firms are most liquidity constrained (Carreira and Silva, 2010).

The dummy capturing the change in liquidity (*Extra Liquidity*) kept by operators since 2008 is not statistically significant in any of the specifications and the standard errors are relatively large. We interpret this result to indicate that although newest farmers had liquidity constraints, these constraints were not affected by the 2008 crisis. These results would need to be interpreted with caution because they are valid only for our sample of Alabama operations and are the result of a cross-sectional data analysis so the time aspects of the post crisis liquidity (2009 vs. 2010 needs for example) cannot be captured well with such data. Nevertheless, we assume that, if at any time after

[12] Specifically we asked, "Access to financing may be a problem given the current economic situation. In order to identify barriers that limit access to financing, please rate the obstacles listed below as they relate to your current operation. Collateral requirements: [with choices] No obstacle, minor obstacle, moderate obstacle, major obstacle."

[13] We asked "If you were to need additional financing now, how difficult would it be to use: Loans from Farm Credit System (*First South Farm Credit, Alabama Farm Credit, Alabama AgCredit, AgFirst* etc.), and Loans from banks or financial institutions (CU, loan fund, etc.)." The answer choice "no access" was coded as one to create the dummy variables.

[14] It is also possible that as a result of our sample characteristics, we are missing constrained operators who started in 2000–2004 and this affects the result. We thank an anonymous reviewer for pointing this out.

Table 3. Reduced Form Investment Equation: Investment as a Function of Cash Flow, Investment Opportunities, Financial Crisis Impact, and Operator and Farm Controls, Ordinary Least Squares

	Newest	New	All
Constant	17.10*	–16.56	11.44
	(10.15)	(18.17)	(7.783)
Cash flow	0.111**	0.0112	0.0634*
	(0.048)	(0.0615)	(0.035)
Extra liquidity	2.812	1.656	1.563
	(2.665)	(5.333)	(2.097)
ROA increase	11.46***	12.08*	11.391***
	(3.460)	(6.500)	(2.889)
ROA decrease	–5.782**	–6.080*	–5.825***
	(2.448)	(3.474)	(1.901)
Female	–7.232**	–5.117	–7.62***
	(3.541)	(5.966)	(2.834)
Experience in farming	–0.0868	0.185	0.0117
	(0.0797)	(0.147)	(0.0671)
Experience in business	–0.0545	0.0931	0.00575
	(0.0807)	(0.119)	(0.0621)
Income from farming	–0.0544	0.0587	–0.0313
	(0.0602)	(0.0879)	(0.0473)
Off-farm work	–1.211	4.076	–0.341
	(2.845)	(4.505)	(2.215)
Off-farm work by spouse	0.916	–0.273	1.436
	(2.409)	(3.661)	(1.786)
Operator age	–0.088	0.105	–0.0361
	(0.115)	(0.173)	(0.0854)
Farm age	1.654	–0.0807	0.00686
	(1.287)	(0.165)	(0.118)
Row crops	0.089	–0.058	0.0512
	(0.061)	(0.045)	(0.0435)
Land value	–0.004**	0.004	–0.00136
	(0.002)	(0.003)	(0.00133)
Inherited	–7.208**	–5.388	–5.053**
	(3.057)	(3.635)	(2.087)
Purchased	–2.023	–3.418	–2.796
	(2.752)	(6.787)	(2.579)
Controls			
Operations type (% sales from operation)	Yes	Yes	Yes
Education	Yes	Yes	Yes
Beginning assets size	Yes	Yes	Yes
Observations	201	104	305
R^2	0.357	0.335	0.251

Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
ROA, return-on-assets ratio.

2008 farmers had to keep more cash, they answered yes to the question asking them about a change in liquidity since 2008.

Few other variables are statistically significant in the ordinary least squares model. We find that farmers who inherited, rather than purchased, their operation would have 7% lower investment for the newest and 5% for all farmers. In the group of newest operations, female operators had 7% less investment than male

operators. This result, combined with the relatively high age of operators and anecdotal evidence, suggests that the sample contains widows receiving an inheritance and disinvesting from farming. Off-farm work by the operator or the spouse and the percentage of income from farming are not associated with higher level of investment. We also find that experience in farming or in other business, operator age, education level, or race are not associated with differences in on-farm investment, contrary to findings for off-farm investment by farmers (Mishra and Morehart, 2001).

We find that $100 increase in land values is associated with approximately 3.8% disinvestment in farming, but this variable is statistically significant only in the first specification for the newest operations. These results suggest that relatively expensive land may promote leasing.

Access to Credit

Because our results suggest that financing constraints for new operators exist, we turn to the credit offer Equation 4 to determine what factors affected operators' access to credit. The results with the marginal impact coefficients are shown in Table 4. Two specifications are estimated—one with the subsample of operators who started since 2005 and one for all operators who started since 2000. We first test for self-selection out of the credit market by testing if a credit supply probit with self–selection is appropriate. The Wald test for independence of Equations 3 and 4 is rejected at the 1% level in both specifications confirming the presence of self-selection.

Table 4 presents the marginal impact from the probit model with self-selection. The first and second columns contain the results for applying and receiving credit for the full sample and the third and fourth columns present the results from applying for and receiving credit for the group of the newest farmers only. The results suggest that, for the full sample, those who thought they had no access to credit were 20% less likely to apply for it than the farmers who thought that they could get credit from banks and other financial institutions. The newest operators were even less likely to apply if they stated that they did not have access to loans as shown by the higher marginal impact of –0.266 (vs. –0.201).

Results from the application for credit (columns 1 and 3) show that lending to farmers remains collateral-driven. Compared with unconstrained farmers for whom collateral was not a problem, farmers for whom collateral was a minor obstacle to obtaining credit were 18% more likely to apply (14% for the newest group), and those who thought collateral was a major obstacle for them to get credit were 27% (or 18% for the newest group) more likely to apply for loans. That is, these farmers needed more credit but discovered (through applying) or knew that their collateral was a problem so they had to apply more often. Clearly, the newest farmers were experiencing more significant credit constraints because they were less likely to apply knowing they had no access, and their own insufficient collateral was more of a deterrent to application (14% and 18% for minor and major problems) compared with all farmers (18% and 27%, respectively).

Results from the credit supply equations (columns 2 and 4) show that the newest farmers were more likely to be denied credit if they had collateral problems compared with all farmers. Compared with farmers without collateral problems, newest farmers with moderate collateral problems were 11% less likely to be approved for credit compared with 6% for the full sample. Similarly, for the farmers for whom collateral was a major problem, these numbers are 21% and 16%, respectively.

We also find, however, that the youngest farmers who had growing businesses were 15% more likely to be approved for loans, whereas only 10% of all farmers with growth were approved. Overall, these results support the idea that, although collateral remains the major determinant of access to credit, business growth, especially for the newest operators, also factors in the lender's decisions, which is consistent with the trend reported in Klinefelter and Penson (2005).

We find that older operations were less likely to apply for loans. One additional year in business is associated with 0.6% and 6% lower probability of applying for credit for the all

Table 4. Probit Heckman for Receiving a Loan, Conditional on Applying: Marginal Effects by Newest and Full Samples

	Applied for Loans	Received Loans	Applied for Loans	Received Loans
Variables	Full sample	Full sample	Newest	Newest
No access to loans from Farm Credit Services	0.076		0.059	
	(0.066)		(0.079)	
No access to loans from banks and financial institutions	–0.201*		–0.266*	
	(0.117)		(0.141)	
Collateral is a minor obstacle to obtaining credit	0.175**	–0.024	0.139*	–0.020
	(0.069)	(0.044)	(0.083)	(0.054)
Collateral is a moderate obstacle to obtaining credit	0.098	–0.061*	0.106	–0.112*
	(0.066)	(0.035)	(0.079)	(0.062)
Collateral is a major obstacle to receiving credit	0.267**	–0.163***	0.181*	–0.205***
	(0.091)	(0.073)	(0.115)	(0.060)
Land values (2007 in $)	–0.016	–0.038	–0.059	–0.0.36
	(0.040)	(0.031)	(0.048)	(0.046)
Dummy growth	–0.035	0.101**	–0.005	0.1490**
	(0.054)	(0.042)	(0.007)	(0.058)
Operator age	–0.006*	0.0049	–0.064**	0.034
	(0.003)	(0.0036)	(0.028)	(0.022)
Income from farming	0.005***	–0.001	0.005***	–0.00066
	(0.001)	(0.001)	(0.001)	(0.0001)
Livestock production (% of farm income)	0.001**	–0.001**	0.002*	–0.0014**
	(0.001)	(0.001)	(0.001)	(0.0004)
Experience in farming	–0.00001	0.001	0.002	0.0008
	(0.0019)	(0.001)	(0.002)	(0.0015)
Off-farm work	0.136**	0.029	0.137*	0.011
	(0.061)	(0.029)	(0.071)	(0.045)
Observations	301	106	208	82
Wald χ^2 (10)	40.14			
Pseudo log likelihood (Prob > χ^2)	–225 (0.000)		–156 (0.000)	
Wald test of equation independence (Pr > χ^2)	10.34 (0.001)		154 (0.000)	

Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

and newest operations, respectively. Furthermore, 1% increase in income from farming is associated with 0.5% increase in probability of applying for a loan. Farmers with off-farm jobs were 13.7% more likely to apply for loans than farmers who did not work off the farm suggesting that income diversification strengthens farmers' confidence to seek loans. We also find that a 10-percentage point increase in income from livestock production is associated with a 1% higher probability to apply for loans and 1% higher probability of being denied a loan. This is a very small effect but it is consistent with observed problems in the market for protein production (Ellinger, 2011).

Conclusions

In this article, we set out to establish how the financial crisis of 2008 affected farmers' credit constraints and what factors contribute to the producers' access to credit. We focus on the most vulnerable farmers—those with a new operation or any part of their operation started in the past 10 years. Survey data from over 300 farmers from Alabama are used to estimate an investment equation linking investment to investment opportunity and cash flow (liquidity). In the literature on financing constraints, a significant cash flow coefficient indicates that internal and external funds are not perfect substitutes and is interpreted as evidence of credit (or liquidity) constraints.

In this context, we test for a relationship between investment and farmers keeping larger liquidity after 2008 as evidence of worsened credit constraints. We find that financing constraints for the newest operators (who started any part of their operations since 2005) with 10% higher liquidity is associated with approximately 1% increase in investment. However, we do not find evidence that the financial crisis worsened these financing constraints for new farming operations in Alabama.

We also identified factors affecting agricultural lenders' decisions to fund producers and found that collateral remains the main obstacle to obtaining loans. At the same time, we found that, in Alabama, farmers' profitability also factored in lending decisions and was relatively more important for the newest operations, consistent with the general trend observed by Klinefelter and Penson (2005).

Our main finding is that newest farmers remain financially constrained even if unaffected by the financial crisis itself. The survey data also show that most new farmers use multiple financial sources to start and expand their operations. Therefore, we believe that programs to encourage entrepreneurship on the farm and support the new generation of farmers remain relevant. For example, the new Farm Bill should continue to include USDA programs targeting beginning farmers and ranchers such as the pilot Beginning Farmer or Rancher and Socially Disadvantaged Farmer or Rancher Contract Land Sales Program that supports land purchase. In view of our results, help with down payment for direct farm ownership also seems relevant and should continue to be available through programs such as the Down Payment Loan Program and the Loan Fund Set Asides. Programs supporting asset building such as the Beginning Farmer and Rancher Individual Development Accounts Pilot Program, which matches farmers' own savings for farm-specific purchases, also seem useful in light of our findings. Future research may focus on evaluating these particular programs and, specifically, on how these programs may alleviate farmers' financing constraints and improve access to bank loans.

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References

Barry, P., R. Bierlen, and N. Sotomayor. "Financial Structure of Farm Business under Imperfect Capital Markets." *American Journal of Agricultural Economics* 82(2000):920–33.

Berger, A., and G. Udell. "The Economics of Small Business Finance: The Roles of Private Equity and Debt Markets in the Financial Growth Cycle." *Journal of Banking & Finance* 22(1998):613–73.

Bierlen, R., and A. Featherstone. "Fundamental q, Cash Flow, and Investment: Evidence from Panel Data." *The Review of Economics and Statistics* 80(1998):427–35.

Boucher, S., M. Carter, and C. Guirkinger. "Risk Rationing and Wealth Effects in Credit Markets: Theory and Implications for Agricultural Development." *American Journal of Agricultural Economics* 90(2008):409–23.

Briggeman, B.C. ""The Role of Debt in Farmland Ownership." *Choices* 26(2nd Quarter, 2011). Internet site: http://www.choicesmagazine.org/choices-magazine/theme-articles/farmland-values/the-role-of-debt-in-farmland-ownership.

Briggeman, B.C., M.A. Gunderson, and B.A. Gloy. "Financial Health of Agricultural Lenders." *American Journal of Agricultural Economics* 91(2009):1406–13.

Briggeman, B.C., C.A. Towe, and M.J. Morehart. "Credit Constraints: Their Existence, Determinants, and Implications for U.S. Farm and Nonfarm Sole Proprietorships." *American Journal of Agricultural Economics* 91(2009):275–89.

Briggeman, B., and C. Zakrzewicz. "Can the Ag Credit Survey Predict National Credit Conditions?" *Federal Reserve Bank of Kansas City Economic Review* 94(2009):93–110.

Carreira, C., and F. Silva. "No Deep Pockets: Some Stylized Empirical Results on Firms Financial Constraints." *Journal of Economic Surveys* 24(2010):731–53.

Cameron, A.C., and P.K. Trivedi. *Microeconometrics: Methods and Applications*. New York, NY: Cambridge University Press, 2005.

Chaddad, F., M. Cook, and T. Heckelei. "Testing for the Presence of Financing Constraints in U.S. Agricultural Cooperatives: An Investment Behavior Approach." *Journal of Agricultural Economics* 56(2005):385–97.

McFadden, D.T., and S. Sureshwaran. "Innovations to Support Beginning Farmers and Ranchers," *Choices* 26(2nd Quarter, 2011). Internet site: http://www.choicesmagazine.org/choices-magazine/theme-articles/innovations-to-support-beginning-farmers-and-ranchers/theme-overview-innovations-to-support-beginning-farmers-and-ranchers.

Cleary, S., P. Povel, and M. Raith. "The U-Shaped Investment Curve: Theory and Evidence." *Journal of Financial and Quantitative Analysis* 42(2007):1–40.

Ellinger, P. "Financial Markets and Agricultural Credit at a Time of Uncertainty," *Choices* 24,1(2009):32–35.

———. "Agricultural Banks Improve Profitability." *Farmdoc Daily*, October 28, 2011. Internet site: http://www.farmdocdaily.illinois.edu/2011/10/agricultural_banks_improve_pro.html.

Fazzari, S., G. Hubbard, and B. Petersen. "Finance Constraints and Corporate Investment." *Brookings Papers on Economic Activity* 1(1988):141–95.

Hartarska, V., and C. Mai. "Financing Constraints and the Family Farm: How Do Families React?" Paper presented at the Southern Agricultural Economics Association Annual Meeting, Dallas, TX, February 2–6, 2008.

Hartarska, V., and D. Nadolnyak. "An Impact Analysis of Microfinance in Bosnia." *World Development* 26(2008):2605–19.

Hayashi, F. "Tobin's Marginal q and Average q: A Neoclassical Interpretation." *Econometrica: Journal of the Econometric Society* 50(1982):213–24.

Hubbard, G.R. "Capital Market Imperfections and Investment." *Journal of Economic Literature* 36(1998):192–225.

Jensen, M., and W.H. Meckling. "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure." *Journal of Financial Economics* 3(1976):305–60.

Klinefelter, D., and J. Penson. "Growing Complexity of Agricultural Lending Decisions." *Choices* 20,1(2005):7–12.

Mishra, A., and M.J. Morehart. "Off-farm Investment of Farm Households: A Logit Analysis." *Agricultural Finance Review* 61(2001):88–101.

Mishra, A., C. Moss, and K. Erickson. "The Role of Credit Constraints and Government Subsidies in Farmland Valuations in the U.S.: An Options Pricing Model Approach." *Empirical Economics* 34(2008):285–97.

Myers, S.C., and N.S. Majluf. "Corporate Financing and Investment Decision When Firms Have Information That Investors Do Not Have." *Journal of Financial Economics* 13(1984):187–221.

Stiglitz, J.A., and A. Weiss. "Credit Rationing in Markets with Imperfect Information." *The American Economic Review* 71(1981):912–27.

Thijssen, G. "Farmers Investment Behavior: An Empirical Assessment of Two Specifications." *American Journal of Agricultural Economics* 78(1996):166–74.

Van de Ven, W.P.M.M., and B.M.S. Van Pragg. "The Demand for Deductibles in Private Health Insurance: A Probit Model with Sample Selection." *Journal of Econometrics* 17(1981):229–52.