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Risk and Incentives: A Not-So-Tenuous Trade-off

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A long-standing gulf exists between the theory of contract formation and the empirical evidence concerning the determinants of the type and terms of contracts. Although theory predicts a negative relationship between risk and effort incentives, the majority of empirical work finds a positive or no relationship (Prendergast, 2002). The risk implications of sharecropping agreements, relative to other contract structure alternatives, have long been analyzed in the contract theory literature (e.g. Johnson, 1950; Cheung, 1965; Stiglitz, 1974; Newberry and Stiglitz, 1979). These theoretical studies tend to focus on the risk-sharing benefits provided through a share contract, weighing them against transaction costs. Arguments against the risk-sharing motivations for contracts have been made in a number of papers by Allen and Lueck (1992, 1993, 1998, 1999, 2002). They argue that commodity, capital, and insurance markets are better equipped to address and mitigate the risks associated with agricultural production. Thus, the importance of risk in determining contract type and terms will be lower in areas or regions where such markets are well developed.

Empirical work on tenancy contract choice has provided mixed results in identifying the relationship between risk and contract choice (e.g. Akerberg and Botticini, 2002; Allen and Lueck, 1999; Fukunaga and Huffman, 2009; Paulson, Katchova, and Lence, 2010). Weaknesses in this empirical literature, however, abound. For instance, investigators often use weakly correlated proxies for riskiness and risk aversion, e.g., crop type as a riskiness proxy and wealth to proxy for risk aversion. Furthermore, with the exception of Rainey et al. (2005), most empirical studies focus on characteristics of the tenant while ignoring characteristics of the landowner.

Huffman and Just (2004) identify five stylized facts that have emerged from the empirical literature on land tenancy. Among these are 1) crop share (cash rent) contracts tend to dominate in developing (developed) areas, 2) crop share contracts persist in agriculture for a wide range of development status, and 3) a 50:50 sharing between landlord and tenant is the most common for observed crop share arrangements. In this paper, we revisit the potential risk management motivations of contracts in the context of land rental agreements in the Corn Belt and their relationship between a widely adopted risk management tool – federally subsidized crop insurance.

Crop insurance is one of the primary components of a menu of programs comprising the federal safety net for agriculture in the U.S. Over the past 15 years, participation in the crop insurance program has increased considerably as new programs have continued to be developed which insure crop yields and revenues at both the farm and county levels, and premium subsidy rates offered to producers have been increased. Total acreage insured has increased from approximately 180 million acres in the late 90s to more than 250 million acres each year since 2008. Total subsidy expenditures have increased even more dramatically from just under \$ 1 billion to nearly \$5 billion annually over the same time period (RMA). To provide some perspective, crop insurance subsidies are now approximately on par with direct payments in terms of total annual expenditure.

During this period of crop insurance program and participation expansion, farmland rental agreements have increasingly converted from share contracts to fixed cash contracts. For example, the average proportion of total acres operated under a cash rent agreement in Illinois

has increased from 26% to 40% since 1997. This trend has been mirrored by a decline in the same measure for share rent agreements from 49% to 38% while land ownership rates among farm operators have remained relatively stable between 22 and 25%. These trends are illustrated in figure 1 using data from the Illinois Farm Business Farm Management (FBFM) Association and the Risk Management Agency of the USDA. Thus, the increases in risk protection achieved through the expansion in crop insurance participation may have been at least partially mitigated by increases in total risk exposure through the shift in types of rental agreements being used by producers.

The relationship between crop insurance use and various types of other management decisions and practices has been a popular area of analysis for agricultural economists. The impact of crop insurance on input use and other risk management decisions, such as hedging, have been particular areas of interest (Babcock and Hennessy, 1996; Coble et al., 2004; Coble, Heifner, and Zuniga, 2000; Horowitz and Lichtenberg, 1993; Quinton, Karagiannis, and Stanton 1993; Roberts, Key, and O'Donoghue 2006; Smith and Goodwin, 1996; Wu, 1999).

The effect of crop insurance on agricultural tenancy agreements, however, has not been as thoroughly examined. This is especially surprising given the importance of land and rental contracts to U.S. crop producers. For example, land costs represent approximately 30 to 40% of total production costs for Illinois crop producers (FBFM). One exception is Paulson, Schnitkey, and Sherrick (2010) which provides a conceptual analysis of the potential risk-reduction offered by crop insurance, hedging, and options under both cash and share rental agreements. Consistent with the arguments made by Allen and Lueck, they find the marginal risk reduction offered by a

crop share arrangement to be reduced when crop insurance and price risk management strategies are also available and utilized.

The standard approach in the contract literature has been to compare contract types and risk changes across heterogeneous individuals in a single cross-section without addressing bias due to unobserved heterogeneity. We, however, use farm-level panel data to examine how contract types change as riskiness changes *within* a farm over time with a fixed-effects model. Using a reduced form, instrumental variable approach to account for the endogeneity of crop insurance participation, we find that crop insurance participation is associated with the recent shift away from share rental agreements in Illinois. While the literature proxies for environmental risk with endogenously chosen characteristics such as crop choice or location, we utilize exogenous crop insurance program characteristics and historical performance measures as instrumental variables. We contend that our focus on agents' exogenous, policy-induced crop insurance choices more directly accounts for risk attitudes than what is usually found in the literature.

Our results support the notion that land rental agreements may be motivated, at least partially, by risk considerations. As the crop insurance program has expanded to provide additional programs such as revenue coverage, farmers have shifted away from share rent agreements. Perhaps more importantly, our approach allows us to comment on the efficiency of federally subsidized crop insurance as a mechanism to reduce risk for agricultural producers. If expansion of crop insurance program offerings - and the resulting increase in federal outlays to support the program - has led to or allowed a shift towards the riskier fixed cash rent agreements, then the risk reduction benefits provided through the subsidization of crop insurance may be overestimated.

Methods

We adopt a reduced form approach where tenancy, measured as the proportion of rented acres which utilize a cash rent agreement, is a function of a set farm characteristics within a fixed effects framework. The farm financial characteristics used as control variables are standard measures used in the agricultural finance literature which examines the relationship between farm tenancy, financial structure, and farm profitability (e.g, Ellinger and Barry, 1987; Garcia et. al, 1982; Rainey et al., 2005). These characteristics include a measure of crop insurance use, farm size, net worth, non-farm income, leverage, and the proportion of farm revenue derived from crop production. Farm size is measured as total tillable acres; the debt-to-asset ratio is used to measure farm leverage.

$$CashRent_{i,t} = \beta_0 + \beta_1 Insurance_{i,t} + \beta_2 Size_{i,t} + \beta_3 Wealth_{i,t} + \beta_4 NonFarm_{i,t} + \beta_5 \frac{D}{A_{i,t}} + \beta_6 CropRev_{i,t} + \varepsilon_{i,t}$$

Crop insurance participation is recorded in the FBFM database as the farmer's share of total insurance premium expenditures. Recognizing that insurance expenditures - even for the same program and coverage level combination - vary by region, crop, and commodity price levels, we construct two alternative normalized insurance indexes to use as proxies for insurance participation or intensity which can be better compared across farms. The first index simply divides insurance expenditures by the insurance price for corn or soybeans for that crop year. The second index measure normalizes expenditures by both insurance price and the aggregate average insurance rate paid by producers in the county. Regression models are estimated using each of the three alternative measures for crop insurance participation.

An instrumental variables approach is used to account for the endogeneity of the insurance participation decision. Based on recent studies of the determinants of crop insurance participation (Sherrick et al. 2004; Woodard and Paulson, 2010), county-level historical measures of program performance and insurance rates are used as exogenous instruments in a first-stage estimation of farm-level insurance use. Performance measures include a rolling 3-year average of the county loss ratio, the deviation of the farm's current trend yield from an estimate of their actual production history (APH) yield guarantee, and a rolling average of the coefficient of variation of yields as a proxy for yield risk. The 65% base rate for the county is included as an instrument to control for exogenous price variation facing farmers for crop insurance.

Data

Our analysis utilizes farm-level data from the Illinois Farm Business Farm Management association which consists of more than 6,000 farmer cooperators who are provided with detailed accounting, tax, and other record-keeping services through a network of approximately 60 field staff. The data includes an unbalanced panel of farm records covering the 2003 to 2008 crop years, and includes detailed financial, agronomic, and demographic information on the cooperating farm operators and households. Additional county-level crop insurance data from selected years of the RMA's Summary of Business is used in constructing historical performance and rating measures which are used as instruments in our model. These include historical premium, indemnity, and liability data reported for Illinois counties across insurance programs and coverage levels.

Summary statistics for the regression variables are reported in table 1. The farms which participate in the FBFM program would generally be classified as relatively large, commercial grain operations. The association includes roughly 20 percent of commercial grain farms in Illinois, providing an excellent representative sample of these types of operations. The percentage of acreage rented under a cash rent agreement averaged 47.3 percent from 2003 to 2008, but year-by-year estimates show that this percentage has steadily increased over time. Insurance expenditures averages \$19.47 per acre, but have increased from an average of about \$13 per acre in 2003 to more than \$30 per acre in 2008. Average farm size in the data is just over 1,000 tillable acres while the average wealth level is approximately \$1.35 million. The average non-farm income for the farm in our sample was \$24,346 per year. The farms in our data used an average of 31.9 percent debt to finance their assets, and an average of nearly 94 percent of total revenues are generated through crop production.

Results

The regression results for the tenancy equation are provided in table 2. The first column reports naive results where the endogeneity of the insurance decision is ignored. Columns three, four, and five report the two-stage IV regression results using the natural logarithm of the three alternative measures of insurance participation - direct insurance expenditures per acre, expenditures normalized by insurance price, and expenditures normalized by insurance rate and price, respectively.

Qualitatively, the results are consistent across all reported specifications. The prevalence of cash rental arrangements is estimated to decline in farm size. Net worth and non-farm income are

estimated to have a positive effect on the percentage of cash rented acres. Leverage and the share of revenue generated from crop production are also estimated to be positively related to the use of cash rent agreements.

The estimated relationship between crop insurance use and cash rent agreements is also consistent across specifications. In the naive regression, a 10 percent increase in insurance expenditures is estimated to increase the percentage of cash rented acres by 0.13 percent. In the IV regressions, the magnitude of this effect increases by a factor of three to five. In our sample, actual crop insurance expenditures, on average, nearly tripled from 2003 to 2008 while the normalized insurance measures increased by approximately 10 percent. The regression results indicate this increase in insurance coverage contributed to a shift in rental arrangements resulting in an up to 3 percent average increase in cash rented acres.

The results reported in table 2 based on the normalized measures of crop insurance participation used the insurance price and county insurance rate for corn policies. Results were also estimated using the insurance price and county insurance rates for soybean policies and were both qualitatively and quantitatively similar to those reported in table 2. A variety of alternative specifications were also estimated as robustness checks, again resulting in very similar results as those reported in table 2.

Conclusions

The relationship between risk and effort incentives occupies a central role in principal-agent theory. In the literature, land tenancy agreements epitomize this question. In spite of a decades-old theoretical literature, the empirical evidence lends mixed, inconclusive support to the postulated risk-incentives tradeoff. In contrast to this empirical literature, we uniquely go to the heart of the issue by examining the relationship between risk-reducing crop insurance and the incentive-determining terms of farmland lease agreements. In addition to focusing squarely on the core issue, we overcome a major shortcoming of the empirical farmland tenancy literature by exploiting plausibly exogenous variation in risk-averse behavior, i.e., crop insurance coverage, to identify the risk-incentive relationship. We isolate the direct relationship between risk and effort incentives by using exogenous policy parameters to instrument for crop insurance coverage. We also account for time-invariant, unobserved characteristics that determine risk attitudes and land tenancy preferences with farm fixed effects.

Our results provide clear, strong evidence for a risk-incentive tradeoff in farmland tenancy agreements. Federal crop insurance coverage increased substantially over the last decade, providing farmers with better risk-management tools. Consequently, farmers moved away from risk-sharing share lease arrangements to riskier cash lease contracts. Our estimates indicate that the 150% increase in average crop insurance coverage between 2003-2008 explains nearly all of the 5 percentage-point increase in the share of leased land under cash agreements. Contrary to the implications of Prendergast (2002) and Allen and Lueck (2002), risk considerations appear to play a big role in determining the terms of farmland leases.

The availability of crop insurance may be allowing producers to take on additional risk through the adoption of relatively riskier land rental arrangements. This brings up important policy considerations given that the crop insurance program is federally subsidized and is now associated with total annual government expenditures which are similar to those for farm commodity programs. The federal support provided for crop insurance provides producers with additional risk reduction, but may be leading to riskier land rental arrangements, reducing the efficiency of taxpayer support in providing risk management services to farmers.

Further research is warranted to better identify the link between crop insurance participation and the choice of type of land tenancy contracts in practices. The current study could be extended to include more data from earlier years or additional data collected from the farm management association cooperators on landlord characteristics. While the results from our study likely extend to other Midwestern states which are dominated by corn and soybean production, additional studies could examine the issue for other regions, and for contracting for other types of crops or livestock. However, the continued lack of farm-level panel data will make this challenging.

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Figures and Tables

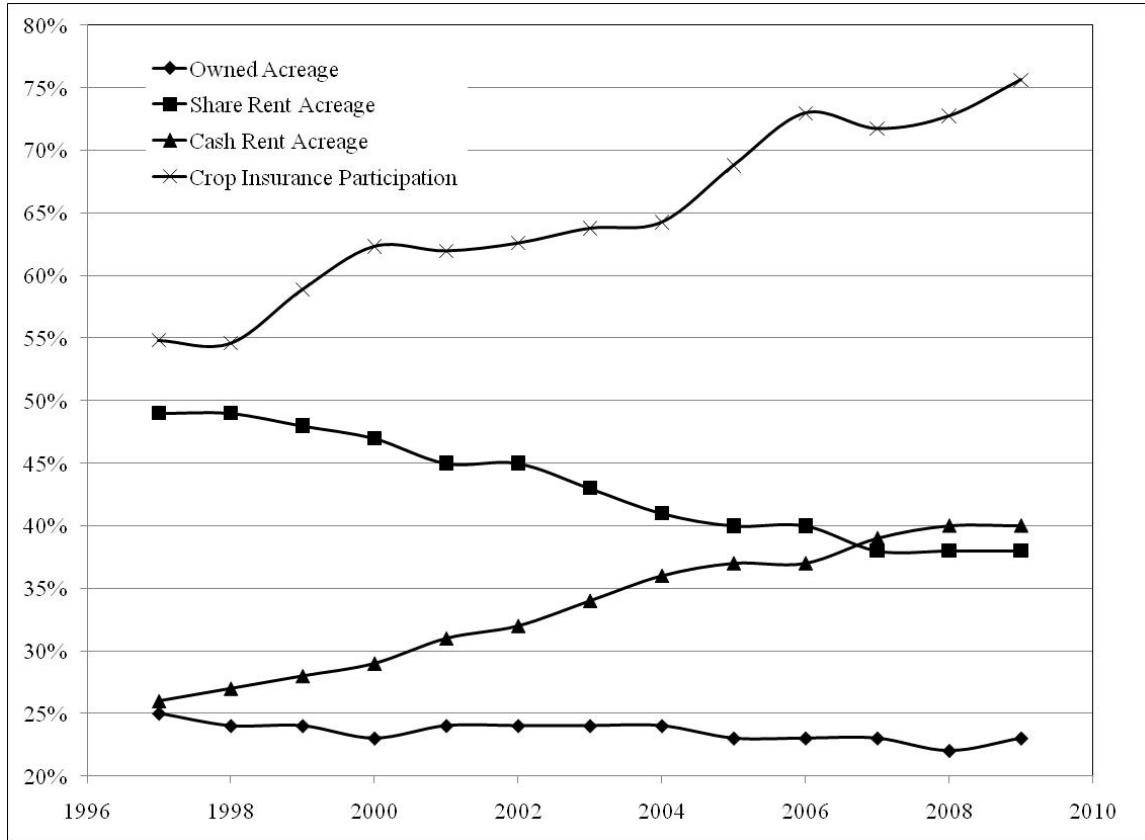


Figure 1. Rental agreement, land ownership, and crop insurance trends in IL, 1997-2009

Table 1. Summary Statistics of Selected Regression Variables

	Mean	Median
Proportion of Rented Acres Under Cash Rent Agreement	0.473	0.430
Insurance Expenditures (\$/acre)	19.47	16.57
Size (Acres)	1,027	857
Net Worth (\$)	1,346,510	965,700
Net Nonfarm Income (\$)	24,346	11,557
Debt/Asset Ratio	0.319	0.239
Crop Revenue Share	0.939	0.979

Source: Illinois Farm Business Farm Management Association

Table 2. Selected Regression Results

	FE	FE-IV	FE-IV ¹	FE-IV ²
Log(Insurance Expenditures)	0.0126*** (0.00283)	0.0560*** (0.00549)	-	-
Log(Normalized Insurance Expenditures)	-	-	0.0469*** (0.0126)	0.0314*** (0.00617)
Log(Farm Size)	-0.0271*** (0.00914)	-0.0156* (0.00934)	-0.0255*** (0.00934)	-0.0264*** (0.00920)
Log(Net Worth)	0.0495*** (0.00409)	0.0283*** (0.00474)	0.0541*** (0.00393)	0.0511*** (0.00398)
Non-farm Income (\$10,000)	0.000817** (0.000387)	0.000693* (0.000392)	0.000799** (0.000393)	0.000797** (0.000389)
Debt/Asset Ratio	0.134*** (0.0188)	0.113*** (0.0192)	0.134*** (0.0191)	0.131*** (0.0189)
Crop Revenue Share	0.117*** (0.0246)	0.0712*** (0.0254)	0.145*** (0.0252)	0.134*** (0.0246)
Obs	12,087	11,548	11,548	11,548
Farms	3,309	2,770	2,770	2,770
R-squared	0.033	0.007	0.003	0.021

Notes: Dependent variable in each model is the percentage of rented tillable acres under a cash rent agreement. Farm-level data from Illinois-FBFM. County-level insurance data from RMA Summary of Business. Data span years from 2003-2008. Instruments include the county base rates for 65% corn and soybean yield coverage, 3-year rolling average loss ratio, coefficient of variation for county corn and soybean yields, and revenue insurance prices for corn and soybeans.

Standard errors are reported below the estimates in parentheses.

*, **, and *** denote statistical significance at the 10%, 5%, and 1% level

¹ Normalized by corn insurance price

² Normalized by corn insurance price and county insurance rate for corn policies