Appendix

Details on Exogeneity of Instrumental Variables

For our study, our instrument is only valid if it influences a producer's crop insurance expenditures but has no direct bearing on cover crop decisions (other than through altering their crop insurance expenditures). The purpose of this appendix is to provide an overview of how the actuarial rating parameters that are used to construct our instrumental variable fit within the current premium rating framework utilized by the USDA Risk Management Agency and to discuss how these rating parameters satisfy the exclusion restrictions necessary to utilize them in an instrumental variables context.

As discussed by (Tsiboe and Turner 2023), the continuous rating formula utilized by RMA to set premium rates consists of two sets of parameters; the first being an "endogenous" set of parameters that are directly influenced by the actions of a producer in either the past or current crop year. The parameters in the "endogenous" set include the producer's choice of insurance unit structure (ex: basic vs enterprise units), their chosen coverage level (i.e. 50%, 55%, 60%, … etc), their choice of production practices (e.x. certified organic, irrigation use). Finally, a producers' history of realized yields (referred to as their "Actual Production History" or APH) is contained in this "endogenous" set of rating parameters. Because these components of the premium rating process are directly influenced by the actions of the producer, they do not satisfy the exclusion restrictions necessary for an instrumental variable. For example, if s producer experiences yield effects from adopting cover crops (either positive or negative), their future premium rate will respond through updates to their actual production history that capture the change in yield.

Alternatively, there are a number of actuarial parameters that directly influence a producers paid premium rate, but are arguably exogenous to any one producers production decisions (including their choices related to cover crop use). These parameters are referred to as the "policy parameter space" by (Tsiboe and Turner 2023) and include the county base rate (α), the continuous rating exponent (β), the catastrophic loading factor (δ) and the county average yield ($\bar{y}_c$).

With the exception of $\bar{y}_c$, which is a simple average of the historic APH of all producers in the same county producing the same crop, the other parameters are not updated on an annual basis but are instead subject to review every 3-5 years (Risk Management Agency 2008). Additionally, these parameters are updated in accordance with RMA's practice of loss cost ratio rate making, which means these parameters are updated only to maintain the actuarial property that the loss cost ratio be equal to the expected indemnity rate.

Since these rating parameters are only updated in response to noticeable degradation of the actuarial performance of an insurance pool, many factors that influence a farmer's yield (weather, changes in production methods, etc.) do not cause changes in these "exogenous" rating parameters since many of these events do not result in indemnity payments (due to deductibles being fairly large)[1]. Even when indemnity payments do occur in response to these events, they must be widespread enough to meaningfully impact actuarial performance. In effect, this means that the actions of a producer have a trivial influence on the "exogenous" set of actuarial rating parameters they will face in the future. Even if a single producer was large enough to single handedly alter the actuarial performance of the county they are in, a number of rate making practices are employed by RMA to further limit the influence that any single producer has on the policy parameters they face in the future.

First, RMA employs what they refer to as "credibility weighting" which is their term for a spatial smoothing algorithm that seeks to attenuate large discontinuities in crop insurance pricing along county borders (Risk Management Agency [RMA] 2009; Coble et al. 2010). Credibility weighting also serves to down-weight the loss experience of counties that are highly variable (in which case the loss experience of neighboring counties is used more heavily in the rate making process). In effect, this means that a single producer's county base rate is based on all producers within their county and all the producers in all adjoining counties. Consequently, the influence that a single producer has on the future base rate that they face is negligible.

A producer's ability to influence the future policy parameters they face is analogous to a U.S. based homebuyer's ability to influence their own mortgage interest rate. For example, a potential homebuyer may

[1] For example, from 2011 to 2021, 77.6% of crop insurance policies sold had a deductible of at least 25%.

temporarily reduce their own spending to try to single-handedly lower national consumer spending metrics with the hope that the federal reserve will lower interest rates in an attempt to restimulate the economy. This in turn will allow the potential homebuyer to purchase their home at a more favorable mortgage interest rate. In this case, the federal reserve interest rate is technically "endogenous" to this homebuyer's behavior since their individual spending technically contributes to national measures of consumer spending, however, the likelihood that an individual consumer's behavior has the potential to manipulate national interest rates in a way that provides them with a financial advantage is minute. Thus, in this case the federal reserve rate is exogenous to any single individual's behavior by virtue of no one person having enough influence to alter consumer demand in a meaningful way.

The above example is somewhat extreme, but our own identification strategy operates on the same principle. The average number of crop insurance policies associated with a county-crop-year group (ex: policies associated with corn producers in a single county in Iowa during the 2018 crop year constitute one group) between 2011-2021 is 128. This means there are 128 crop insurance policies that contribute to the average county's loss experience that influences the county base rate. When credibility weighting is considered, the average county has an additional 669 policies in adjoining counties that have some level of influence on the county base rate. In other words, within the average county, collusion among the purchasers of approximately 800 policies (or at least a large portion of those) is required for intentional influence of their county base rate to occur. However, even widespread collusion does not guarantee favorable rates for this potential group of coordinated producers.

In addition to credibility weighting which spatially smooths county base rates, when RMA subjects a particular county/crop pair to a rate review (which as noted above takes place on either a 3 or 5 year cycle), the historic loss experience data from the previous 20 years is utilized starting from two crop years before the current crop year. This imposes additional temporal separation between the decisions of a producer and the county base rate they face. Lastly, RMA retains the right to use their professional judgement to subjectively rate crop insurance policies in cases where they believe their standard rating practices are not adequate which provides an additional buffer between a producer's behavior and their county base rate (Coble et al. 2010).

Additional Regression Results

Table S1: Ordinary Least Squares Regression Results

	Pre-2018 Farm Bill	Post-2018 Farm Bill	Full Sample
asinh(FCIP exp/acre)	0.0027***	0.0024***	0.0026***
	(0.0003)	(0.0005)	(0.0002)
asinh(cons. payment/acre)	0.0057***	0.0070***	0.0061***
	(0.0003)	(0.0006)	(0.0003)
Female	-0.0053***	-0.0002	-0.0034***
	(0.0015)	(0.0025)	(0.0013)
Beginner farm	-0.0022	0.0002	-0.0012
	(0.0014)	(0.0024)	(0.0012)
asinh(acres)	-0.0010***	-0.0026***	-0.0016***
	(0.0003)	(0.0005)	(0.0002)
Crop share	0.0117***	0.0152***	0.0129***
	(0.0011)	(0.0021)	(0.0010)
Cattle	0.0065***	0.0091***	0.0075***
	(0.0010)	(0.0018)	(0.0009)
PDSI Avg.	0.0020**	0.0056***	0.0030***
	(0.0009)	(0.0016)	(0.0008)
asinh(operator age)	-0.0166***	-0.0091***	-0.0141***
	(0.0017)	(0.0031)	(0.0015)
Partly owned	0.0052***	0.0066***	0.0057***
	(0.0009)	(0.0016)	(0.0008)
Rented	0.0046***	0.0030	0.0042***
	(0.0013)	(0.0024)	(0.0012)
College grad.	0.0040***	0.0081***	0.0054***
	(0.0008)	(0.0014)	(0.0007)
Retirement	-0.0141***	-0.0067	-0.0120***
	(0.0024)	(0.0044)	(0.0021)
Residential/lifestyle	-0.0165***	-0.0067**	-0.0133***
	(0.0020)	(0.0033)	(0.0017)
Lower Sales	-0.0129***	-0.0075**	-0.0109***
	(0.0019)	(0.0032)	(0.0017)
Higher Sales	-0.0100***	-0.0118***	-0.0102***
	(0.0020)	(0.0034)	(0.0017)
Large	-0.0074***	-0.0022	-0.0054***
	(0.0020)	(0.0033)	(0.0017)
Very Large	0.0008	-0.0010	0.0006
	(0.0018)	(0.0029)	(0.0015)
Trend	-0.0182***	-0.0021	-0.0022
	(0.0011)	(0.0016)	(0.0014)
Constant	36.7576***	4.3013	4.5150
	(2.1613)	(3.1642)	(2.7734)
Observations	82798	36368	119166
Marginal Effect (FCIP Exp.)	0.002	0.001	0.002

Notes: Standard errors in parentheses. * p<0.01, ** p<0.05, *** p<0.01. The farm level data is from 2012-2021 Agricultural Resource Management Survey (ARMS) Phase 3 data. All models included additional controls for ERS research region and year fixed effects. Marginal Effects for FCIP Expenditures reported in the footer of the table are for a $1 increase per acre in crop insurance expenditures.

Table S2: Two-Staged Least Squares Regression Results

	Pre-2018 Farm Bill		Post-2018 Farm Bill		Full Sample	
	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage
asinh(FCIP exp/acre)		-0.006		0.004		-0.004
		(0.008)		(0.014)		(0.007)
asinh(cons. payment/acre)	0.021***	0.006***	0.045***	0.007***	0.028***	0.006***
	(0.004)	(0.000)	(0.006)	(0.001)	(0.003)	(0.000)
Female	-0.015	-0.005***	-0.009	-0.000	-0.012	-0.004***
	(0.020)	(0.002)	(0.027)	(0.003)	(0.016)	(0.001)
Beginner farm	-0.073***	-0.003*	-0.021	0.000	-0.056***	-0.002
	(0.018)	(0.002)	(0.026)	(0.002)	(0.015)	(0.001)
asinh(acres)	0.119***	0.000	0.130***	-0.003	0.123***	-0.001
	(0.004)	(0.001)	(0.005)	(0.002)	(0.003)	(0.001)
Crop share	1.182***	0.022**	1.105***	0.013	1.160***	0.021**
	(0.014)	(0.010)	(0.021)	(0.016)	(0.012)	(0.008)
Cattle	-0.083***	0.006***	-0.089***	0.009***	-0.084***	0.007***
	(0.013)	(0.001)	(0.020)	(0.002)	(0.011)	(0.001)
PDSI Avg.	0.076***	0.003**	0.075***	0.005***	0.075***	0.004***
	(0.011)	(0.001)	(0.017)	(0.002)	(0.010)	(0.001)
asinh(operator age)	-0.176***	-0.018***	0.015	-0.009***	-0.116***	-0.015***
	(0.022)	(0.002)	(0.033)	(0.003)	(0.019)	(0.002)
Partly owned	0.262***	0.008***	0.259***	0.006	0.262***	0.007***
	(0.011)	(0.002)	(0.017)	(0.004)	(0.009)	(0.002)
Rented	0.226***	0.007***	0.253***	0.003	0.235***	0.006***
	(0.017)	(0.002)	(0.026)	(0.004)	(0.014)	(0.002)
College grad.	-0.010	0.004***	0.023	0.008***	0.000	0.005***
	(0.010)	(0.001)	(0.015)	(0.001)	(0.008)	(0.001)
Retirement	-0.364***	-0.017***	-0.525***	-0.006	-0.426***	-0.015***
	(0.032)	(0.004)	(0.047)	(0.009)	(0.026)	(0.004)
Residential/lifestyle	-0.331***	-0.020***	-0.441***	-0.006	-0.375***	-0.016***
	(0.026)	(0.003)	(0.035)	(0.007)	(0.021)	(0.003)
Lower Sales	-0.344***	-0.016***	-0.466***	-0.007	-0.391***	-0.014***
	(0.025)	(0.003)	(0.034)	(0.007)	(0.020)	(0.003)
Higher Sales	0.003	-0.010***	-0.223***	-0.011**	-0.076***	-0.011***
	(0.027)	(0.002)	(0.036)	(0.005)	(0.021)	(0.002)
Large	0.217***	-0.005**	0.024	-0.002	0.146***	-0.004**
	(0.026)	(0.003)	(0.035)	(0.003)	(0.021)	(0.002)
Very Large	0.340***	0.004	0.172***	-0.001	0.276***	0.003
	(0.024)	(0.003)	(0.031)	(0.004)	(0.019)	(0.002)
Trend	-0.033**	-0.018***	0.015	-0.002	0.011	-0.002
	(0.014)	(0.001)	(0.017)	(0.002)	(0.017)	(0.001)
Initial rate	-0.815***		-0.866***		-0.822***	
	(0.085)		(0.130)		(0.071)	
Constant	66.354**	37.246***	-29.389	4.352	-22.585	4.370
	(28.580)	(2.219)	(33.701)	(3.186)	(34.022)	(2.786)
Observations	82798	82798	36368	36368	119166	119166
First Stage F	91.863		44.133		133.571	
Wu-Hausman P-val.	0.264		0.896		0.334	
Marginal Effect (FCIP Exp.)		-0.003		0.002		-0.003

Notes: Standard errors in parentheses. * p<0.01, ** p<0.05, *** p<0.01. The farm level data is from 2012-2021 Agricultural Resource Management Survey (ARMS) Phase 3 data. All models included additional controls for ERS research region and year fixed effects. Marginal Effects for FCIP Expenditures reported in the footer of the table are for a $1 increase per acre in crop insurance expenditures.

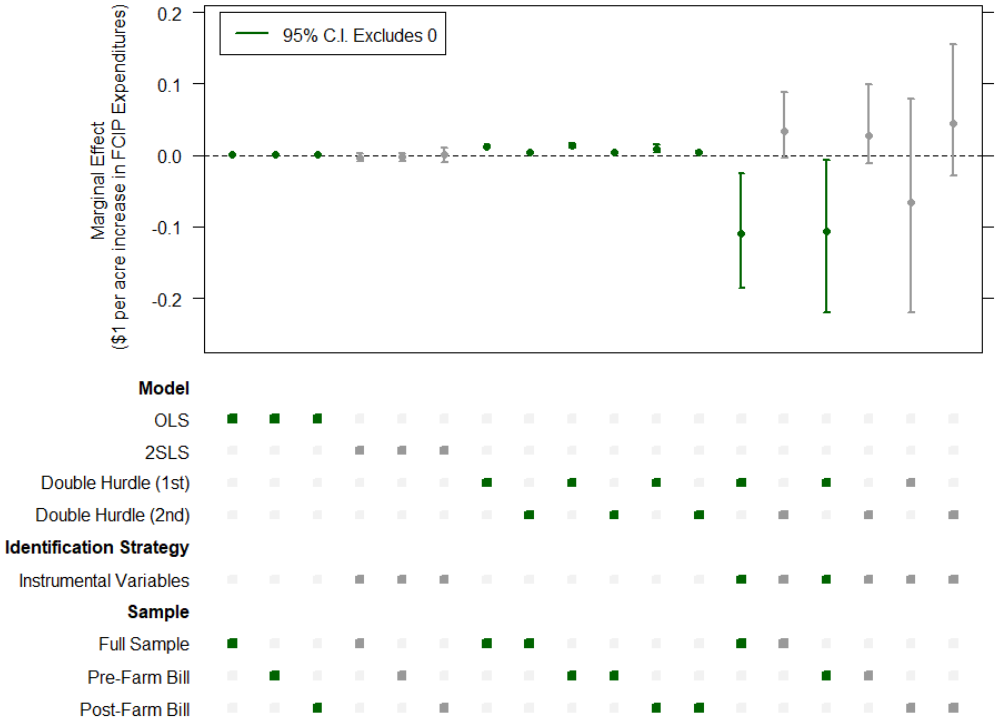
Table S3: Double Hurdle Regression Results

	Pre-2018 Farm Bill		Post-2018 Farm Bill		Full Sample	
	1st Stage	2nd Stage	1st Stage	2nd Stage	1st Stage	2nd Stage
asinh(FCIP exp/acre)	0.0280***	0.0583***	0.0166**	0.0522***	0.0251***	0.0562***
	(0.0046)	(0.0094)	(0.0068)	(0.0112)	(0.0038)	(0.0071)
asinh(cons. payment/acre)	0.1074***	0.0611***	0.1041***	0.0394***	0.1061***	0.0523***
	(0.0048)	(0.0107)	(0.0072)	(0.0117)	(0.0040)	(0.0076)
Female	-0.1289***	-0.2362***	0.0037	-0.0631	-0.0682***	-0.1511***
	(0.0336)	(0.0774)	(0.0391)	(0.0651)	(0.0253)	(0.0515)
Beginner farm	-0.0542**	-0.0512	0.0161	-0.0117	-0.0253	-0.0367
	(0.0274)	(0.0482)	(0.0365)	(0.0589)	(0.0218)	(0.0401)
asinh(acres)	0.0624***	-0.2900***	0.0414***	-0.2361***	0.0537***	-0.2699***
	(0.0056)	(0.0162)	(0.0077)	(0.0198)	(0.0045)	(0.0146)
Crop share	0.3273***	0.0846**	0.3014***	0.0068	0.3174***	0.0436
	(0.0210)	(0.0394)	(0.0294)	(0.0514)	(0.0170)	(0.0349)
Cattle	0.3221***	-0.3489***	0.3353***	-0.2684***	0.3275***	-0.3237***
	(0.0175)	(0.0422)	(0.0256)	(0.0472)	(0.0144)	(0.0322)
PDSI Avg.	0.0912***	-0.1295***	0.1041***	-0.0798*	0.0946***	-0.1122***
	(0.0156)	(0.0322)	(0.0232)	(0.0431)	(0.0129)	(0.0286)
asinh(operator age)	-0.3226***	-0.2123***	-0.1890***	-0.0182	-0.2734***	-0.1502***
	(0.0303)	(0.0602)	(0.0433)	(0.0751)	(0.0247)	(0.0477)
Partly owned	0.1378***	0.0120	0.1142***	0.0179	0.1295***	0.0113
	(0.0164)	(0.0398)	(0.0230)	(0.0404)	(0.0133)	(0.0271)
Rented	0.0522**	0.1776***	-0.0196	0.1618***	0.0284	0.1710***
	(0.0244)	(0.0607)	(0.0357)	(0.0604)	(0.0200)	(0.0380)
College grad.	0.1474***	-0.0880***	0.1760***	-0.0447	0.1579***	-0.0719***
	(0.0140)	(0.0263)	(0.0197)	(0.0336)	(0.0114)	(0.0226)
Retirement	-0.3808***	-0.3367***	-0.2616***	0.0583	-0.3421***	-0.1591**
	(0.0471)	(0.1094)	(0.0663)	(0.1092)	(0.0381)	(0.0769)
Residential/lifestyle	-0.4360***	-0.3372***	-0.2308***	-0.0673	-0.3566***	-0.2141***
	(0.0357)	(0.0847)	(0.0456)	(0.0795)	(0.0280)	(0.0552)
Lower Sales	-0.3085***	-0.3875***	-0.2176***	-0.1464*	-0.2686***	-0.2886***
	(0.0343)	(0.0911)	(0.0438)	(0.0786)	(0.0269)	(0.0545)
Higher Sales	-0.1772***	-0.3162***	-0.2108***	-0.2711***	-0.1819***	-0.2930***
	(0.0346)	(0.0863)	(0.0461)	(0.0867)	(0.0275)	(0.0563)
Large	-0.1339***	-0.1952***	-0.1247***	0.0465	-0.1222***	-0.0941*
	(0.0333)	(0.0643)	(0.0435)	(0.0751)	(0.0263)	(0.0505)
Very Large	-0.0063	0.0807	-0.0765**	0.1019	-0.0195	0.0995**
	(0.0305)	(0.0639)	(0.0379)	(0.0663)	(0.0237)	(0.0449)
Trend	-0.5924***	-0.0225	-0.0433**	-0.0172	-0.0417*	-0.0022
	(0.0223)	(0.0513)	(0.0212)	(0.0354)	(0.0213)	(0.0370)
Constant	1194.3062***	47.8448	86.3298**	36.6178	83.6734*	7.0040
	(45.0446)	(103.5925)	(42.8879)	(71.5274)	(43.0855)	(74.7626)
Observations	82798	9748	36368	4576	14324	119166
Marginal Effect (FCIP Exp.)	0.016	0.005	0.01	0.008	0.014	0.006

Notes: Standard errors in parentheses. * p<0.01, ** p<0.05, *** p<0.01. The farm level data is from 2012-2021 Agricultural Resource Management Survey (ARMS) Phase 3 data. All models included additional controls for ERS research region and year fixed effects. Marginal Effects for FCIP Expenditures reported in the footer of the table are for a $1 increase per acre in crop insurance expenditures.

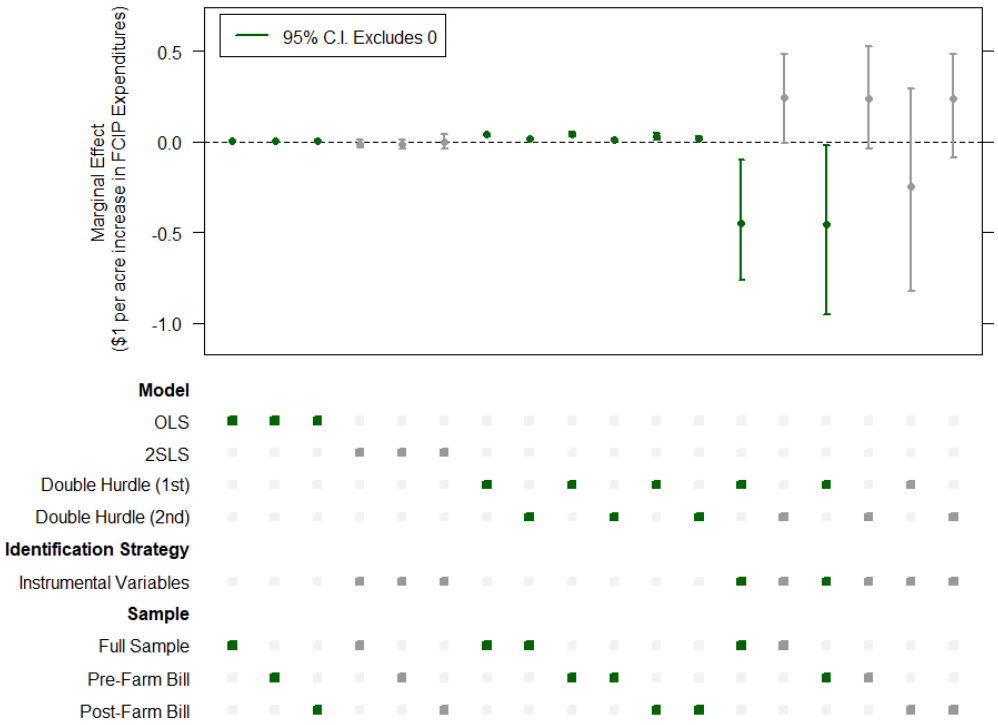
Robustness Checks

Figure S1: Marginal Effects (Scaled Up)



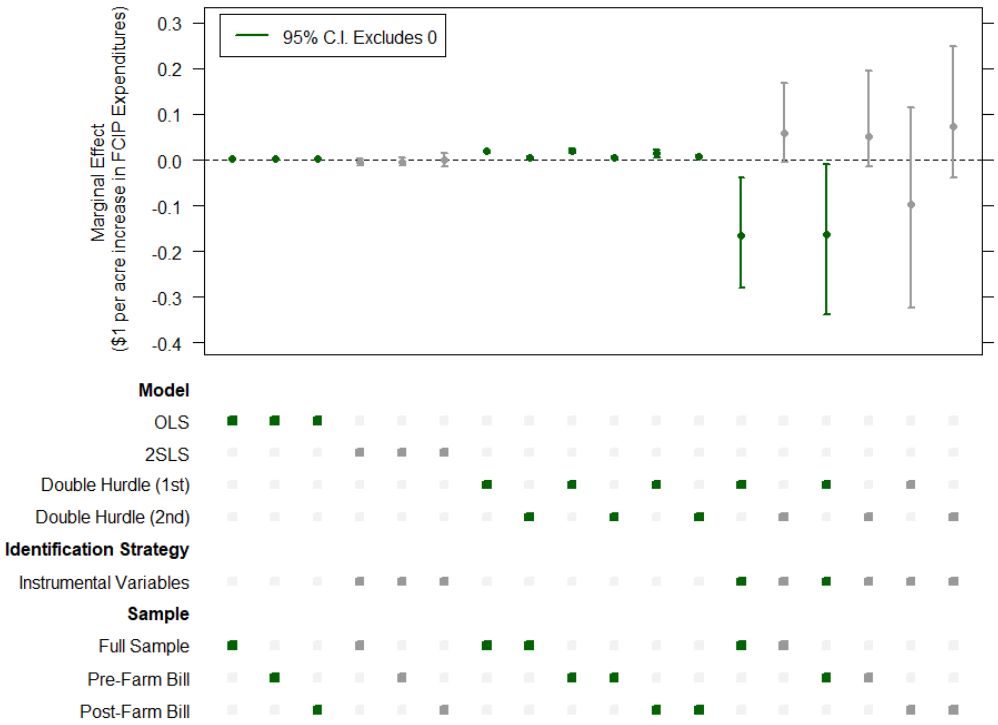
Note: Dots in the upper portion of the figure represent point estimates for the marginal effects while the associated error bars represent 95% confidence intervals. The lower portion of the figure represents the model specification which is indicated by which combination of squares are filled in in the column directly below the point estimate. For the entire figure, green shading indicates that the marginal effect for a particular specification is statistically distinct from zero while grey shading indicates statistical insignificance. For example the specification defined by the far left column of the figure indicates a marginal effect that is close to zero, but positive and statistically significant and was estimated with an OLS model, did not use any form of instrumental variables, and was estimated on the full data sample. Alternatively, the specification defined by the far left column of the figure indicates a marginal above zero which is statistically insignificant and comes from the 2nd equation in a double hurdle model that was estimated using an instrumental variables strategy and was estimated on a sample consisting of observations from after the 2018 Farm Bill.

Figure S2: Marginal Effects (Scaled Down)



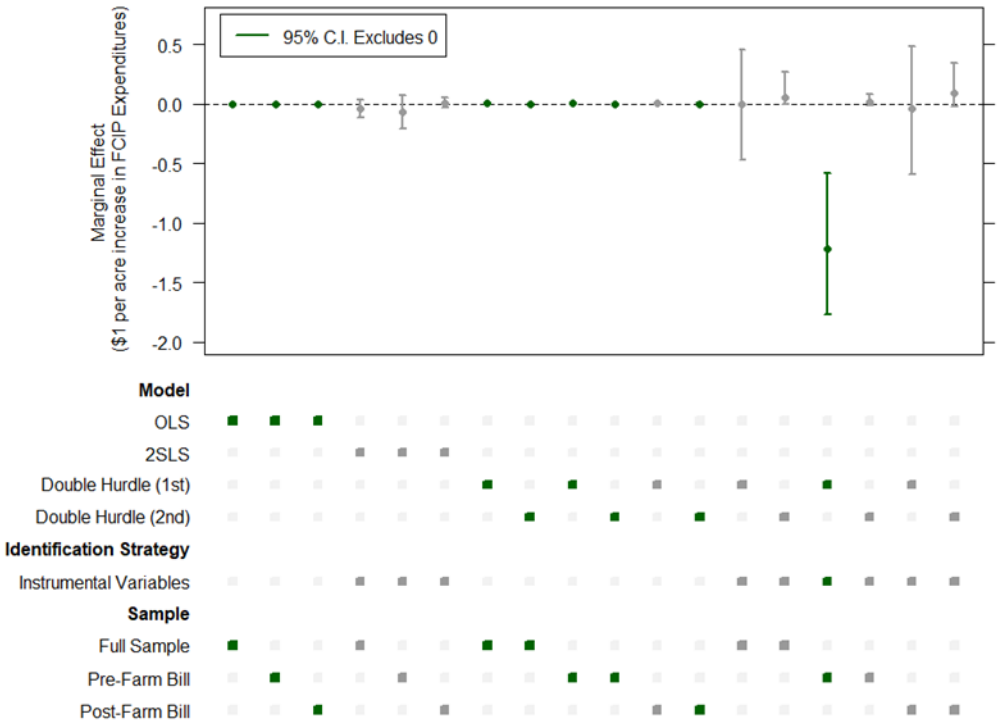
Note: Dots in the upper portion of the figure represent point estimates for the marginal effects while the associated error bars represent 95% confidence intervals. The lower portion of the figure represents the model specification which is indicated by which combination of squares are filled in in the column directly below the point estimate. For the entire figure, green shading indicates that the marginal effect for a particular specification is statistically distinct from zero while grey shading indicates statistical insignificance. the specification defined by the far left column of the figure indicates a marginal effect that is close to zero, but positive and statistically significant and was estimated with an OLS model, did not use any form of instrumental variables, and was estimated on the full data sample. Alternatively, the specification defined by the far left column of the figure indicates a marginal above zero which is statistically insignificant and comes from the 2nd equation in a double hurdle model that was estimated using an instrumental variables strategy and was estimated on a sample consisting of observations from after the 2018 Farm Bill.

Figure S3: Marginal Effects (Logged Outcome)



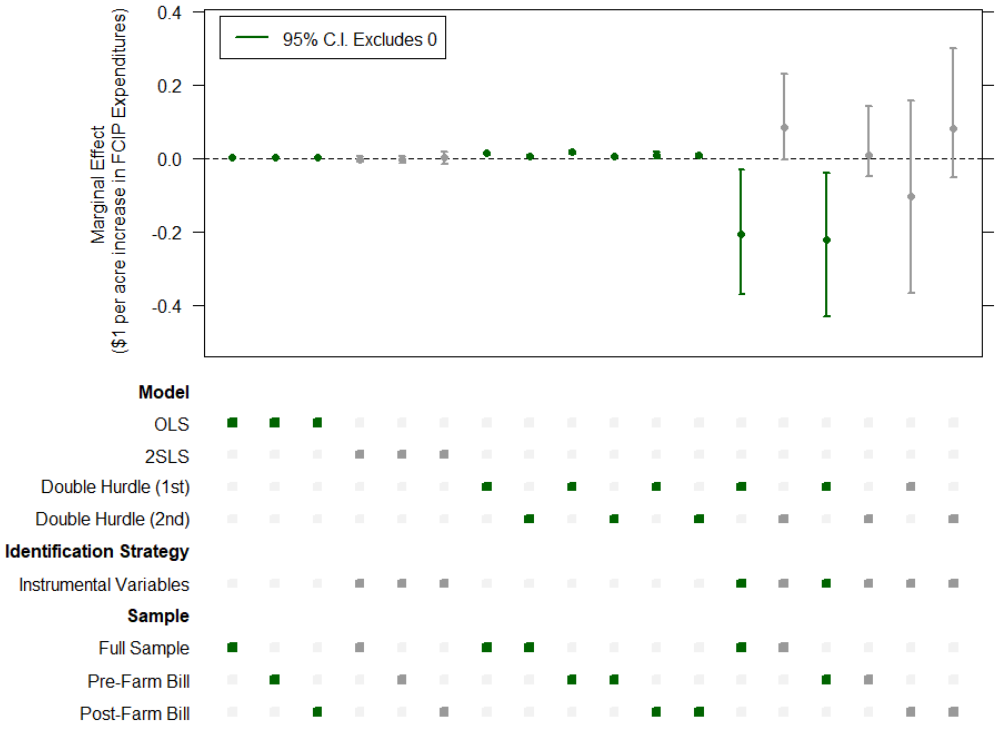
Note: Dots in the upper portion of the figure represent point estimates for the marginal effects while the associated error bars represent 95% confidence intervals. The lower portion of the figure represents the model specification which is indicated by which combination of squares are filled in in the column directly below the point estimate. For the entire figure, green shading indicates that the marginal effect for a particular specification is statistically distinct from zero while grey shading indicates statistical insignificance. For example, the specification defined by the far left column of the figure indicates a marginal effect that is close to zero, but positive and statistically significant and was estimated with an OLS model, did not use any form of instrumental variables, and was estimated on the full data sample. Alternatively, the specification defined by the far left column of the figure indicates a marginal above zero which is statistically insignificant and comes from the 2nd equation in a double hurdle model that was estimated using an instrumental variables strategy and was estimated on a sample consisting of observations from after the 2018 Farm Bill.

Figure S4: Marginal Effects (FCIP Participants Only)



Note: Dots in the upper portion of the figure represent point estimates for the marginal effects while the associated error bars represent 95% confidence intervals. The lower portion of the figure represents the model specification which is indicated by which combination of squares are filled in in the column directly below the point estimate. For the entire figure, green shading indicates that the marginal effect for a particular specification is statistically distinct from zero while grey shading indicates statistical insignificance. For example, the specification defined by the far left column of the figure indicates a marginal effect that is close to zero, but positive and statistically significant and was estimated with an OLS model, did not use any form of instrumental variables, and was estimated on the full data sample. Alternatively, the specification defined by the far left column of the figure indicates a marginal above zero which is statistically insignificant and comes from the 2nd equation in a double hurdle model that was estimated using an instrumental variables strategy and was estimated on a sample consisting of observations from after the 2018 Farm Bill.

Figure S5: Marginal Effects (Alternative instrumental variable).



Note: Figure S5 reports results where the instrumental variable is defined as the average subsidy rate for 65% and 75% coverage level yield protection policies (as discussed in (Yu, Smith, and Sumner 2018)) interacted with the initial rate (as discussed in the main manuscript). Dots in the upper portion of the figure represent point estimates for the marginal effects while the associated error bars represent 95% confidence intervals. The lower portion of the figure represents the model specification which is indicated by which combination of squares are filled in in the column directly below the point estimate. For the entire figure, green shading indicates that the marginal effect for a particular specification is statistically distinct from zero while grey shading indicates statistical insignificance. For example, the specification defined by the far left column of the figure indicates a marginal effect that is close to zero, but positive and statistically significant and was estimated with an OLS model, did not use any form of instrumental variables, and was estimated on the full data sample. Alternatively, the specification defined by the far left column of the figure indicates a marginal above zero which is statistically insignificant and comes from the 2nd equation in a double hurdle model that was estimated using an instrumental variables strategy and was estimated on a sample consisting of observations from after the 2018 Farm Bill.