Title: The Economic Welfare Impacts of the new Agricultural Insurance and Shallow Loss Programs

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Abstract: The 2014 farm bill continued the expansion of the federally subsidized crop insurance program and introduced a number of new shallow loss programs, maintaining the ongoing shift of federal subsidies to risk management programs. This study describes the shifts over the past fifteen years and discusses the impacts of the newly instituted PLC, ARC, and SCO on taxpayer outlays. A stylized model demonstrates the subtle interactions between the new SCO and crop insurance programs through farmers' decisions to alter their insurance coverage levels. The results suggest increased taxpayer outlays and potentially adverse environmental consequences.

Keywords: 2014 farm bill, crop insurance, shallow loss, welfare effects

JEL Codes: Q18, H53, D61

Improved farm income safety nets have become a mantra of, and perhaps even a religious creed for agricultural interest groups in the United States over the past fifteen years. Those lobbies have persistently claimed that farmers face exceptional production and price risks that are not encountered by other sectors of the economy, requiring that farmers receive special protections to enable them to be financially solvent. For example, a particularly extreme justification is the assertion that, absent heavily subsidized farm income safety net programs, agricultural production in the United States will collapse and most Americans will often go to bed hungry despite their relatively high incomes and wealth.

The assertions that farmers face exceptional price or financial risks are at best only weakly supported by previous studies (Goodwin, 2011; Wright and Gardner 1995) and that, absent farm subsidies, the US food production and distribution system would collapse. Nevertheless, since the early 1980s the farm sector has become increasingly successful in shifting farm subsidy programs toward heavily subsidized agricultural insurance (Glauber, 2013; Smith and Glauber, 2012). More recently, "shallow loss" farm income safety net programs—intended to make payments to farmers when farm revenues decline modestly from their expected levels—have amplified these transfers. In this study, we discuss why the policies that have been developed and implemented in the 2014 farm bill are generally unlikely to create appropriate incentives for farmers to reduce agricultural production and financial risks. In fact, agricultural insurance subsidies and shallow loss programs tied to farms' current production decisions increase incentives for risk taking by farmers to a considerable extent, precisely because those programs enable farmers to shift the financial risks inherent in their operations from

themselves to the federal government and tax payers (see, for example, Babcock and Hennessy, 1996; Smith and Goodwin, 2013; Smith and Glauber, 2012; Wright, 2014).[1]

The shift of subsidies toward shallow loss and risk management programs has occurred progressively over the past fifteen years through the provisions of the 2000 Agricultural Risk Protection Act (ARPA) and the three subsequent farm bills: the 2002 Farm Security and Rural Investment Act (FISRA), the 2008 Food Conservation and Energy Act (FCEA) and the 2014 Agricultural Act (Zulauf and Orden, 2014; Coble 2014; Smith, Babcock and Goodwin 2012a and 2012b; and Smith, 2014). The 2000 ARPA began the trend by legislating a substantial increase in premium subsidies for the federal crop insurance program and, after subsequent legislative increases, the current premium rate is on average approximately 62 percent of the estimated actuarially fair premium, with farmers paying less than a third of the full cost of the insurance program (Glauber, 2013; Goodwin and Smith, 2013; Smith 2011).

In addition to initiating major increases to federal subsidies of the crop insurance program, the 2002 FISRA introduced the countercyclical payments (CCP) program, which provided payments for eligible crops (corn, rice, soybeans, cotton, wheat, barley, sorghum, peas and lentils, and minor oilseeds) when current year national average prices were relatively low, but payments would be made on the basis of historical production. Subsequently, the 2008 farm bill introduced an explicit shallow loss program called the Average Crop Revenue (ACRE) program as an alternative to CCP. Under the ACRE program, farmers would receive payments for a crop when per acre revenues declined below 90 percent of their estimated recent historical average levels. In addition, ACRE subsidy payments were not effectively decoupled from current production, because they

were typically based on farms' planted acres in a particular year (Goodwin and Smith, 2011). On a per acre basis, ACRE payments for an individual farm could be as much as 25 percent of the farm's estimated recent historical average revenues.

The 2008 farm bill also continued to encourage a more extensive crop insurance program, introduced a new crop disaster aid program called the Supplemental Revenue Assistance (SURE) program, and four other disaster aid programs targeted to livestock, fish, and tree and orchard operations. Subsidized SURE program payments were also paid on all planted acres for eligible crops and, therefore, were also coupled to current production decisions. The Congressional Budget Office estimated that the SURE program outlays would result in relatively small subsidy payments, somewhere in the range of $400 million to $500 million (Congressional Budget Office, 2008). However, actual SURE subsidies amounted to over two billion dollars for crop losses in 2009 and were also substantial in 2010 (Smith and Watts, 2010; Bekkerman, Smith, and Watts, 2012).

While the crop and livestock disaster aid programs were discontinued at the end of 2011 because of a funding sunset clause, all of the programs except for the SURE program were reestablished in the 2014 Agricultural Act. The 2014 farm bill continued the trend of shifting farm subsidies toward farm income safety net and risk management programs by terminating the direct payments, CCP, ACRE shallow loss, and several dairy price support programs, and replacing them by a menu of new risk management and shallow loss initiatives. These included a dairy "margin protection program," under which payments are made when the difference between the price of raw milk and an estimate of dairy cow feed costs sufficiently declines, a heavily subsidized quasi crop

revenue insurance program for cotton called the Stacked Income Protection Plan (STAX), and three new shallow loss programs for crops (other than cotton) that were previously covered by the direct payments, countercyclical payments, and ACRE programs.[2]

The three new 2014 farm bill shallow loss subsidy programs are the Price Loss Coverage (PLC), Agricultural Risk Coverage (ARC), and Supplementary Insurance Coverage Options (SCO) programs. They are each intended to protect farmers against "shallow losses;" that is, they are intended to make payments to farmers when farm revenues from covered crops fall only modestly below their expected levels. The objective of these three new programs seems to be to substantially reduce farmers' exposure to most of the revenue and financial risks otherwise inherent in most business operations while to some extent offsetting subsidy losses associated with the termination of the direct payments program. While farmers and crop insurance companies are the direct beneficiaries of the subsidized crop insurance and shallow loss programs, but agricultural lenders also receive benefits. When coupled with subsidized crop insurance, these programs substantially reduce the risks associated with mortgage and, especially, operating loans to farm operations to the point that those loans are almost risk free. The commensurate implication is that interest rates charged on loans to agricultural operations are likely to be substantially lower than would otherwise be the case.

The PLC, ARC, and SCO farm income safety net programs and their interaction with the federal agricultural insurance program are the major focus of this paper. In particular, we examine the potential economic welfare and environmental consequences of the new programs. The effects are subtle because of the ways in which the PLC, ARC and SCO programs are structured and, as a consequence, how they interact with one

another and other agricultural policies. However, the implications for government spending are unambiguous: the programs are designed to increase transfers to farmers from the public purse.

Trends in farm subsidy expenditures

Figure 1 characterizes the changing landscape of farm subsidy programs toward farm safety net and risk management objectives through increased implementation of federally subsidized crop insurance products and shallow loss programs. The figure shows annual average expenditures on farm bill subsidies over the three periods covered by the provisions of the 1996, 2002 and 2008 farm bills (1996–2001, 2002–2008, and 2009–2013) and the Congressional Budget Office's (CBO's) January 2014 expenditure estimates for the 2014 Agricultural Act for the 2014–2018 period. These data are collected from the USDA Office of Inspector General's Commodity Credit Corporation fiscal year financial statements, the USDA Risk Management Agency's summary of business and fiscal year audit reports, and the Environmental Working Group. The actual and expected expenditures are categorized into three categories: traditional farm subsidy price support and related programs, crop insurance and disaster aid subsidies, and the direct payment programs (introduced in the 1996 "Freedom to Farm" farm bill).[3]

The basic pattern is clear: spending on annual crop insurance and disaster aid subsidies increased by 70 percent during 2002–2008 relative to 1996–2001, increasing from an annual average of $2.849 billion to $4.883 billion. This largely resulted from substantial increases in crop insurance subsidy rates legislated by the 2000 ARPA (Glauber, 2013). Annual disaster aid and crop insurance subsidy outlays again increased

substantially during 2008–2013 and, at an average of $8.433 billion, were 75% higher than during 2002–2008.

The growth of crop insurance and disaster aid spending was due in large part to considerable increases in crop insurance subsidy payments, resulting from substantially higher nominal prices of corn, soybeans, wheat and other heavily insured crops (Glauber 2013). The reason for that increase was straightforward and embedded in the structure of the crop insurance subsidy program. On a per acre basis, for any given level of crop insurance coverage, total premiums are essentially proportional to the per acre value of the insured crop, which itself is proportional to the price of the crop. The federal subsidy, then, is a pre-specified proportion of the total premium. When the prices of corn and other related crops more than doubled between 2009 and 2013 relative to their levels between 2002 and 2006 (largely as a result of the 2005 and 2007 Renewable Fuel Standards), crop insurance subsidy payments also increased substantially. The introduction of the SURE program further contributed to higher outlays, with annual subsidy payments under that program averaging over $1 billion annually between 2009 and 2011 (Bekkerman, Smith, and Watts, 2012).

In contrast, spending on price supports and other "traditional" commodity based subsidy programs declined substantially after 2008. Between 1996 and 2008 annual average outlays on the loan rate based price support program and other relatively long standing initiatives such as the dairy subsidy programs, the cotton export subsidy program, and the Countercyclical Payments program averaged approximately $7.8 billion. However, spending on these programs plummeted to an annual average of $1.245 billion between 2009 and 2013, largely because substantially higher prices for

corn, wheat and several other commodities meant that almost no subsidy payments were made under the loan rate and countercyclical payment programs.

Annual average direct payments program subsidies remained relatively stable over the entire 1996–2013 period, averaging between $5.1 and $5.2 billion. Spending on the direct payments program was slightly lower in 2009 –2013 because farmers were given the option of enrolling their farm in the ACRE program, in which case they became ineligible for CCP and had to accept a 20 percent reduction in their direct payments program check. As a result, depending on the crop, between 10 and 15 percent of the areas eligible for direct payments were enrolled in the ACRE program (Farm Service Agency, 2013), with corresponding reductions in direct payment subsidy expenditures.

Proportionally, therefore, the share of total spending on farm subsidies allocated to disaster aid and crop insurance programs increased from 18 percent between 1996 and 2001 to 27 percent between 2002 and 2008, and to 57 percent between 2009 and 2013. Figure shows that this share was estimated by the CBO to increase to 76 percent over in 2014–2018. However, the 2014 farm bill also shifted funding away from the direct payments program to the three new shallow loss programs for crops originally covered by the direct payments program. When the CBO's estimates of annual expected expenditures for the new shallow loss programs (approximately $2.9 billion) are included with the expected outlays on crop insurance and disaster aid, the total outlays on programs intended to prevent farmers from experiencing shortfalls in their expected average revenues increases to over 99 percent of total subsidy outlays on farm safety and risk management programs.[4]

Several analyses have raised concerns about the CBO cost estimates for the new PLC, ARC, and SCO programs. While the CBO's estimate of the aggregate annual subsidy outlays on the three programs is $2.9 billion, which assumes a continuation of relatively high crop market prices (for example, $4.55 per bushel for corn and $5.75 per bushel for wheat). Smith, Babcock and Goodwin (2012a and 2012b), for example, estimated that for the PLC and ARC programs alone, the annual costs could amount to substantially more than $6 billion if prices for corn and wheat revert back to their 2001–2006 levels (around $3 a bushel for corn and $4.30 a bushel for wheat).

The most recent (at time of writing) Food and Agriculture Policy Research Institute (FAPRI) forecast for the 2014 corn crop price is $3.40 per bushel and that these prices are likely to remain below $4.00 in 2015 and 2016 (Food and Agriculture Policy Research Institute, 2014). The 2014 FAPRI wheat price forecast is $5.98, declining to $5.39 in 2015 and potentially recovering to higher levels in subsequent years. The FAPRI soybean price forecasts are less than $10 per bushel throughout 2014–2017, which is likely to result in substantially higher PLC and/or ARC payments than those assumed by the CBO in its 2013 projections (in each year the 2013 the CBO's soybean forecast exceeded $10 per bushel). Moreover, the FAPRI forecasts assume that the Renewable Fuels Standard (RFS)—the federal ethanol mandate—will continue to be enforced, an assumption that seems less likely to hold given recent changes in the structure of the US Congress. The termination of the RFS would result in a substantial reduction in the industrial demand for corn and, quite conceivably, a substantial further reduction in the prices of corn and related feed grains and oilseeds. Hence, total annual average spending on shallow loss program farm subsidies is likely to be much larger than the $2.9 billion

CBO estimate, possibly well in excess of $5 billion (which represents higher total outlays that the now discontinued direct payments program).

Federal crop insurance in the context of the 2014 farm bill.

Over the past 25 years, the federal crop insurance program has emerged as the primary source of farm subsidies. Figure 2 shows that insured crop acreage increased from fewer than 100 million acres in 1990 to more than 285 million acres in 2013, even though the numbers of policies sold has remained relatively stable since 1997.[5] Total insured liabilities increased relatively consistently from less than $20 billion in 1990 to a peak of $119 billion in 2012, before declining to $105 billion in 2013 as a result of falling prices for heavily insured corps such as corn, soybeans, and wheat. Total premium subsidies increased roughly in proportion to liabilities from less than $200 million in the early 1990s to a peak of over $7.4 billion in 2011 (a more than 3,700 percent increase). The 2014 farm bill explicitly mandates the continuation of the federal crop insurance program, with premium subsidy rates maintained at the levels determined under the provisions of the 2000 ARPA and a requirement that administrative and operations subsidies to crop insurance companies be maintained at existing levels.

The primary reason for the expansion of insured acres under the program has been the substantial increases in premium subsidy rates that occurred as a result of the 1994 Crop Insurance Reform Act. The provisions of that Act increased average subsidy rates from 20–30 percent to over 40 percent of the estimated actuarially fair premium, and the 2000 ARPA further increased the subsidies to an average of 62 percent of the actuarially fair premium. The proportional structure of premium rate subsidies meant that during the

period when the prices of corn, wheat, soybeans and other crops experienced substantial increases, insurance coverage was provided for significantly higher liabilities and federal government expenditures on subsidies was accordingly higher as well.

Another factor contributing to the program's rapid expansion and the growth of government subsidies after 1994 was the development of revenue insurance products, as mandated by the 1994 Crop Insurance Reform Act. Revenue products combine a yield insurance guarantee with the equivalent of a subsidized futures contract and, in the most widely used revenue product (originally called the harvest price option contract), a subsidized put. Under that revenue insurance contract, if at harvest time the crop price (as measured by the relevant futures contract) exceeds the price expected at planting time when the crop was insured (using the same futures contract), then the farmer's liability for the crop is increased. In some instances, this structure can result in farmers receiving indemnities that increase their gross income above the amount that they expected when they planted the crop (Babcock, 2012). This occurred for many corn and soybean producers in 2012, when Midwest corn-belt states experienced a major drought.

Farm and other interest groups have made concerted efforts to expand the scope of subsidized insurance products since the late 1980s. The 1994 Crop Insurance Reform Act mandated the development of revenue insurance products and also provided for the development of county based are yield and revenue products (Glauber, 2013). The 2002 farm bill introduced what has become known as the 508(h) process, allowing for the development of a wide range of crop insurance product proposals. The 508(h) process allows private entities (often sponsored by producer groups) to develop niche products and then be compensated by the USDA RMA for developing those products. Most of

these initiatives appear barely to generate enough premiums to cover their development and maintenance costs, but the 508(h) process continues to be reauthorized by Congress, perhaps as a way of placating producer groups representing small acre crops.

As a result, currently over 20 different categories of insurance products exist. However, figure 3 shows that only two product categories—crop specific yield and revenue insurance based on historical farm yields in which payments are triggered by farm yields or estimated per acre revenues based on farm yields—account for over 95 percent of total federal crop insurance liability, premiums and premium subsidies. The remaining eighteen products account for less than five percent of the federal crop insurance book of business, with county-based area yield and revenue products and the rainfall index product for livestock forage accounting for more than half of that residual amount.

Through the 508(h) process, two additional initiatives were mandated in the 2014 farm bill. One is a revenue insurance product for peanut growers based on a Rotterdam price index that may not be well-correlated with domestic peanut prices, thus raising serious questions about the actuarial validity of such a product. The second is a margin insurance program for rice, which insures the difference between estimated per acre revenues and estimated variable costs. Both peanut and rice producers were recipients of substantial direct payments and both have been offered extremely favorable target prices under the new PLC program. For example, the new peanut PLC target price exceeded the national average peanut price observed in 10 of the previous 12 years in 2002–2013. It is plausible to interpret the introduction of these two new insurance products as another

means by which the peanut and rice producers are being compensated by legislators for the loss of direct payments.

The 2014 farm bill PLC, ARC, and SCO programs

The PLC, ARC, and SCO programs were established by Titles I and XI provisions of the 2014 farm bill. These programs are applied to the same commodities for which farmers received subsidies under the discontinued direct payment, CCP, and ACRE programs.[6] For each crop, a farm must choose whether to participate in the PLC program or the ARC program. If the PLC program is chosen, then the farm may also choose to obtain additional insurance coverage for the crop through the new SCO program. However, if the ARC program is chosen for the crop, then the farm cannot purchase SCO coverage for that crop.

Price Loss Coverage

The PLC program has the following structure. A reference price or "trigger" price is established for each eligible commodity. If the national average price for the crop over the crop's marketing year falls below the reference price, the farmer receives a payment equal to the difference between the crop's reference price and the national average price over the marketing year on the amount of the crop eligible for such payment. For example, if the reference price for wheat is $5.50 per bushel of wheat and the national average price of wheat for the 2014 crop year were $5.00 per bushel, the per bushel price loss coverage payment would be $0.50. Under the PLC, farms establish a historical production base. This production base is obtained by multiplying a historically

determined amount of "base acres" for the crop by an historically determined per acre base yield for the crop.

The farm receives a subsidy equal to the price loss coverage payment multiplied by 85 percent of its production base. The 2014 farm bill provides agricultural producers to use their existing base acres and base yields, which determined their direct payment subsidies, to be used for the new PLC and ARC programs. For many farms, these base acres and base yields were established on the basis of planted acres for each eligible crop either in the early and mid-1980s or between 1998 and 2001. However, farmers will also have the option of updating their production bases using more recent data on planted areas and yields.

Many farmers are likely to update their production bases to take advantage of increases in their yields over the past thirty years. For example, in the mid-1980s, the national annual average per acre yield for corn was approximately 90 bushels. Over the past five years, national corn yields have averaged 156 bushels per acre. Farms that take advantage of yield updating for corn are therefore likely to increase the per acre base yield eligible for subsidy payments by between 25 and 50 percent. Yields for many other crops have also increased substantially, making base updating attractive many farmers who plan to participate in the PLC. Under such "base updating," payment yields for each eligible crop will be set equal to 90 percent of the average yield for that crop over the five year period 2008–2012.

Subsidized PLC payments are determined by current market prices, and, in fact, the structure of the PLC is essentially identical to the CCP program. The only differences are that prices triggering payment under the PLC are much higher than those used under

the CCP program and the production bases on which PLC payments will be made are likely to be much larger for many crops because of base updating.[7]

Agricultural Risk Coverage

The agricultural risk coverage program (ARC) makes subsidy payments to farmers when, in the current year, the estimated average revenue per acre for a crop (the current year crop yield multiplied by the national average marketing year price for that crop) falls below 86 percent of the estimated historical average per acre revenue for the crop over the most recent five years.[8] On a per acre basis, ARC payments are capped at 10 percent of the five-year estimated historical average revenue.

Farmers have two options within the ARC program: to choose payments that are based on their farm's historical yields for the crop (both in computing the historical average per acre revenue for the crop and the estimated current year revenue) or based on current and historical average yields in the county in which a farm is located. If the farmer chooses to base ARC program participation on farm-level yields for a crop, ARC payments are only 65 percent of the farm's base acres for that crop. In addition, such a farm will also have to enroll all of its crops in the farm yield ARC program. Alternatively, if the farm choses to base ARC participation on county yields, it will receive ARC payments on 85 percent of the farm's base acres for each crop enrolled in the program. In addition, the farm would be free to allocate other crops to either the county-based ARC or the PLC program. Most farmers who enroll in the ARC program are likely to choose the ARC county yield option rather than the ARC farm yield option.

The ARC program is more complex than the PLC program because, regardless of the chosen ARC option, the revenue trigger for an ARC payment is likely to change

annually. However, prices used in computing the ARC per acre revenue trigger for a crop can never be less than the PLC trigger price. Thus, for example, if the price of corn falls and remains below the PLC trigger of $3.70 per bushel, the ARC trigger revenue will effectively have a floor based on that price. However, this floor is likely to increase over time because, on average, corn yields are likely to continue trending upward.

Several considerations are appropriate for understanding broader economic implications of farmers choosing to participate in these programs. First, if farmers believe that national average prices for crops such as corn are likely to fall measurably below their PLC reference prices, many of them would be likely to sign up for the PLC program. If, for example, the national average price of corn were expected to be approximately $3.40 per bushel, then the PLC payment on each eligible bushel would be $0.30. Smith and Goodwin (2014) have estimated that an updated national production base for corn would be about 12.4 billion bushels, implying an annual PLC subsidy for corn growers of approximately $3.2 billion if all growers signed up for that program. Second, as discussed above, PLC and ARC subsidy payments are likely to substantially exceed the CBO estimates used to compute the budget scores that resulted in the House and Senate agricultural committees claiming budget savings from the two programs. Third, however, as Babcock (2014) has noted, the impacts of the PLC and ARC programs on farmers' resource allocation decisions are likely to be relatively modest, as subsidies made under those programs are tied to a farm's historical planting decisions and production outcomes, and not to the farm's current year production decisions (unless the farm has chosen the ARC farm yield option).

The Supplementary Insurance Coverage Option

The SCO is an insurance product that allows farmers to obtain coverage through a group based area (county) yield or revenue insurance product for shallow losses. It is only available for crops enrolled in the PLC program. Under the SCO, farmers have the option of purchasing an area yield product that will pay them an indemnity when, at the area level, either average yields or average revenues fall below 86 percent of their expected levels. Coverage is capped at the difference between 86 percent of the expected area yield or revenue and the level of coverage selected by the farm under an underlying federally subsidized insurance contract.

For example, a farm that typically uses an insurance product based on the farm's own yield history (what is known as an actual production history (APH) yield or revenue product) may select a coverage level of 75 percent for on-farm yield losses, meaning that it will only receive an indemnity when its actual yields or revenues at the farm level fall below 75 percent of their expected level. In that case, the farm can use an SCO insurance contract where payments for losses are capped at 11 percent, the difference between 86 percent and the farm's selected 75 percent coverage level for its underlying contract.

The farmer is required to pay only 35 percent of the actuarially fair premium for an SCO contract, where the actuarially fair premium is the expected average annual indemnity payment. Moreover, in contrast to the PLC and ARC, farmers can insure and receive SCO subsidies on the total area planted to the crop in the current year. The federal government pays all SCO administrative costs and 65 percent of the actuarially fair premium. The SCO is clearly linked to and interacts with the farm's crop insurance decision in complex ways. We explore these links and their implications for both the

budgetary costs of the federal crop insurance program and farms' input use decisions, moral hazard behaviors, and the environmental implications of those behaviors.[9]

A formal analysis of the PLC-SCO and APH Crop Insurance Programs

The PLC and SCO programs can affect production and crop insurance participation decisions. These effects are illustrated in the following model for a farm producing a single crop and maximizing an expected per acre profit function, $E(\pi)$. This function which consists of expected profits from market sales (M), crop insurance (CI) indemnities, price loss coverage (PLC) payments, and supplemental coverage option (SCO) receipts,

$$E(\pi) = E(M) + E(CI) + E(PLC) + E(SCO). \quad (1)$$

Rational producers are assumed to make adjustments to changes in government programs by altering the level of their production inputs, X, and/or insurance coverage levels, c, to maximize expected profits on an insured farm. Bekkerman, Smith, and Watts (2012) derive the marginal effects associated with input level decisions in response to changes in subsidized government programs. The payment structure of the new SCO, which is inversely related to a producer's level of crop insurance coverage, implies that producers may also alter coverage levels to re-optimize their expected profits. In equation (1), the optimal values of the coverage level decision variable can be determined by setting $dE(\pi)/dc = 0$ and solving for the variable of interest.

To evaluate the marginal effect $dE(\pi)/dc$, we define the four components of the expected profit function. Expected profits from market sales are characterized as

(2)

$$E(M) = \int_0^{\infty} \int_0^{\infty} \left[rf(X)v - X - Z_1\big(c(X)\big) - Z_2(k - c(X)) \right] g(v)h(r)dvdr,$$

where $f(X)v$ represents a farmer's realized per acre yield, which is composed of a deterministic component, $f(X)$, and a multiplicative random component, v; $Z_1\big(c(X)\big)$ is the per acre premium paid for crop insurance coverage; $Z_2\big(k - c(X)\big)$ is the per acre premium paid for SCO coverage, which depends on a farmer's crop insurance coverage level decision and an exogenously determined SCO coverage cap, k; and $g(v)$ and $h(r)$ are probability density functions of random variables representing shocks to output, v, and the market price, r. We assume that the function $f(X)$ is well-behaved and twice differentiable; the price of X is normalized to one.

The per acre expected crop insurance indemnity for a yield insurance product is[10]

$$E(CI) = \int_0^{v_{ci}} p_{ci} \left(c(X)\mu - f(X)v \right) g(v)dv. \tag{3}$$

The terms p_{ci} and μ represent the projected price at which indemnifiable losses for the crop are valued and the crop's per acre APH yield, and these terms are normalized to unity without loss of generality. Crop insurance indemnities are made when a farm's production levels fall below the selected crop insurance trigger value, $v_{ci} = c(X)/f(X)$. Farms that participate in the price loss coverage program also receive expected PLC payments, the expected value of which is characterized by the function

(4)

$$E(PLC) = \int_0^{r_{plc}} 0.85[0.9b\mu\,(p_{plc} - r)]h(r)dr.$$

Expected PLC payments are a proportion of a farm's historical production capacity—the product of its base acreage, b, and its APH, μ—and the difference between a PLC reference price, p_{plc}, and the market price. These payments are made when the market price falls below the program's trigger price; that is, when $r_{plc} = p_{plc}$.

If farmers enroll in the PLC program, they may also choose to purchase the supplemental coverage option. The expected returns from the SCO program are

$$E(SCO) = \int_{v_{ci}}^{k} p_{sco}(\mu_Y - f(Y)\omega)g(\omega)d\omega, \tag{5}$$

where the payouts depend on the SCO reference price, p_{sco}, historical county level APH yields, and the realized county level per acre yield, which is composed of the deterministic component $f(Y)$ and a multiplicative random component, ω, that is distributed following the function $g(\omega)$.[11] The integration endpoints v_{ci} and k represent the fact that SCO payments are conditional on the difference between the crop insurance trigger level and the SCO cap. The term v_{ci} is a function of farmers' crop insurance coverage level decisions, implying that expected SCO payments are conditional on those decisions.

The marginal effect of crop insurance coverage level decisions on total expected profits is determined by setting

$$\frac{dE(\pi)}{dc} = \frac{dE(M)}{dc} + \frac{dE(CI)}{dc} + \frac{dE(PLC)}{dc} + \frac{dE(SCO)}{dc} = 0 \quad (6)$$

where

$$\frac{dE(M)}{dc} = -\frac{\partial Z_1}{\partial c} + \frac{\partial Z_2}{\partial c},$$

$$\frac{dE(CI)}{dc} = 1,$$

$$\frac{dE(PLC)}{dc} = 0,$$

$$\frac{dE(SCO)}{dc} = -\frac{c(x)}{f(x)^2}[1 - f(Y)].$$

The full derivation of these terms is presented in the Appendix. Assuming that $E[f(Y)] = \mu_Y = 1$, the last term is zero and the marginal effect of coverage level on expected total profit is

$$\frac{dE(\pi)}{dc} = 1 - \frac{\partial Z_1}{\partial c} + \frac{\partial Z_2}{\partial c}. \quad (7)$$

Marginal increases in a farmer's crop insurance coverage would result in higher crop insurance premium expenditures, $\frac{\partial Z_1}{\partial c} > 0$, but lower SCO coverage outlays, $\frac{\partial Z_2}{\partial c} <$

0. This implies that farmers could increase their expected total profits by altering their crop insurance coverage decisions and participating in the SCO program. For example, if the reduction of a farmer's coverage level results in an overall reduction of crop insurance and SCO premium costs relative to expected crop insurance receipts, then the farmer's total expected profits would increase. A closed-form solution for the profit maximizing coverage level could be determined under further assumptions about the function form of $Z_1\big(c(X)\big)$ and $Z_2(k - c(X))$.

In the general case shown above, setting $\frac{dE(\pi)}{dc} = 0$ and solving for $\frac{\partial Z_1}{\partial c}$ can provide insights about an individual farmers' crop insurance coverage decision; that is, $\frac{\partial Z_1}{\partial c} = 1 + \frac{\partial Z_2}{\partial c}$. This equality indicates that $\frac{\partial Z_1}{\partial c}$ decreases with the introduction of the SCO program, implying that farms can increase their expected profits by lowering their crop insurance coverage levels. While the extent to which this re-optimization behavior occurs is dependent on the existing crop production and insurance conditions for an individual farm, the general inference is that the SCO program allows farmers to shift some portion of their production and financial risk to the new, highly subsidized supplementary insurance instrument. As a result, the introduction of the SCO program is likely to reduce the portion of crop insurance premiums collected from agricultural producers without also reducing the amount of liabilities. The difference will be made up through increased taxpayer outlays.

At the same time, however, a reduction in the farm's underlying multiple peril coverage is likely to reduce incentives for moral hazard behaviors, with the consequence (at the margin) of increasing incentives for the use of risk reducing inputs such as herbicides and pesticides, as well as yield increasing inputs such as nitrogen fertilizer.

The implication is that the environmental consequences of the SCO at the intensive margin are likely to be adverse. At the extensive margin, the incentives associated with the likely overall increase in subsidies tied to the joint multiple peril and SCO insurance products would be for farmers to expand their production of crops, perhaps into areas where soils are more erosive.

Conclusion

In many ways, describing the existing insurance program and the new SCO insurance and shallow loss programs as "risk management" programs is really an oxymoron. As discussed above, those programs provide few incentives for farmers to reduce the production risks they face, which are also substantial sources of price volatility at the aggregate market level. In fact, the empirical evidence (reviewed by Goodwin and Smith, 2013b) consistently indicates that precisely the opposite is the case for farm yield based insurance products that are 95 percent of the subsidized insurance book of business in the United States. While the programs may allow farmers to face fewer financial risks, the programs' structure of transferring farmers' financial risks to society as a whole via government subsidies is likely to increase the underlying variability in the value of agricultural products. In addition, in the case of the SCO, the environmental consequences are likely to be adverse.

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Endnotes

[1] As Goodwin (2011) points out, there is a direct analogy between the incentives created by subsidized crop insurance programs for increased risk taking by farmers and the incentives created for increased risk taking by financial institutions when they are able to offload those risks onto the federal government (as in the 1980s savings and loan crisis) or other private sector institutions (as in the 2007–2008 mortgage loan crisis).

[2] The STAX program is also a shallow loss program in that it provides payments to farmers when, at the county level, per acre revenues fall below 90 percent of their expected levels. It is also coupled to current production because farmers are able to enroll every acre planted to cotton in the program. Thus, in the context of the WTO, the STAX program is clearly an orange box program viewed as providing production distorting subsidies.

[3] Traditional price support programs include price support loans, countercyclical, market loss assistance, loan deficiency, cotton competitiveness, marketing assistance loans, and loan implementation payments. Direct payments are production flexibility contracts, direct payments, deficiency, diversion, dairy milk income loss, and oilseed payments. Crop insurance payments are determined as the sum of indemnity outlays, subsidies on premiums, and administrative subsidies less the collected premiums. Lastly, disaster payments include all ad-hoc, SURE program, and noninsured assistance payments.

[4] The CBO estimates also included outlays on conservation programs. The expenditures on conservation programs authorized under the 2008 farm bill have been approximately $6 billion annually. They are projected by the CBO to average approximately $5.5 billion annually under the provisions of the 2014 farm bill (CBO, 2014).

[5] After spiking in 1995 and 1996 because of certain provisions in the 1994 Crop Insurance Reform Act linking eligibility for other USDA programs to crop insurance purchases, purchased crop insurance policies reverted to lower levels after the 1994 provisions were rescinded.

[6] The eligible crops include wheat, corn, grain sorghum, barley, oats, rice, peanuts, soybeans, other oilseeds, chickpeas, dry peas, and lentils. Cotton is excluded because it is served by the STAX program.

[7] For example, the price that would trigger a PLC payment for corn, $3.70 per bushel, is 57 percent higher than the price that would have triggered a CCP payment under the provisions of the 2008 farm bill, $2.35 per bushel. Similarly, the PLC trigger price for wheat is 5 percent higher than its CCP trigger price and the PLC trigger price for soybeans is 66 percent higher.

[8] The historical average revenue for a crop is computed by multiplying the crop's estimated five-year Olympic national average price (as reported by the USDA National Agricultural Statistical Service) by the relevant five year crop yield Olympic average (at either the county level or the farm level depending on the ARC option selected by the farm).

[9] It should be noted that the Stacked Income Protection Plan (STAX) for cotton is very similar to the SCO insurance program for other crops. It is also an area (county) based insurance product in which payments are triggered if, at the county level, actual county average revenues (actual county average yields multiplied by the national average cotton price) fall sufficiently below their expected levels. However, it differs in two important ways that make indemnity payments more likely and, on a per-unit of cotton production

basis, subsidies larger. First, cotton producers will receive STAX payments when county wide average revenues fall below ninety percent of their expected levels. Second, the subsidy rate will be larger; farmers will only pay 20 percent of the estimated actuarially fair premium with the federal government picking up all other costs. Given the volatility of cotton prices within any given year, on an annual basis payments under this program may often be substantial and, on a per-pound of cotton basis, proportionally also quite substantial.

[10] It is straightforward to characterize this function for other crop insurance products.

[11] The terms p_{sco} and μ_Y are normalized to unity without a loss of generality.

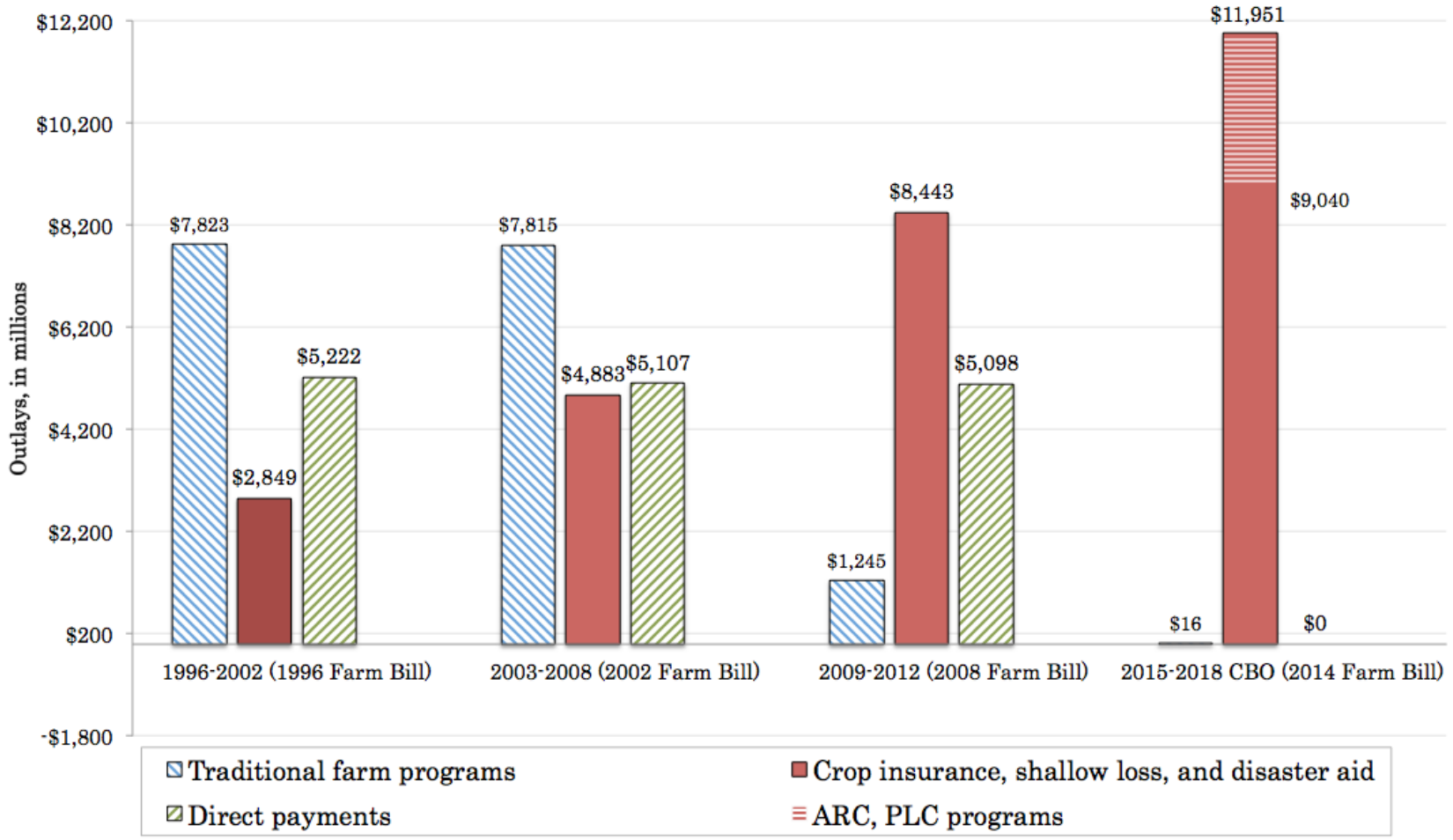

Figure 1: Government actual and projected expenditures on agricultural commodity programs by type, 1996–2018

Sources: Actual expenditure data are from the Commodity Credit Corporation "Commodity Estimates Book" table 35, the Environmental Working Group, and the USDA Office of Inspector General's "Federal Crop Insurance Corporation/Risk Management Agency's Financial Statements." The Congressional Budget Office's (CBO's) projections are from the January 27, 2014 estimates. Traditional price support programs include price support loans, countercyclical, market loss assistance, loan deficiency, cotton competitiveness, marketing assistance loans, and loan implementation payments. Direct payments are production flexibility contracts, direct payments, deficiency, diversion, dairy milk income loss, and oilseed payments. Crop insurance payments are determined as the sum of indemnity outlays, subsidies on premiums, and administrative subsidies less the collected premiums. Lastly, disaster payments include all ad-hoc, SURE program, and noninsured assistance payments.

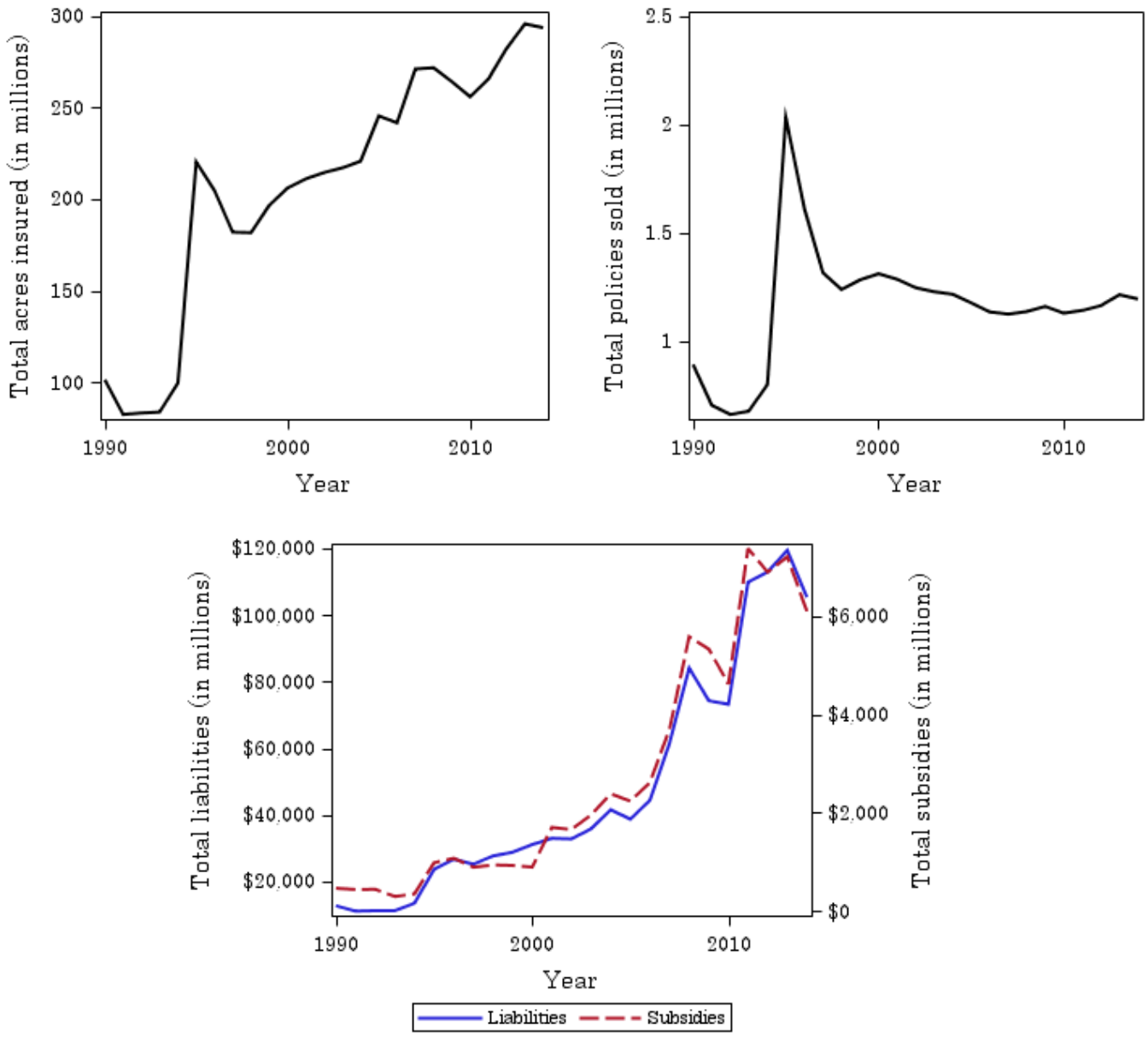

Figure 2: Total insured acres, policies sold, liabilities, and subsidies for crop insurance programs, 1990–2013

Notes: The data are collected from the USDA Risk Management Agency's Summary of Business reports. Total subsidies include both premium subsidies and administrative expense reimbursements.

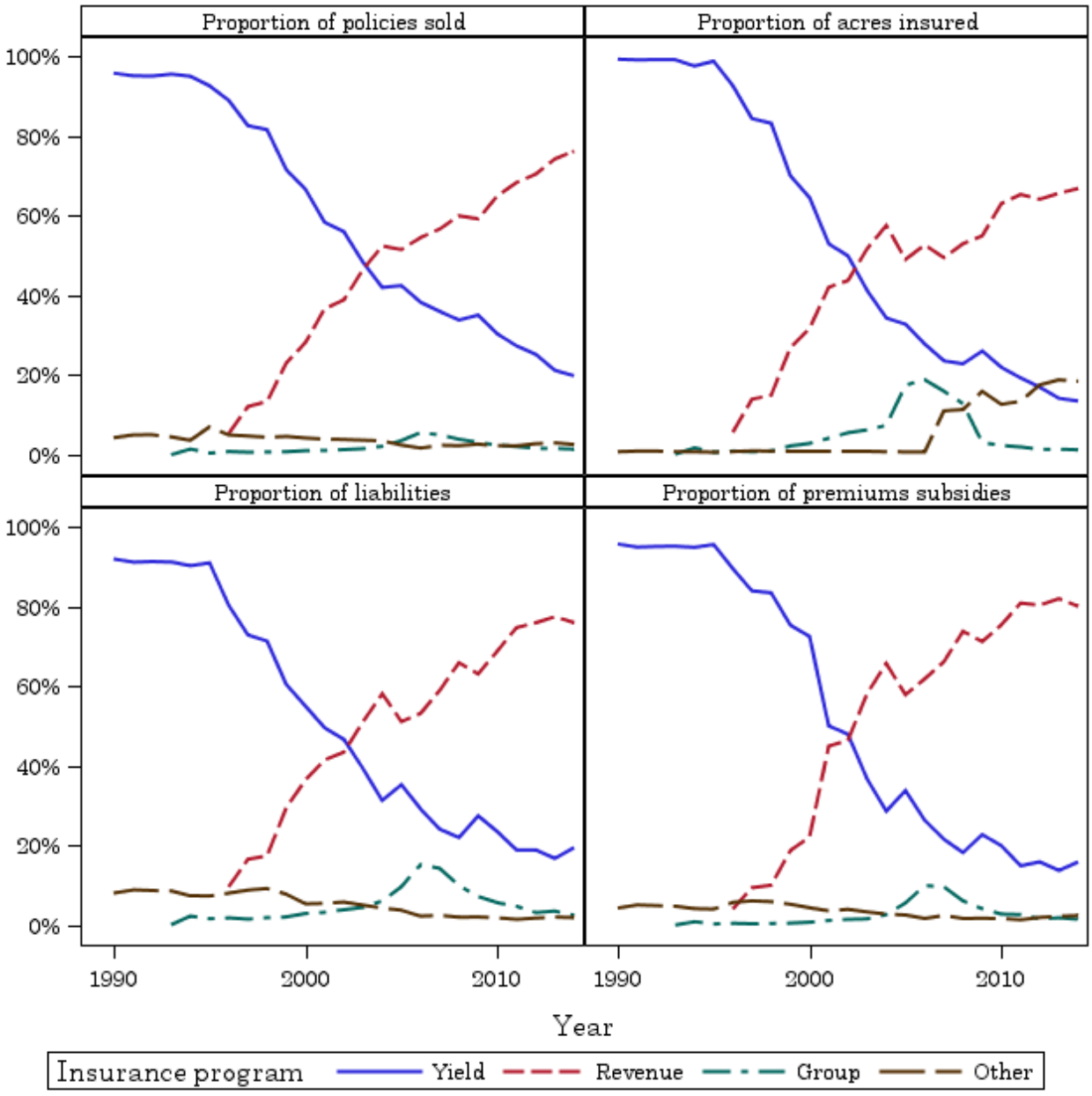

Figure 3: Proportion of policies sold, acres insured, liabilities, premium subsidies by crop insurance program category, 1990–2013

Notes: The data are collected from the USDA Risk Management Agency's Summary of Business reports. Premium subsidies do not include administrative expense reimbursements.

Appendix

The marginal effects of coverage levels on the expected profit components are as follows.

Farms' expected market profits

$$E(M) = \int_0^{\infty}\int_0^{\infty}\left[rf(X)v - X - Z_1\big(c(X)\big) - Z_2(k - c(X))\right]g(v)h(r)dvdr$$

$$\frac{dE(M)}{dc} = \int_0^{\infty}\int_0^{\infty}\left[-\frac{\partial Z_1}{\partial c} + \frac{\partial Z_2}{\partial c}\right]g(v)h(r)dvdr = -\frac{\partial Z_1}{\partial c} + \frac{\partial Z_2}{\partial c} \quad \text{(A.1)}$$

Farms' expected crop insurance indemnities

$$E(CI) = \int_0^{v_{ci}} p_{ci}\,(c(X)\mu - f(X)v)g(v)dv$$

$$\frac{dE(CI)}{dc} = \int_0^{v_{ci}} \frac{\partial c(X)}{\partial c}\,g(v)dv = 1 \quad \text{(A.2)}$$

Farm's expected Supplemental Coverage Option program payments

$$E(SCO) = \int_{v_{ci}}^{k} p_{sco}(\mu_Y - f(Y)\omega)g(\omega)d\omega$$

$$E(SCO) = \int_0^{k} p_{sco}(\mu_Y - f(Y)\omega)g(\omega)d\omega - \int_0^{v_{ci}} p_{sco}(\mu_Y - f(Y)\omega)g(\omega)d\omega \quad \text{(A.3)}$$

$$\frac{dE(SCO)}{dc} = \frac{\partial v_{ci}}{\partial c}\left[p_{sco}\left(\mu_Y - f(Y)\frac{c(X)}{f(X)}\right)\right] = -\frac{1}{f(X)}\left[p_{sco}\left(\mu_Y - f(Y)\frac{c(X)}{f(X)}\right)\right]$$

Normalizing $p_{sco} = 1$ and $\mu_Y = 1$, equation (A.3) simplifies to $\frac{dE(SCO)}{dc} = -[1 - f(y)]\frac{c(X)}{f(X)^2}$.