Potential Distortionary Effects of Relocating Generic Base Acres

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Abstract:

The Agricultural Act of 2014 brings significant changes to U.S. farm policy, eliminating Countercyclical (CC), Fixed Direct, and Average Crop Revenue Election (ACRE) programs, and introducing new Price Loss Coverage (PLC) and Agriculture Risk Coverage (ARC) programs, which provide payments calculated using historic (base) acreage. These payments support field crops, excluding cotton. As a result, producers with base acres associated with cotton production will be allowed to relocate these "generic base" acres annually and receive support for whatever supported crop they plant on these generic base acres. Thus, profit maximizing producers with generic base may stop planting cotton and instead plant crops supported by PLC and ARC programs. Using USDA data, this paper investigates the potential distortions associated with the reallocation of generic base acres as farmers "plant for the program."

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The road to passing the most recent comprehensive, omnibus agriculture farm bill, albeit never smooth, was rockier than usual. For the first time ever, the House of Representatives voted down a version of the bill in the summer of 2013. However, after several delays and the failed vote in the House, the Agricultural Act of 2014 (P.L. 113-79) was passed into law in February of 2014. The new farm bill introduces the most far reaching policies changes since the 1996 farm bill (P.L. 110–234). Policy changes in the 1996 bill were largely driven by efforts to comply with World Trade Organization (WTO) obligations, stipulating member nations must reduce their use of production-promoting and trade-distorting agricultural policies.

Despite Congress' efforts to reform U.S. agricultural policy and meet WTO obligations, in 2002, Brazil brought claims to the WTO dispute settlement body, arguing that U.S. cotton subsidies violated these obligations. Brazil eventually won the dispute and American taxpayers promised to pay Brazil $147.3 million each year until "successor legislation" was passed (United States Trade Representative 2010). As a result, for the first time in the 81 year history of field crop subsidy programs, cotton was singled out in the 2014 farm bill and will be subsidized under a different set of programs than the other "program crops", which include corn, wheat, barley, and oats. Specifically, cotton is excluded from two new crop programs: a modified countercyclical payment program called Price Loss Coverage (PLC), which provides payments based on historic production (acreage and yields during a set historic time period) when prices fall below reference prices, and Agriculture Risk Coverage (ARC), which provides payments when revenues falls below benchmark revenues. The new farm bill also expands the existing subsidized crop insurance program (CIP) by introducing two shallow-loss insurance programs: the Supplemental Coverage Option (SCO) program, which is available to cotton and other grain crop producers, and the Stacked Income Protection Plan (STAX) program, which is only available to cotton producers. Both SCO and STAX complement the longstanding CIP.

The Agricultural Act of 2014 also eliminated Countercyclical (CC), Fixed Direct (FD), and Average Crop Revenue Election (ACRE) payment programs. The CC program provided payments based on historic production when effective prices fell below target prices, while the FD program provided fixed annual payments based on historic production. For both programs, historic production was determined by crop specific acreage and yields during a specific previous time period. These historic acres are referred to as “base acres”. While cotton producers are no longer entitled to payments calculated using base acres such as payments under the new PLC program or ARC program, cotton producers with historic base acres associated with cotton production now have the ability to reassign these cotton base acres, referred to as “generic base”, each year to another planted program crop (i.e., corn, soybeans, wheat, etc.). For that year, those generic base acres are considered base acres for the program crop to which they were assigned for the purposes of calculating program payments.

Thus, while these unprecedented changes to the treatment of cotton in the new farm bill make significant progress towards reforming cotton subsidy programs, the producers’ ability to reallocate generic base acres each year has the potential to cause producers to “plant for the program”. Since target support prices are known when planting decisions are made, producers with generic base acres can use this information, in conjunction with information pertaining to input prices and expected output prices, to make planning decisions. As a result, production distortions are likely.

Using United States Department of Agriculture (USDA) data and simulation analyses, these potential production distortions are analyzed. Specifically, I analyze the impacts of reallocating generic base acres on farmland acreage allocations, yields, and prices using estimated elasticities. Area and yield elasticities are estimated directly using traditional methods as well as calculated from the parameters of the Chambers and Just (1989) profit function following the method outline by Arnade and Kelch (2007). The analysis focuses on fifteen states with cotton base acreage under the 2008 farm bill. The analysis is conducted for the entire U.S. as well as four cotton producing regions: the Southeast, the Delta, the Southern Plains and the Southwest.

Overview of 2014 Farm Bill Policies

The Agricultural Act of 2014 eliminated CC, FD, ACRE and disaster payments for program crops, replacing them with new programs such as PLC, ARC, SCO and STAX. PLC is a modified countercyclical payment program, which replaces the CC program and works in a similar manner. ARC essentially replaces ARCE; ARC provides revenue protection by providing payments when actual revenues falls below benchmark revenues. Cotton production is excluded from both PLC and ARC programs, while producers with base acres of other program crops must choose between the two programs. These program election decisions are binding for the duration of the farm bill period. Furthermore, acres enrolled in ARC are not eligible to participate in the SCO program. PLC and ARC covered commodities included barley, corn, grain sorghum, oats, peanuts, rice, soybeans, wheat and other oilseeds (canola, crambe, flax, mustard, rapeseed, safflower, sesame, and sunflower).

Under the PLC program, producers with historic production of the enrolled covered commodity receive a payment when the effective price of the covered commodity for the crop year is less than the reference price for the covered commodity for the crop year. The effective price is the higher of the 12 month national average market price or the 12 month national average loan rate. The reference prices for each covered commodity are stated in the 2014 farm bill and are summarized in table 1; on average, these reference prices are 39 percent higher than the support prices associated with the CC program under the 2008 farm bill. PLC payments are awarded to 85 percent of base acres. Hence, crop specific PLC payments are calculated as:

$$(1) \qquad P^{PLC} = \max\left(P_t^{REF} - P_t^{EFF}, 0\right) \times .85 B_l \times \bar{Y}$$

where P_t^{PLC} is the crop specific PLC payment at time *t*, P_t^{REF} is the reference price stated in the farm bill for time *t*, P_t^{EFF} is the effective price for time *t* as discussed above, B is the producer's base acres of the covered commodity and $\bar{\mathrm{Y}}$ is historic yield.

Producers selecting to participate in the ARC program must choose between individual or county-level coverage. If individual coverage (ARC-individual) is selected, payments are triggered when actual revenue is less than 86 percent of farm-level benchmark revenue with payments calculated on 65 percent of base acres. If ARC-individual is selected, the producer must enroll all eligible crops. If county-level coverage (ARC-county) is selected, payments are triggered when actual revenue is less than 86 percent of county-level benchmark revenue with payments calculated on 85 percent of base acres. If ARC-county is selected, the producer is allowed to choose which crops to enroll in ARC versus PLC on a commodity-by-commodity basis. The maximum possible payment under either option (ARC-individual or ARC-county) is 10 percent of the benchmark revenue. Individual benchmark revenue is the product of the five year Olympic average of farm yield (with lower bound at 70 percent of transitional yield) and the 12 month national average market price (with lower bound at the reference price pro-rate to reflect crop mix). Per-acre individual actual revenue is the product of total production and the higher of 12 month national average market price or 12 month national average loan rate summed across crops and then divided by acres planted. County benchmark revenue is calculated as an Olympic five year average of historical county yields (with lower bound at 70 percent of transitional yield) multiplied by the Olympic five year 12 month national average market price (with lower bound at reference price). Actual county revenue is calculated as the actual average county yield for the crop year multiplied by the higher of 12 month national average market price or 12 month national average loan rate. Hence, ARC payments are calculated as:

$$P_t^{ARC} = \min[\max(0, 0.86\,\mathrm{G}_t^{ARC} - R_t^{ARC}), 0.10\,\mathrm{G}_t^{ARC}] \times \phi\,\mathrm{B}_\mathrm{t}$$

where P_t^{ARC} is the ARC payment at time t, G_t^{ARC} is the per-acre benchmark revenue (individual or county depending on program election), R_t^{ARC} is the corresponding per-acre actual revenue for the crop year (individual or county depending on program election), and ϕ is 65 percent if ARC-individual is selected and 85 percent if ARC-county is selected.

Both PLC and ARC payments are calculated using historic production values (base acres and historic yields). Under the 2014 farm bill, landowners are given the option to update their base acres and yields. Thus, landowners have the option of continuing to have payments calculated based on base acreage and yields used to calculate payments under the 2008 farm bill or they can update base acres to the crops grown in 2008-2012 and update yields to 90 percent of 2008-2012 average yields. Landowners make updating decision on commodity-by-commodity basis. While landowners must decide whether or not to update their base acres and yields, farm operators decide in which program to enroll specific base acres with the operators receiving the payments.

As previously stated, operators make a one-time program election for the entire farm bill period. If the operators do not elect either PLC or ARC or fail to unanimously agree if there are multiple farm operators, then, by default, the acreage is placed into the PLC program and operators must forego receiving payments for one year.

While cotton base acres are not eligible to receive either PLC or ARC payments, producers with historic cotton base acreage, now referred to as generic base, may reallocate these generic base acres to which ever planted covered commodity they choose. In addition, they have the ability to reallocate these generic base acres each year. For example, if an operator has 100 cotton base acres (generic base acres) he may choose to plant 75 of those acres with corn and the remaining 25 to wheat, assuming that the operator enrolled in ARC-county for corn and PLC for wheat, then the 75 acres planted with corn will be treated as corn base acreage in that crop year and receive a ARC-county payment if one is triggered, the other 25 acres planted with wheat would be wheat base acres for that crop year and used in the calculation of wheat PLC payments if a payment is triggered. Given the ability to reallocate generic base acreage each year, producers attempting to maximize profits will allocate their generic base acreage to the most profitable covered commodity and plant those acres with the associated crop. Hence, the ability to reallocate base acres entices farm operators to "plant for the program." This paper aims to measure the potential production distortions associated with the annual reallocation of base acres. Table 2 summarizes base acreage under the 2008 farm bill and production for 2009 – 2013 by commodity. As shown, approximately 18 million acres of generic base acres may now be reallocated to other crops on an annual basis.

Producer aiming to maximize profits will use price projection to determine in which program to enroll each covered commodity as well as use this information to make planting decisions. When the low price estimates of WASDE projections are used, all commodities except medium/short grain rice and soybeans will receive a payment under either the ARC or PLC program (Zulauf and Schnitkey 2014). However, these prices will not trigger payments under the ARC-county program for long grain rice or under the PLC program for oats and wheat. At these prices levels, both programs will make payments for barley, corn, and sorghum. At these predicted prices, enrollment in ARC has expected higher payments for corn, oats, and wheat, while PLC has higher expected payments for barley and sorghum (Zulauf and Schnitkey 2014). To give some sense of the potential size of these payments, the highest expected per-acre payment using the low range WASDE price projections is for long grain rice at $120 per-acre under the PLC program; the next highest per-acre payment at these low price estimates is $79 per-acre for corn under the ARC-county program (Zulauf and Schnitkey 2014).

The 2014 farm bill also introduces a special revenue insurance program for cotton, Stacked Income Protection Plan (STAX). STAX is similar to the SCO for which cotton is also eligible. Both STAX and SCO reduce insurance deductibles by covering shallow losses. Eligibility for participating in SCO is contingent upon participating in the CIP, while participation in STAX is not contingent upon participation in the CIP. Acres enrolled in STAX are not eligible for SCO. Given higher subsidies on STAX premiums (80 percent for STAX versus 65 percent for SCO) and higher coverage rates (maximum of 90 percent for STAX and 86 percent of SCO), it is likely that cotton producers will elect to participate in STAX over SCO. Given the complexity of these programs and participation and coverage level decisions, these programs are not analyzed in the following analyses; instead the analyses focus on the impacts of reallocating generic base acreage.

The new farm bill also continues the longstanding nonrecourse marketing assistance loan (MAL) and loan deficiency payment (LDP) programs for all program crops including cotton. However, the 2014 farm bill requires cotton loan rates to decline (up to 10%) with market prices; this is not required for other crops. Loan rates for the other program crops are stated in the bill. The MAL program assists farmers by supporting commodity prices and providing short-term financing, enabling farmers to pay their bills soon after harvest while spreading sales over the marketing year. If the market price is below the loan rate at maturity, MAL recipients are allowed to forfeit the commodity pledged as collateral to the Commodity Credit Corporation (CCC) in satisfaction of loan repayment. Alternatively, in lieu of receiving MAL, eligible producers can elect to receive loan deficiency payments (LDP), which pay producers the difference between the market price and the support price (loan rate). LDP were introduced in the 1985 farm bill to reduce deliveries of pledged collateral to the CCC and hence reduce the costs associated with the MAL program.

The next section formally presents the decisions faced by the farmer operator. Specifically, operators must decide in which programs to enroll each commodity, crop mix and input mix. [1]

Theory

Assume that farmers maximize their expected profits, including profits generated by production and participating in farm program, by choosing the optimal program participation, allocation of acreage, and use of other production inputs. Equation 3 illustrates the expected utility maximization problem of a typical farmer where both acreage A and quantity of inputs X are choice variables. Let E be the expectation operator over the random variables, output prices and yields. We consider three types of government payments: loan deficiency payments, PLC payments and ARC payments.

[1] Decisions to update base acreage and yields are not addressed in order to focus on the potential impacts of the reallocated generic base acreage each year.

(3)

$$\max E\left[\pi_t\right]=$$

$$\max E\Bigg[\sum_{i=1}^{I}\Big[P_{it}\left(\tilde{A}_{it},\tilde{Y}_{it}\right)\times Y_{it}\left(\mathbf{X_{it}},t,\varepsilon\right)\times A_{it}+\Big[\max\Big(P_t^{LDP}-\Big(P_{it}\left(\tilde{A}_{it},\tilde{Y}_{it}\right)-\eta_i\Big),0\Big)\times Y_{it}\left(X_{it},t,\varepsilon\right)\times A_{it}\Big]$$

$$-\left(\sum_{j=1}^{J}\omega_{jt}X_{ijt}\right)-r_{it}A_{it}-C_{it}\left(A_{it-1}\right)\Bigg]+\sum_{k=1}^{K}\Big[\min[\max(0,0.86\,\mathrm{G}_{kt}^{ARC}-R_{kt}^{ARC}),0.10\,\mathrm{G}_{kt}^{ARC}]\times\phi\,\mathrm{B}_{\mathrm{kt}}\Big]$$

$$+\sum_{l=1}^{L}\Big[\max\Big(P_{lt}^{REF}-\Big(P_{lt}\left(\tilde{A}_{lt},\tilde{Y}_{lt}\right)-\mu_l\Big),0\Big)\times .85B_{lt}\times\bar{Y}_l\Big]\Big)\Big]$$

$$\text{s.t. } L_t=\sum_{i=1}^{I}A_{it}$$

The producer maximizes expected profit by deciding which of the *i* crops to produce, how many acres to allocate of each crop, the quantity of inputs to apply to each crop acre at time *t*, and which commodities to enroll in each program (PLC or ARC). For simplicity, we assume that the producer choose his crop mix from only the set of program crops or leaving the land fallow (idle), and hence $i\in\left\{\text{program crops including cotton, idle}\right\}$. Profit is the difference between revenue (including revenues received from market activity and participation in government program) and costs. $P_{it}\left(\tilde{A}_{it},\tilde{Y}_{it}\right)$ is the expected market price received by the producer for the i^{th} crop at time *t*; it is a function of aggregate acres planted by all producers, $\tilde{A}_{it}$, and average aggregate yield on all acres planted, $\tilde{Y}_{it}$. $Y_{it}\left(\mathbf{X_{it}},t,\varepsilon\right)$ is the average per-acre yield on the producer's acres planted with the i^{th} crop at time *t*; it is a function of input use at time *t*, where input use is represented by the vector $\mathbf{X_{it}}$; time *t* representing the technology and production methods available, and ε, a stochastic component allowing for exogenous variants such as weather, pests infestation or disease. A_{it} is the number of acres of the i^{th} crop planted by the producer at time *t*. The product of $P_{it}\left(\tilde{A}_{it},\tilde{Y}_{it}\right)$, $Y_{it}\left(\mathbf{X_{it}},t,\varepsilon\right)$ and A_{it} represents market revenues.

All program crops, including cotton, are entitled to non-recourse marketing assistance loans (MAL) and loan deficiency payments (LDP) under the 2014 farm bill. MAL and LDP coupled payments are paid on actual production (the product of $Y_{it}\left(\mathbf{X_{it}}, t, \varepsilon\right)$ and A_{it}) when P_t^{LDP} exceeds the posted county price. I allow P_t^{LDP} to represent MAL or LDP depending on the producers program enrollment. To maintain tractability of the model, I follow Bhaskar and Beghin (2010) by using η_i to link $P_{it}\left(\tilde{A}_{it}, \tilde{Y}_{it}\right)$ and the posted county price, where η_i is the average gap between season average price and the posted county price. This abstraction eliminates introducing another stochastic variable to the model.

The cost of input *j* associated with the i^{th} crop at time *t* is the product of ω_{jt}, the unit cost of input *j*, and X_{ijt}, the amount of input *j* used to produce the i^{th} crop at time *t*. r_{it} is the per-acre variable cost of land associated with the i^{th} crop at time *t*. I allow some of the inputs to be quasi-fixed factors that cannot be allocated to the production of another output. For example, a cotton harvest can only be used to harvest cotton and is no use in the production of corn. C_{it} is the fixed costs associated with the i^{th} crop at time *t* and is a function of production decisions in the previous time period and hence captures crop rotation decision and constraints as well has asset fixity.

As discussed in the previous section, for program crops other than cotton, the producer may elect to participate in either the ARC or PLC program. The producer is also allowed to reallocate his generic base acres to any program crop of his choosing each year. Thus, the second to last term in Equation 3 represents potential payments associated with the *K* crops enrolled in the ARC program and the last term in Equation 3 represents potential payments associated with the *L* crops enrolled in the PLC program. Note that $P_{lt}^{\text{REF}} = \left(P_{lt}\left(\tilde{A}_{lt}, \tilde{Y}_{lt}\right) - \mu_l\right)$; again this abstraction eliminates introducing another stochastic variable to the model. Also, note that $K \supseteq I$, $L \supseteq I$, and $K \cap I = \varnothing$. It should also be noted that the farmer receives PLC and ARC payments even if the associated base acres are planted with a different program crop unless the base acres are generic base acres. If the base acres are generic base, then the acres must be planted with the specific crop to receive the payment. Thus, $B_k = \tilde{B}_k + \widehat{B}_k$, where $\tilde{B}_k$ represents historic base acres associated with production of the k^{th} commodity and $\widehat{B}_k$ represents generic base acres reallocated to the k^{th} commodity with $\widehat{B}_k$ less than or equal to the total acreage planted in the k^{th} commodity.

As the constraint suggests, the sum of total acres planted of the *I*-1 program crops must be less than or equal to the total acres operated by the farm. It is possible to optimize profit by having idle acreage A_{idle}. Thus, if both planted acreage and idle acreage are included in the profit maximization model, the sum of total acres planted of the *I* crops equals the total acres operated by the farm, *L*, and the constraint binds. Note, however, that total acreage operated is not fixed across time because farmers can buy, sell, rent, or lease land.

I assume that production decisions are made in the presence of output price and yield uncertainty. Input costs are assumed to be known when acreage decisions are made. Thus, within the profit function, uncertainty lies with revenues, not costs. The farmer solves the problem presented in equation 3 by selecting acreage, program participation and other input uses to maximize expected profit. This yields *I* reduced form acreage equations for each time period *t*:

$$(4) \qquad A_{it} = f\left(\mathbf{P_t}, \mathbf{P_t^{LDP}}, \boldsymbol{\eta}, \boldsymbol{\omega}_\mathbf{t}, \mathbf{r_t}, \mathbf{A_{t\text{-}1}}, \mathbf{G_t^{ARC}}, \mathbf{P_t^{REF}}, \boldsymbol{\gamma}, \mathbf{B_t}, \mathbf{\bar{Y}_t}\right).$$

And *J* reduced form input equations:

$$(5) \qquad X_{jt} = f\left(\mathbf{P_t}, \mathbf{P_t^{LDP}}, \boldsymbol{\eta}, \boldsymbol{\omega}_\mathbf{t}, \mathbf{r_t}, \mathbf{A_{t\text{-}1}}, \mathbf{G_t^{ARC}}, \mathbf{P_t^{REF}}, \boldsymbol{\gamma}, \mathbf{B_t}, \mathbf{\bar{Y}_t}\right).$$

where $\mathbf{P_t}, \mathbf{P_t^{LDP}}, \boldsymbol{\eta}, \boldsymbol{\omega_t}, \mathbf{r_t}, \mathbf{A_{t-1}}, \mathbf{G_t^{ARC}}, \mathbf{P_t^{REF}}, \boldsymbol{\gamma}, \mathbf{B_t}$, and $\mathbf{\bar{Y}_t}$ are vectors.

Ultimately to determine the potential impact of the ability to reallocate generic base, own-price and cross-price elasticities are necessary. The next section discusses the estimation procedures used to obtain elasticity estimates to be used in a series of simulation analyses.

Methodology and Data

Since the PLC and ARC programs have not yet began, it is necessary to simulate potential responses to these programs. To do so, I estimate own-price and cross price elasticities using support price data from the 1996, 2002 and 2008 farm bills and USDA-National Agricultural Statistical Service (USDA-NASS) Quick Stata data pertaining to state-level acreage, yields and producer prices for the years 1996-2013 as well as farm-level USDA-NASS Agricultural Resource Management Survey (ARMS) data pertaining to crop mix, acreage, yields, and input use for the same time period. All prices are adjusted by the consumer price index (U.S. Department of Labor Bureau of Labor Statistic 2014), and hence are in real dollars.

Prior to changes introduced in the 1996 farm bill, the producers' production decisions were significantly influenced by their acreage allotment (e.g., Duffy, Richardson and Wohlgenant 1987; Morzuch et al. 1980). Under acreage allotment programs, the total aggregate acreage needed to produce a specific target quantity of a particular crop was determined at the national level and producers were awarded rights to produce the commodity on a set number of acres (their acreage allotment) based on their prior production. Producers received high support prices on quantities produced on their allotment and lower prices or even penalties on production exceeding their allotment. Thus, allotment allocations essentially dictated production decisions. For this reason, I use data after 1996 to estimate the elasticities. However, it should be noted that allotment programs for some commodities continued after 1996 for example peanuts and sugar.

Since the central research question pertains to the potential distortions associated with reallocating generic base acreage, the elasticities will be estimated using data from fifteen states with cotton base acreage under the 2008 farm bill. The analysis is conducted for the entire fifteen cotton producing states (which I refer to as the entire U.S.) as well as four cotton producing regions: the Southeast (Alabama, Florida, Georgia, North Carolina, South Carolina, and Virginia), the Delta (Arkansas, Kansas, Louisiana, Mississippi, Missouri, and Tennessee), the Southern Plains (New Mexico, Oklahoma, and Texas) and the Southwest (Arizona and California).

ARMS data indicates that a relatively high percentage of cotton producers also produce other program crops. Table A.1, in the appendix, shows that a fairly higher percentage of cotton producers also produce corn, peanuts, sorghum, soybeans or wheat. This suggest that cotton producers already own the fixed factors necessary to produces other crops, providing some evidence that cotton producers may shift production away from cotton in order to capture PLC or ARC payments.

Until recently, area elasticities and/or yield elasticities have been estimated separately to determine supply responses to prices. However, duality-based models suggest that supply elasticities must be derived from a consistent theoretical framework. Fortunately, Arnade and Kelch (2007) have developed a consistent theoretical framework to jointly estimate area and yield responses, which builds on Chambers and Just (1989) works. Using the methods proposed by Arnade and Kelch (2007), area and yield elasticities can be calculated from the estimated parameters of the Chambers and Just (1989) (C and J) profit function, which allows for quasi-fixed inputs. Specifically, Chambers and Just (1989) model the producer's decisions as consisting of two steps: first, choosing the optimal levels of outputs and variable inputs and, second allocating quasi-fixed inputs such as land to the production of particular products.

While estimating area and yield elasticities jointly using Arnade and Kelch (2007) approach maybe superior, the USDA continues to predict agricultural supply by estimating yield and acreage elasticities separately (Arnade and Kelch 2007). Thus, I also estimate acreage and yield responses directly. These estimations employ panel state-level data and do not require any assumptions about the functional form of the profit function, while estimates obtain using the Arnade and Kelch (AK) method employ cross-sectional farm-level data and require assumptions about the functional form of the profit function. Hence, both have benefits and drawbacks.

I begin by estimating the yield and acreage elasticities separately using traditional methods. Since both expected market price and government support programs influence producers' acreage and yield decisions, it is necessary to construct a supply-inducing price which incorporates farm program provisions and market price into one supply-inducing price. Shumway (1983) constructs the supply-inducing price as the higher of the lagged market price or the support price, $Max(P_{t-1}, P_t^{LDP})$. The problem with this approach is that in years when market prices are high it assumes that government support policies have no effect on producers' decisions. Thus, following Romain (1983) and Duffy, Richardson and Wohlgenant (1987), I also construct the supply-inducing price as:

$$(6) \qquad SP_t = WG_t \times P_t^{LDP} + (1 - WG_t) \times P_{t-1}$$

where $WG_t = 1/(1 + (\mathrm{P}_{t-1}^{EFF} / P_t^{LDP})$. This specification of the supply-inducing price places some weight on the support price even when the expected market price (lagged price) exceeds the support price. The expected market price is the realized producer price from the previous period. Because futures prices do not capture regional differences, I do not use them as measures of price expectations. Furthermore, Gardner's (1979) work suggests that at the national level lagged prices perform as well as future prices.

The I acreage response equations to be estimated are:

$$(7) \qquad \ln(\hat{A}_{ist}) = \alpha_{0i} + \alpha_{1i}\ln(EP_{ist}) + \alpha_{2i}\ln(\hat{A}_{ist-1}) + \alpha_{3i}t + \sum_{m=1}^{M}\alpha_{m+3i}\ln(EP_{st}^{m}) + \xi_{it}$$

where ln is the natural log operator, $\hat{A}_{ist}$ is the total acreage planted to the i^{th} crop in state s at time t, EP_{st}^{i} is the expected price (either $Max(P_{t-1}, P_{t}^{LDP})$, the higher of the support or lagged price or supply-inducing price, SP_{t}, depending on the model) of the i^{th} crop in state s at time t. $\hat{A}_{ist-1}$ is the total acreage planted to the i^{th} crop in state s at time t-1, the lagged dependent variable is included to capture asset fixity and crop rotation decision; this partial adjustment approach incorporates the fixed costs of switching production to a different crop. t is the year, representing market conditions as well as technology and production methods available. EP_{st}^{m} is the expected price of the m^{th} competing enterprise. For the U.S. analysis, competing enterprises consist of corn, peanuts, sorghum, soybeans, and wheat. In the Delta region, competing enterprises are corn, sorghum soybeans, and wheat. In the Southeast region, competing enterprises are corn, peanuts, soybeans and wheat. In the Southwest region, competing enterprises are corn and wheat; and in the Southern Plain, competing enterprises are corn, peanuts, sorghum, and wheat. ξ_{it} is a randomly normally distributed error term with mean zero. $\alpha_{o} - \alpha_{m+3}$ are parameters to be estimated. The model is estimated in double-log form so that the parameter estimates can be interpreted as elasticities.

Similarly, the I yield response equations to be estimated are:

$$(7) \qquad \ln(\hat{Y}_{ist}) = \beta_{0i} + \beta_{1i}\ln(EP_{ist}) + \beta_{2i}\ln(\hat{Y}_{ist-1}) + \beta_{3}t + \sum_{m=1}^{M}\beta_{m+3i}\ln(EP_{st}^{m}) + \upsilon_{it}$$

where $\hat{Y}_{ist}$ is average yield of the i^{th} crop in state *s* at time *t*, is the average yield of the i^{th} crop in state *s* at time *t-1*, υ_{it} is a randomly normally distributed error term with mean zero, $\beta_o - \beta_{m+3}$ are parameters to be estimated, and all other elements are as defined previously. Again, the model is estimated in double-log form so that the parameter estimates can be interpreted as elasticities.

I also estimate the area elasticities using the AK approach. The first order conditions (FOC) of the profit maximization problem in equation 3 indicate the derivatives of the profit function with respect to each land allocation term A_{it} equals the shadow price of land:

$$(8) \qquad \frac{\partial \pi_t(\cdot)}{\partial A_{it}} = \lambda$$

where λ is the LaGrange multiplier and represents the shadow price of land.

Following AK, to improve the efficiency of estimation, I impose the condition that all allocation derivatives are equal and set them equal to the observed price of land since in optimality the shadow price should be equal to the price of land. The shadow price equations can be jointly estimated with the system of output supply and input demand equations. This approach allows the estimated parameters of the shadow price equations to be used to calculate the area elasticities for each crop.

Assume the profit function can be written as:

$$(9) \qquad \pi(\cdot) = G(\cdot) + \sum_{i=1}^{I}\sum_{n=1}^{N}\gamma_{in}P_iA_{in} + \sum_{n=1}^{N} d_{nn}A_n^2$$

To reduce notational clutter, assume $G(\cdot)$ represents the component of the profit function that does not include the land allocation variables and dropping the time subscript. The *I* supply equations are obtained from the profit equation in equation 3 by applying Hoteling's Lemma:

$$(10) \qquad \frac{\partial \pi(\cdot)}{\partial P_i} = S_i = \frac{\partial G(\cdot)}{\partial P_i} + \sum_{n=1}^{N} \gamma_{in} A_{in} .$$

The *J* input demand functions are obtained similarly by applying Hoteling's Lemma. Shadow price equations are obtained by taking the derivative of (9) with respect to A_{it}.

$$(11) \qquad \frac{\partial \pi_t(\cdot)}{\partial A_{it}} = \lambda = \sum_{n=1}^{N} \gamma_{in} P_i + 2 d_{in} A_1 .$$

When estimating the functions using a systems approach, restrictions can be impose to insure that the properties of a profit function are satisfied.

Jointly solving the shadow price equations and the constraint in equation 3 for A_{it} yields a function for the area allocated to the production of i^{th} crop. Area allocation elasticites with respect to output price P_i can be calculated as:

$$(12) \qquad \frac{\partial A_n}{\partial P_i} = \frac{\sum_{j \neq n} \left(\gamma_{nj} - \gamma_{ij} \right) / 2 \times d_{jj}}{\left(\sum_{j \neq n} d_{nn} / d_{jj} + 1 \right)} .$$

Once elasticity estimates are obtained, these values along with the price projections in table 3 and reference prices in table 1 can be used simulate the acreage, and ultimately the supply response, associated with the ability to reallocate base acreage. The elasticity estimates are obtained using the higher of the lagged market price or the support price as the supply-inducing price and then repeating using the supply-inducing prices formula presented in equation 6 as a robustness check.

Results (Note: This study is on-going and the results presented are preliminary.)

Table 4 – 7 present the results of the acreage elasticity estimation for cotton using the standard approach. As predicted by theory, own price elasticities are positive and statistically significant in almost all models. The cross-price elasticities for corn are negative and statistically significant

in the models for the entire U.S., and Delta and Southeast regions. Surprisingly, the cross-price elasticities for peanuts, when statistically significant, are positive in the model for the entire U.S. and Southeast region, suggesting that cotton acreage increase as peanut prices increase. The cross-price elasticities for soybeans are also positive and statistically significant in some models. The cross-price elasticities for wheat and sorghum are negative when statistically significant.

Discussion and Implications

The elasticities suggest that producers with generic base will be most responsive to changes in corn prices and may allocate generic base acreage to the production of corn. However, the positive cross-price elasticities are surprising and contrary to theoretical predictions. Given these, unexpected elasticities more work needs to be done before the simulation analysis can be pursued. The unexpected elasticities also justify using other elasticity estimation methods, such as the AK method.

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Table 1. Reference Prices

Commodity	Reference Price
Wheat	$5.50 per bushel
Corn	$3.70 per bushel
Grain Sorghum	$3.95 per bushel
Barley	$4.95 per bushel
Oats	$2.40 per bushel
Long Grain Rice	$14.00 per hundredweight
Medium Grain Rice	$14.00 per hundredweight
Soybeans	$8.40 per bushel
Other Oilseeds	$20.15 per hundredweight
Peanuts	$535.00 per ton
Dry Peas	$11.00 per hundredweight
Lentils	$19.97 per hundredweight
Small Chickpeas	$19.04 per hundredweight
Large Chickpeas	$21.54 per hundredweight

Note: Data are taken for the Agricultural Act of 2014.

Table 2. Base Acres and Planted Acres by Commodity (Millions of Acres)

Commodity	Base Acres	Planted Acres				
		2009	2010	2011	2012	2013
Upland Cotton	17.97	9.01	10.77	14.43	12.03	10.21
Barley	8.57	3.57	2.88	2.57	3.66	3.53
Corn	84.69	86.38	88.19	91.94	97.29	95.37
Oats	3.02	3.35	3.11	2.35	2.70	2.98
Peanuts	1.47	1.12	1.29	1.14	1.64	1.07
Rice	4.40	3.14	3.64	2.69	2.70	2.49
Sorghum (grain)	11.65	6.60	5.37	5.45	6.26	8.06
Soybeans	50.35	77.45	77.40	75.05	77.20	76.84
Wheat	73.80	59.02	52.62	54.28	55.29	56.24

Note: Base acreage is calculated from unpublished USDA-Farm Service Agency data. Planted acreage is calculated from USDA-National Agricultural Statistics Service Quick Stat data.

Table 3. Farm Price Projections

	2014/ 2015	2015/ 2016	2016/ 2017	2017/ 2018	2018/ 2019
Corn ($/bu.)	3.50	3.89	4.02	4.10	4.10
Soybeans ($/bu.)	10.00	9.10	9.78	10.08	10.23
Wheat ($/bu.)	5.90	5.36	5.50	5.70	5.90
Upland cotton (cents/lb.)	61.41	60.79	60.19	60.71	61.54
Sorghum ($/bu.)	3.41	3.60	3.75	3.87	3.91
Rice ($/cwt)	14.64	13.94	14.24	14.25	14.30
Barley ($/bu.)	5.15	4.62	4.66	4.76	4.81
Oats ($/bu.)	3.25	3.12	3.22	3.27	3.28
Peanuts (cents/lb.)	21.36	23.02	22.08	22.21	22.19

Note: Price projection data were obtained from the Food and Agricultural Policy Research Institute (FAPRI) at Iowa State University.

Table 4. Elasticity of Cotton Acreage Using High Prices

	(1) U.S.	(2) Delta	(3) Southeast	(4) Southwest	(5) Southern Plains
$Ln(MaxP^{COTTON})$	0.4788***	0.5902***	0.2680	0.5187*	1.0552***
	(0.0973)	(0.1912)	(0.1633)	(0.2813)	(0.2486)
$Ln(MaxP^{CORN})$	-0.6251***	-0.7358***	-0.6642***	-0.3110	0.2127
	(0.1246)	(0.2670)	(0.2079)	(0.4006)	(0.4433)
$Ln(MaxP^{PEANUTS})$	0.2006***		0.3144**		-0.0716
	(0.0631)		(0.1223)		(0.1486)
$Ln(MaxP^{Sorghum})$	-0.1427***	-0.2569**			-0.8931**
	(0.0476)	(0.1149)			(0.3686)
$Ln(MaxP^{Soybeans})$	0.0847	0.5974**	0.4223**		
	(0.0561)	(0.2872)	(0.2094)		
$Ln(MaxP^{Wheat})$	0.1718	-0.2193	0.0080	-0.1565	-0.0559
	(0.1065)	(0.2413)	(0.1871)	(0.3270)	(0.2385)
$Ln(A_{t-1}^{COTTON})$	0.9621***	0.8915***	0.9850***	0.7168***	1.0041***
	(0.0102)	(0.0187)	(0.0175)	(0.1001)	(0.0142)
Year	0.0247***	0.0099	0.0252***	-0.0107	0.0337***
	(0.0052)	(0.0077)	(0.0077)	(0.0126)	(0.0114)
N	306	108	108	36	54
State FE	No	No	No	No	No
R-squared	0.9703	0.9637	0.9699	0.8872	0.9912
Adj R-squared	0.9695	0.9612	0.9678	0.8684	0.9898
Log-likelihood	37.4599	13.7955	35.3371	4.2987	14.6387
F-value	1213.1059	379.2527	460.7038	47.1839	736.4999

Note: Market price and acreage data are from USDA-National Agricultural Statistics Service Quick Stat data. Support price data are from various farm bills legislation.

Table 5. Elasticity of Cotton Acreage Using High Prices and State Fixed Effects

	(1) U.S.	(2) Delta	(3) Southeast	(4) Southwest	(5) Southern Plains
Ln($MaxP^{COTTON}$)	0.5744***	0.6619***	0.5956***	0.7711**	1.0766***
	(0.0890)	(0.1771)	(0.1492)	(0.3153)	(0.1842)
Ln($MaxP^{CORN}$)	-0.6096***	-0.7671***	-0.2770	-0.4754	0.1483
	(0.1259)	(0.2531)	(0.1891)	(0.4033)	(0.3502)
Ln($MaxP^{PEANUTS}$)	0.1962***		0.3019***		0.0226
	(0.0613)		(0.1085)		(0.1111)
Ln($MaxP^{Sorghum}$)	-0.1782***	-0.2026*			-0.6731**
	(0.0479)	(0.1159)			(0.2794)
Ln($MaxP^{Soybeans}$)	0.1830**	0.3288	-0.1711		
	(0.0803)	(0.2702)	(0.2048)		
Ln($MaxP^{Wheat}$)	-0.0441	-0.1382	-0.1834	-0.2340	-0.2134
	(0.1049)	(0.2262)	(0.1605)	(0.3221)	(0.1874)
Ln(A_{t-1}^{COTTON})	0.7206***	0.7066***	0.3882***	0.7782***	0.3754***
	(0.0295)	(0.0424)	(0.0909)	(0.1047)	(0.1008)
Year	0.0224***	0.0124*	0.0260***	0.0025	0.0302***
	(0.0048)	(0.0071)	(0.0065)	(0.0148)	(0.0085)
N	306	108	108	36	54
State FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.9787	0.9710	0.9800	0.8965	0.9954
Adj R-squared	0.9769	0.9673	0.9775	0.8751	0.9944
Log-likelihood	88.4121	25.8942	57.3885	5.8519	32.0852
F-value	538.3996	264.9378	388.0629	41.8703	1050.0018

Note: Market price and acreage data are from USDA-National Agricultural Statistics Service Quick Stat data. Support price data are from various farm bills legislation.

Table 6. Elasticity of Cotton Acreage Using Calculated Supply-Inducing Price

	(1) U.S.	(2) Delta	(3) Southeast	(4) Southwest	(5) Southern Plains
$Ln(SP^{COTTON})$	0.9066***	0.9120***	0.3036	0.6879*	1.2941***
	(0.1935)	(0.2457)	(0.2023)	(0.3484)	(0.2775)
$Ln(SP^{CORN})$	0.3783	0.4603	-0.7356***	-0.3838	0.3756
	(0.2942)	(0.4309)	(0.2369)	(0.4056)	(0.4919)
$Ln(SP^{PEANUTS})$	0.2605**		0.3940***		0.0155
	(0.1202)		(0.1479)		(0.1699)
$Ln(SP^{Sorghum})$	-1.4540***	-1.4156***			-1.1903***
	(0.2326)	(0.3411)			(0.4065)
$Ln(SP^{Soybeans})$	0.1888	0.4512	0.5220**		
	(0.2430)	(0.3626)	(0.2523)		
$Ln(SP^{Wheat})$	0.0441	-0.4639*	-0.0317	-0.1067	-0.1357
	(0.1770)	(0.2741)	(0.2263)	(0.3477)	(0.2641)
$Ln(A_{t-1}^{COTTON})$	1.0278***	0.8995***	0.9849***	0.7296***	1.0086***
	(0.0142)	(0.0181)	(0.0174)	(0.0973)	(0.0138)
Year	0.0393***	0.0135*	0.0325***	-0.0074	0.0395***
	(0.0083)	(0.0080)	(0.0095)	(0.0129)	(0.0127)
N	109	104	108	36	54
State FE	No	No	No	No	No
R-squared	0.9822	0.9681	0.9701	0.8879	0.9918
Adj R-squared	0.9808	0.9658	0.9680	0.8692	0.9906
Log-likelihood	45.7894	18.1017	35.6287	4.4074	16.7042
F-value	691.4677	415.9019	463.2759	47.5062	795.5747

Note: Market price and acreage data are from USDA-National Agricultural Statistics Service Quick Stat data. Support price data are from various farm bills legislation.

Table 7. Elasticity of Cotton Acreage Using Calculated Supply-Inducing Price

	(1) U.S.	(2) Delta	(3) Southeast	(4) Southwest	(5) Southern Plains
$\ln(SP^{COTTON})$	1.1446***	0.9229***	0.5681***	1.0469**	1.2290***
	(0.1793)	(0.2376)	(0.1880)	(0.3950)	(0.2117)
$\ln(SP^{CORN})$	0.3509	0.1019	-0.1617	-0.5927	0.1650
	(0.2861)	(0.4357)	(0.2387)	(0.4103)	(0.3916)
$\ln(SP^{PEANUTS})$	0.2224**		0.3296**		0.1292
	(0.1118)		(0.1360)		(0.1307)
$\ln(SP^{Sorghum})$	-1.1140***	-1.0137***			-0.7874**
	(0.2438)	(0.3528)			(0.3215)
$\ln(SP^{Soybeans})$	-0.2293	0.1943	-0.1265		
	(0.2372)	(0.3556)	(0.2588)		
$\ln(SP^{Wheat})$	-0.0884	-0.3492	-0.3728*	-0.1837	-0.2945
	(0.1784)	(0.2704)	(0.2085)	(0.3393)	(0.2089)
$\ln(A_{t-1}^{COTTON})$	0.6827***	0.7531***	0.4502***	0.8017***	0.4068***
	(0.0814)	(0.0452)	(0.0949)	(0.1029)	(0.1017)
Year	0.0429***	0.0142*	0.0260***	0.0086	0.0358***
	(0.0079)	(0.0078)	(0.0085)	(0.0155)	(0.0097)
N	109	104	108	36	54
State FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.9870	0.9723	0.9782	0.8985	0.9955
Adj R-squared	0.9849	0.9686	0.9754	0.8775	0.9945
Log-likelihood	62.7350	25.4039	52.6811	6.2025	32.6622
F-value	470.3067	265.7889	355.0054	42.7888	1072.7882

Note: Market price and acreage data are from USDA-National Agricultural Statistics Service Quick Stat data. Support price data are from various farm bills legislation.

Appendix:

Table A.1. Percentage of Cotton Producers Engaging in Production of Other Program Crops.

Year	Barley	Corn	Oats	Peanuts	Rice	Soybeans	Sorghum	Wheat
1996	1.0%	44.2%	1.0%	20.3%	3.6%	41.5%	19.8%	34.6%
1997	2.4%	37.9%	2.5%	19.5%	3.7%	50.5%	14.4%	35.6%
1998	2.0%	37.7%	3.1%	21.2%	4.6%	40.0%	15.4%	41.7%
1999	1.8%	30.6%	1.1%	17.0%	7.3%	43.5%	14.7%	29.4%
2000	2.0%	35.3%	1.5%	14.5%	19.5%	48.3%	15.6%	27.1%
2001	0.2%	46.2%	2.8%	17.7%	10.5%	42.0%	19.6%	29.6%
2002	1.8%	43.4%	3.2%	17.6%	9.9%	53.3%	16.3%	35.2%
2004	1.1%	35.7%	2.5%	35.9%	7.0%	38.5%	12.1%	20.3%
2005	0.6%	41.6%	2.2%	28.8%	8.5%	31.4%	16.1%	21.1%
2006	0.5%	30.7%	1.8%	23.3%	7.5%	40.8%	11.2%	18.6%
2007	0.5%	53.6%	2.5%	19.6%	5.7%	45.3%	15.3%	37.2%
2008	1.4%	49.8%	3.6%	28.3%	4.2%	46.9%	19.5%	51.2%
2009	1.3%	40.0%	1.3%	27.1%	3.2%	36.1%	16.0%	36.3%
2010	0.5%	46.2%	2.0%	26.8%	6.7%	39.5%	12.7%	28.4%
2011	5.3%	39.7%	2.0%	20.8%	4.0%	32.3%	15.6%	32.5%
2012	0.7%	45.3%	0.5%	24.6%	5.0%	45.3%	13.6%	36.8%
2013	0.5%	51.4%	2.6%	54.3%	4.8%	37.3%	14.5%	37.1%