A Framework for Estimating the Linked Economic Contribution of Cotton Production, Ginning, Oilseed Milling, and Warehousing

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Introduction

- Cotton is the most important crop and second most important agricultural commodity in Texas, based on cash receipts and total contribution to gross state product. Cotton production results in economic contribution throughout the entire economy through backward production linkages as farms purchase production inputs and as farmers and suppliers' employees purchase goods and services.
- Cotton ginning, warehousing, and cottonseed milling create additional economic contributions, but models estimating the economic contribution of the entire cotton industry must be modified to prevent double counting of inputs from prior stages of production and processing. Furthermore, these industries present a challenge because they are part of broader sectors in the IMPLAN model, and the costs of these agricultural businesses may not match the cost functions of the broader sector.
- This study considers a standard method by which to modify IMPLAN models to better represent cotton production, processing, and handling and compares the modified models to IMPLAN default production functions.

Data & Methods

- Most economic contribution studies assume that cotton has the same cost function whether produced on the Texas High Plains or the Mississippi Delta. In reality, growing conditions, production methods (e.g., dryland and irrigated), and therefore cost functions vary across sub-regions even within a single state. Dudensing, Robinson, and Hanselka (2016) address regionalization of cotton cost functions using Extension crop budgets.
- This study includes the economic contributions of downstream processing and warehousing, following Guerrero et al. (2012) but considering differences in cost functions between the Texas High Plains and Gulf Coast. These regions and production systems represent the bulk of Texas cotton (Figure 1).

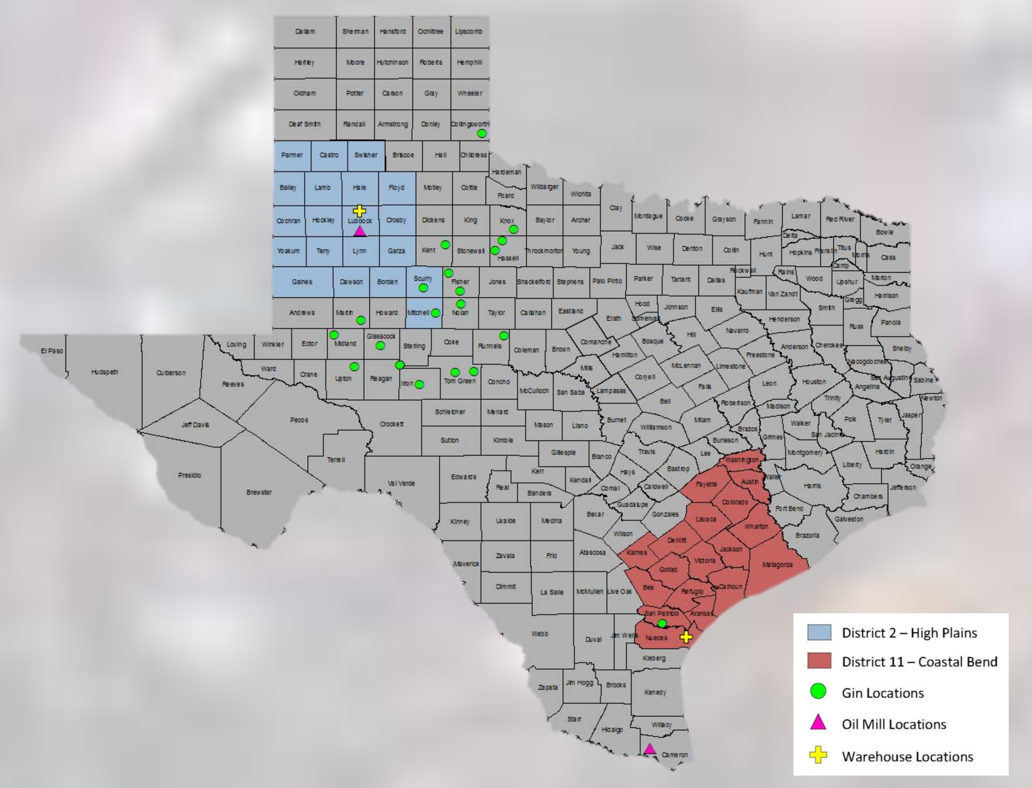

Figure 1. Texas Map Displaying Production Regions & Gin/Warehouse/Oil Mill Locations

- Cotton production cost data for Extension Districts 2 and 11 were obtained from Texas A&M AgriLife Extension Service (2015) crop budgets. Gin, warehouse, and oil mill cost data were obtained from surveys of these businesses in the High Plains and Gulf Coast (Martinez, forthcoming; Park, Dudensing, and Hanselka, 2014; Dudensing and Falconer, 2010). Due to limited data, only one oil mill cost function was created for the state.

Data & Methods Continued

- An IMPLAN model using default Texas data serves as the baseline. Additional models represent the modifications of value added components alone or value added components along with industry production coefficients. When measuring the contribution of an entire regional cluster, it is important not to double count production within the backward-linked supply chain. For example, the default oilseed mill spends 60 cents of every dollar on crop commodities, including cottonseed. However, cottonseed linkages are already included in the contribution of cotton production. Setting the cotton industry's local use ratio to zero broke backward links to the local cotton industry, which produces 94 percent of raw cotton commodity products.
- Study area data were customized to represent the local value added coefficient based on budget proprietor income, other property income, wages, and taxes. When indirect taxes were not provided by surveyed businesses, the IMPLAN estimated tax share was subtracted from other property income.
- Industry production was customized by replacing some default absorption coefficients with values calculated from the regional budgets. The budget surveys focused on major expenses while IMPLAN allocates expenses across a larger number of industries. To estimate payments across the entire economy, the budget-driven coefficients were not held as fixed but rather were allowed to vary when the model rebalanced.

Table 1. Multipliers for Regions, Industry Sectors and Modeling Phases

	Default	District 2 Dryland Rebalanced	District 2 Irrigated Rebalanced	District 11 Irrigated Rebalanced
Production:				
Output Multipliers	1.82	2.07	2.09	1.98
Value Added Multipliers	1.08	0.70	0.85	0.83
Employment Multipliers	12.14	13.84	13.51	14.43
Ginning:				
Output Multipliers	1.91	2.13		2.07
Value Added Multipliers	1.22	1.15		1.12
Employment Multipliers	34.10	35.47		34.70
Warehousing:				
Output Multipliers	1.84	2.37		2.12
Value Added Multipliers	1.15	1.04		0.96
Employment Multipliers	14.08	18.32		16.11
Oil Mill:				
Output Multipliers	1.51	1.65		
Value Added Multipliers	0.31	0.57		
Employment Multipliers	2.95	3.95		

Results and Discussion

- Economic activity by the cotton industry (direct effects) ripples through the state economy as firms purchase inputs (indirect effects) and pay employees who also make regional purchases (induced effects).
- Value added multipliers for the cotton industry varied by up to 35 percent when the default production function was modified to reflect regional cost functions while output and employment multipliers varied by 14%-19% (Table 1). Ginning and oil mill output and value added multipliers were within about 10% of the default multipliers for those sectors while the oil mill employment multiplier differed from the default by 34%. Cotton warehouse multipliers for the High Plains and Gulf Coast are very different from the broader default warehousing sector and from each other, which is logical given different scales and storage lengths.
- Adjusting the value added components to reflect the regional budgets resulted in the greatest change in the multipliers in all production scenarios, regions, and stages of production or processing. In all three farm production scenarios, income was much smaller than estimated by IMPLAN on a national basis. Thus, a

Results and Discussion Continued

larger proportion of Texas cotton sales were paid to supplying businesses (intermediate expenditures) than to households (wages, proprietor income, and other property income). Indirect or business-to-business spending results in greater multipliers than does spending directly by households.

- Multipliers do vary between regions and production methods. Even relatively small deviations in multipliers result in large differences in economic contribution over millions of dollars in cash receipts.
- Table 2 shows the economic contribution of the forward-linked cotton industry to the state of Texas using the rebalanced multipliers. The industry contributed an estimated $5.8 billion in output, including $2.3 billion in value added or "GDP" and $1.5 billion in labor income, as well as 39,300 full- and part-time jobs in 2013. Value added and labor income are components of output so these figures cannot be summed.
- Cotton production contributed an estimated $4.5 billion in output, including $1.8 billion in value added or "GDP" and $1.1 billion in labor income, as well as 29,500 full- and part-time jobs in 2013.
- Ginning contributed $432.7 million in output, $233.6 million in GDP, $182.2 million in labor income, and 7,200 jobs.
- Warehouses contributed $103.6 million in output, $47.4 million in GDP, $31.2 million in labor income, and 800 jobs.
- Oil milling contributed $749.8 million in output, $261.1 million in GDP, $191.6 million in labor income, and 1,800 jobs.
- Modelers should strive to formulate models using as much information as possible. However, at minimum, the study area data should be modified to reflect value added components.

Table 2. Economic Impact of the Cotton Industry in Texas, 2013

	Output	Value Added	Labor Income	Employment
Production:				
Direct Effect	$2,164,067,200	$504,502,700	$296,516,000	11,600
Indirect Effect	$1,616,522,400	$858,147,200	$533,356,200	12,700
Induced Effect	$728,916,500	$415,583,900	$238,585,200	5,200
Total Effect	**$4,509,506,100**	**$1,778,233,800**	**$1,068,457,400**	**29,500**
Ginning:				
Direct Effect	$203,552,500	$109,524,100	$107,197,800	5,700
Indirect Effect	$105,525,700	$53,579,000	$34,513,800	600
Induced Effect	$123,652,900	$70,532,900	$40,496,500	900
Total Effect	**$432,731,100**	**$233,636,000**	**$182,208,100**	**7,200**
Warehousing:				
Direct Effect	$44,930,700	$12,145,700	$11,081,200	360
Indirect Effect	$37,081,000	$22,950,600	$13,025,400	280
Induced Effect	$21,554,100	$12,297,300	$7,055,800	160
Total Effect	**$103,565,800**	**$47,393,600**	**31,162,400**	**800**
Oil Mill:				
Direct Effect	$452,193,900	$95,276,700	$93,196,600	90
Indirect Effect	$167,696,900	$91,683,600	$55,814,400	750
Induced Effect	$129,892,600	$74,104,400	$42,555,200	950
Total Effect	**$749,783,400**	**$261,064,700**	**$191,566,200**	**1,800**
Total Cotton Industry:				
Direct Effect	$2,864,744,300	$721,449,200	$507,991,600	17,800
Indirect Effect	$1,926,826,000	$1,026,360,400	$636,709,800	14,300
Induced Effect	$1,004,016,100	$572,518,500	$328,692,700	7,200
Total Effect	**$5,795,586,400**	**$2,320,328,100**	**$1,473,394,100**	**39,300**