

# Converting Ag Budgets to I-O Sectors



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for Collaborative Science

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# Steps to converting Ag Budget to I-O production function

1. Develop a detailed enterprise budget
2. Map budget sub-categories onto input-output sectors
3. Convert a sector's costs that include retail, wholesale and transportation margins into producer prices only
4. Allocate the sum of retail, wholesale and transportation contributions to their respective sectors
5. Separate margined costs into domestically produced and imported shares
6. Aggregate the imported contributions across sectors and assign to a single "imports" sector
7. Scale the margined and import-purged accounts up to the regional output level and determine the factor share of each sector.

# 1. Developing an enterprise budget

- Enterprise budget determines quality of I-O production function.
- At minimum, enterprise budget should include info on fixed and variable input costs (i.e. “KLEFMA” inputs)
- Fixed inputs typically include information on “DIRTI five”
- Enterprise budget used as if it came from representative firm in region.

	A	B	C	D	E	F	G
1	Cultural_practice...	Washington Grass Seed Production		Units: \$/acre			
2		Budget Category					
3	Irrigated Burn Gras...	SumM2MT01-					
4	Irrigated Non-burn ...	OriginalValues					
5	Non-irrigated Burn ...			IB	INB	NIB	NINB
6	Non-irrigated Non-...			Irrigated Burn	Irrigated Non-	Non-irrigated	Non-irrigated
7				Grass Seed, WA	burn Grass	Burn Grass	Non-burn Grass
8	Budget Category ...				Seed. WA	Seed. WA	Seed. WA
9	Variable Cost						
10	Fixed Cost						
11	Profit						
12		1 Variable Cost	1 Open Field Burn	4.80	0.00	6.00	0.00
13			10 Direx 4L	0.00	0.00	3.22	1.43
14			11 Sencor	0.00	0.00	5.42	2.41
15			12 Bivert	0.00	0.00	0.18	0.08
16			13 Bronate	0.00	0.00	0.92	3.96
17			14 Roundup	7.03	8.55	0.00	0.00
18			15 Roundup-RT	0.00	0.00	6.62	16.14
19			16 Sticker	0.00	0.00	0.25	0.67
20			17 21-0-0-24	10.72	8.12	0.00	0.00
21			18 16-20-0-0	0.00	0.00	1.45	3.87
22			19 34-0-0	28.00	23.33	0.00	0.00
23			2 Bale/haul/stack	0.00	12.50	0.00	12.50
24			20 Duirex	2.56	1.42	0.00	0.00
25			21 15-15-11-10	25.35	19.50	0.00	0.00
26			22 Anhydrous (82%)	0.88	1.46	0.00	0.00
27			23 Grass Seed	3.20	5.33	3.25	8.67
28			24 15-30-6-6.5	2.15	3.58	0.00	0.00
29			25 Buctril	2.75	4.58	3.78	10.08
30			26 Bueno 6	2.00	3.33	0.00	0.00
31			27 Banvel	16.20	15.00	0.00	0.00
32			28 Tilt	3.81	3.17	1.49	2.46
33			29 Pump Start Fee	10.50	10.50	0.00	0.00
34			3 Crewcut/Vacuum	0.00	9.17	0.00	9.17
35			30 Irrigation Layout	1.50	1.50	0.00	0.00
36			31 Irrigation Electricity	32.00	33.33	0.00	0.00
37			32 Irrigation Pickup	1.50	1.50	0.00	0.00
38			33 Tractor Repair	0.96	1.60	0.98	2.46

## 2. Mapping budget categories onto I-O sectors

- Budget categories assigned to I-O sector accounts.
- Payments to labor, capital and government assigned to primary factor accounts within value added.
- Overhead can be split into I-O accounts (i.e. legal, accounting, etc.)
- See Thorvaldson (2011) for mapping of Colorado corn to IMPLAN sector scheme.
- Process can be streamlined through the use of a relational data model.

	A	B	C	D	E	F
1	Cultural_practice...	Washington Grass Seed Producti	Units: \$/acre			
2	Irrigated Burn Gras...					
3	Irrigated Non-burn...					
4	Non-irrigated Burn...	SumM2MT05-Margin1Values	Column Lab			
5	Non-irrigated Non...					
6	Sector_ID_Name					
7	14.1 Proprietary Gr...					
8	14.2 Common Gras...					
9	202 *Nitrogenous ...					
10	204 *Agricultural C...					
11	210 *Petroleum Pr...					
12	26 Agricultural Ser...					
13	309 *Farm Machin...					
14	443 Electricity					
15	451 Auto					
16	456 Banking					
17	494 Legal					
18	507 Accounting					
19	601 *Employee Co...					
20	456 Banking					
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						

# 3. Distinguish between purchaser and producer price expenditures

- Determine which budget categories are in purchaser vs. producer prices
- Un-margined budget categories give biased weight to some sectors, while under-representing other sectors
- For WA grass seed, fertilizer, pesticide, fuel and oil are assumed to be in purchaser prices (i.e. require margining)
- Retail, wholesale and transportation margins for these sectors obtained from BEA benchmark I-O table
- Remaining sectors assumed to be in producer prices

	A	B	C	D	E	F
1	Cultural_practice...	Washington Grass Seed Production	Units: \$/acre			
2						
3	Irrigated Burn Grass Se...	SumM2MT05-Margin1Values				
4	Irrigated Non-burn Gra...		IB	INB	NIB	NINB
	Non-irrigated Burn Gra...		Irrigated Burn Grass Seed, WA	Irrigated Non-burn Grass Seed, WA	Non-irrigated Burn Grass Seed, WA	Non-irrigated Non-burn Grass Seed, WA
	Non-irrigated Non-bur...					
5						
6	Margin_ID_Name	1 Not Margined				
7	1 Not Margined	14.1 Proprietary Grass Seed	3.20	5.33		
8	2 Margined	14.2 Common Grass Seed			3.25	8.67
9	3 Value added	26 Agricultural Services	0.00	0.00	4.15	1.84
10	4 Profit	443 Electricity	32.00	33.33	0.00	0.00
		456 Banking	16.78	17.99	29.24	33.91
		459 Insurance	0.48	0.48	1.81	2.00
		462 Real Estate	14.08	14.08	12.80	12.80
		494 Legal	7.59	7.63	4.18	4.32
		507 Accounting	7.59	7.63	4.18	4.32
		2 Margined				
		202 *Nitrogenous And Phosphatic Fertilizer	67.10	55.99	10.25	10.35
		204 *Agricultural Chemicals	34.35	36.05	22.20	38.08
		210 *Petroleum Products	8.76	8.34	6.24	7.75
		309 *Farm Machinery and Equipment	6.91	32.81	17.26	38.95
		451 Auto	1.50	1.50	0.00	0.00
		3 Value added				
		601 *Employee Compensation	56.16	55.75	19.38	20.51
		602 Indirect Business Taxes	1.45	1.43	5.40	5.97
		603 Proprietary Income	50.04	50.02	61.48	62.50
		4 Profit				
		9004 Profit	83.31	-25.65	155.21	-7.16
28		<b>Grand Total</b>	<b>391.30</b>	<b>302.70</b>	<b>357.02</b>	<b>244.81</b>

# 4. Allocating margin contributions to responsible sectors

- Producer price share of purchaser prices (by sector) available from the U.S. Bureau of Labor Statistics
- Producer prices for retail, wholesale and transportation sectors measured using the shares of intermediate demand in the forward-staged production flow for the sectors that require margining
- These intermediate demand shares reduce the expenditures of the sectors whose costs are measured in purchaser prices
- By including the sum of the retail, wholesale and transportation sectors' contributions, the result is an accurate set of producer-price expenditures by sector for the enterprise.

	A	B	C	D	E	F
1	Cultural_practice_...	Washington Grass Seed Production	Units: \$/acre			
2						
3	Irrigated Burn Grass ...	SumM2MT11-Margin2Values	Column Labels			
4	Irrigated Non-burn Gr...		IB	INB	NIB	NINB
5	Non-irrigated Burn Gr...	Row Labels	Irrigated Burn Grass Seed, WA	Irrigated Non-burn Grass Seed, WA	Non-irrigated Burn Grass Seed, WA	Non-irrigated Non-burn Grass Seed, WA
6	Non-irrigated Non-bu...					
7	Margin_ID_Name	1 Not Margined				
8	1 Not Margined	14.1 Proprietary Grass Seed	3.20	5.33		
9	2 Margined	14.2 Common Grass Seed			3.25	8.67
10	3 Value added	26 Agricultural Services	0.00	0.00	4.15	1.84
11	4 Profit	443 Electricity	32.00	33.33	0.00	0.00
12		456 Banking	16.78	17.99	29.24	33.91
13		459 Insurance	0.48	0.48	1.81	2.00
14		462 Real Estate	14.08	14.08	12.80	12.80
15		494 Legal	7.59	7.63	4.18	4.32
16		507 Accounting	7.59	7.63	4.18	4.32
17		2 Margined				
18		202 *Nitrogenous And Phosphatic Fertilizer	47.31	39.47	7.23	7.30
19		204 *Agricultural Chemicals	24.22	25.42	15.65	26.85
20		210 *Petroleum Products	8.09	7.71	5.77	7.16
21		309 *Farm Machinery and Equipment	5.33	25.29	13.30	30.03
22		433 Railroads And Related Services	0.31	0.34	0.13	0.23
23		435 Motor Freight Transportation	1.22	1.34	0.53	0.90
24		436 Water Transportation	0.19	0.21	0.08	0.14
25		437 Air Transportation	0.07	0.07	0.03	0.05
26		438 Pipe Lines, Except Natural Gas	0.24	0.26	0.10	0.18
27		447 Wholesale Trade	21.47	23.55	9.34	15.88
28		448 AGG OTHER RETAIL	0.01	0.01	0.00	0.00
29		449 General Merchandise Stores	0.00	0.00	0.00	0.00
30		450 Food Stores	0.09	0.09	0.04	0.06
31		451 Auto	2.08	2.13	0.25	0.43
32		455 Miscellaneous Retail	0.18	0.20	0.08	0.14
33		479 Automobile Repair And Services	2.41	2.64	1.05	1.78
34		482 Miscellaneous Repair Shops	5.44	5.97	2.37	4.03
35		3 Value added				
36		601 *Employee Compensation	56.16	55.75	19.38	20.51
37		602 Indirect Business Taxes	1.45	1.43	5.40	5.97
38		603 Proprietary Income	50.04	50.02	61.48	62.50
39		4 Profit				
40		9004 Profit	83.31	-25.65	155.21	-7.16
		<b>Grand Total</b>	<b>391.32</b>	<b>302.72</b>	<b>357.03</b>	<b>244.83</b>

# 5. Create import-purged sector expenditures

- Separate each producer-priced expenditure category into domestically-purchased share and imported share
- Percent of input purchased locally defined as regional purchase coefficient (RPC)
- Product of input expenditure and its RPC equals its import-purged amount
- Product of input expenditure and 1-RPC equals its imported amount
- Inserting a new row containing the sum of all imported expenditures completes the transformation from ag budget to I-O production function

	A	B	C	D	E	F
1	Cultural_practice_...	Units: cost share/acre	Washington Grass Seed Production			
2		SumM2MT15-DomImpValues	Column Labl			
3	Irrigated Burn Grass ...	Row Labels	IB	INB	NIB	NINB
4	Irrigated Non-burn G...					
5	Non-irrigated Burn G...					
6	Non-irrigated Non-b...					
7	Margin_ID_Name					
8	1 Not Margined	1 Not Margined				
9	2 Margined	14.1 Proprietary Grass Seed	2.40	4.00		
10	3 Value added	14.2 Common Grass Seed			2.44	6.50
11	4 Profit	26 Agricultural Services			3.34	1.48
12	5 Imports	443 Electricity	29.32	30.54		
13		456 Banking	10.19	10.93	17.76	20.60
14		459 Insurance	0.30	0.30	1.15	1.27
15		462 Real Estate	9.86	9.86	8.96	8.96
16		494 Legal	5.51	5.53	3.03	3.14
17		507 Accounting	6.02	6.04	3.31	3.42
18		1 Not Margined Total	63.60	67.20	39.99	45.37
19		2 Margined				
20		202 *Nitrogenous And Phosphatic Fertilizer	6.50	5.42	0.99	1.00
21		204 *Agricultural Chemicals	2.91	3.05	1.88	3.22
22		210 *Petroleum Products	4.93	4.70	3.51	4.37
23		309 *Farm Machinery and Equipment	2.59	12.30	6.47	14.61
24		433 Railroads And Related Services	0.22	0.24	0.10	0.16
25		435 Motor Freight Transportation	1.01	1.11	0.44	0.75
26		436 Water Transportation	0.19	0.21	0.08	0.14
27		437 Air Transportation	0.03	0.03	0.01	0.02
28		438 Pipe Lines, Except Natural Gas	0.06	0.07	0.03	0.04
29		447 Wholesale Trade	19.74	21.65	8.59	14.60
30		448 AGG OTHER RETAIL	0.01	0.01	0.00	0.00
31		450 Food Stores	0.08	0.09	0.04	0.06
32		451 Auto	1.97	2.03	0.24	0.41
33		455 Miscellaneous Retail	0.17	0.19	0.07	0.13
34		479 Automobile Repair And Services	2.17	2.38	0.94	1.60
35		482 Miscellaneous Repair Shops	3.05	3.35	1.33	2.26
36		2 Margined Total	45.63	56.82	24.72	43.37
37		3 Value added				
38		601 *Employee Compensation	56.16	55.75	19.38	20.51
39		602 Indirect Business Taxes	1.45	1.43	5.40	5.97
40		603 Proprietary Income	133.35	24.37	216.69	55.34
41		3 Value added Total	190.96	81.55	241.47	81.82
42		5 Imports				
43		606 Total Imports	91.13	97.14	50.85	74.27
44		5 Imports Total	91.13	97.14	50.85	74.27
45		Grand Total	391.32	302.72	357.03	244.83

# 6. Scaling import-purged accounts to regional output level

- Import-purged, per unit accounts now need to be scaled to regional output of new sector
- Regional output of new sector equal to the product of total cost per acre and the number of acres harvested

	A	B	C	D	E	F
1						
2						
3						
4		SumM2MT17-ScaledValues	Column Labels			
5		Row Labels	IB	INB	NIB	NINB
6		1 Not Margined				
7		14.1 Proprietary Grass Seed	50,585	84,255		
8		14.2 Common Grass Seed			95,411	254,527
9		26 Agricultural Services			130,702	57,950
10		443 Electricity	618,011	643,697		
11		456 Banking	214,856	230,349	695,309	806,359
12		459 Insurance	6,405	6,405	44,854	49,563
13		462 Real Estate	207,735	207,735	350,721	350,721
14		494 Legal	116,093	116,629	118,595	122,714
15		507 Accounting	126,812	127,397	129,545	134,044
16		1 Not Margined Total	1,340,497	1,416,467	1,565,138	1,775,878
17		2 Margined				
18		202 *Nitrogenous And Phosphatic Ferti	136,996	114,313	38,865	39,244
19		204 *Agricultural Chemicals	61,250	64,281	73,515	126,102
20		210 *Petroleum Products	103,999	99,013	137,580	170,873
21		309 *Farm Machinery and Equipment	54,618	259,304	253,304	571,784
22		433 Railroads And Related Services	4,642	5,103	3,759	6,399
23		435 Motor Freight Transportation	21,276	23,342	17,194	29,228
24		436 Water Transportation	3,913	4,336	3,203	5,479
25		437 Air Transportation	644	714	531	906
26		438 Pipe Lines, Except Natural Gas	1,270	1,392	1,026	1,742
27		447 Wholesale Trade	416,005	456,388	336,138	571,402
28		448 AGG OTHER RETAIL	199	180	118	176
29		450 Food Stores	1,743	1,902	1,397	2,367
30		451 Auto	41,614	42,729	9,351	15,887
31		455 Miscellaneous Retail	3,646	3,991	2,932	4,982
32		479 Automobile Repair And Services	45,655	50,085	36,888	62,705
33		482 Miscellaneous Repair Shops	64,338	70,582	51,984	88,366
34		2 Margined Total	961,805	1,197,655	967,785	1,697,641
35		3 Value added				
36		601 *Employee Compensation	1,183,684	1,175,127	758,748	802,745
37		602 Indirect Business Taxes	30,562	30,140	211,372	233,684
38		603 Proprietary Income	2,810,618	513,646	8,481,897	2,166,174
39		3 Value added Total	4,024,864	1,718,914	9,452,017	3,202,602
40		5 Imports				
41		606 Total Imports	1,920,682	2,047,451	1,990,253	2,907,100
42		5 Imports Total	1,920,682	2,047,451	1,990,253	2,907,100
43		Grand Total	8,247,849	6,380,487	13,975,192	9,583,221



# 7. Converting levels to factor shares

- Import-purged, producer price expenditures converted to factor shares by dividing each input by total expenditure
- A sector's production function, expressed as factor shares show the proportion of each input needed to generate a dollar's worth of output
- These shares, also known as absorption coefficients, are used as column data for the new sector within the input-output accounts
- Developing I-O factor shares can lead to a more tailored analysis for specific enterprises in a particular region

	A	B	C	D	E	F
1	Cultural_practice_...	Units: cost share/acre	Washington Grass Seed Production			
2		SumM2MT17-ShareValues	Column Label			
3	Irrigated Burn Grass Se...	Row Labels	IB	INB	NIB	NINB
4	Irrigated Non-burn Gras...					
5	Non-irrigated Burn Gras...	1 Not Margined				
6	Non-irrigated Non-burn ...	14.1 Proprietary Grass Seed	0.61 %	1.32 %		
7	Margin_ID_Name	14.2 Common Grass Seed			0.68 %	2.66 %
8	1 Not Margined	26 Agricultural Services			0.94 %	0.60 %
9	2 Margined	443 Electricity	7.49 %	10.09 %		
10	3 Value added	456 Banking	2.60 %	3.61 %	4.98 %	8.41 %
11	4 Profit	459 Insurance	0.08 %	0.10 %	0.32 %	0.52 %
12	5 Imports	462 Real Estate	2.52 %	3.26 %	2.51 %	3.66 %
13		494 Legal	1.41 %	1.83 %	0.85 %	1.28 %
14		507 Accounting	1.54 %	2.00 %	0.93 %	1.40 %
15		1 Not Margined Total	16.25 %	22.20 %	11.20 %	18.53 %
16		2 Margined				
17		202 *Nitrogenous And Phosphatic Fertilizer	1.66 %	1.79 %	0.28 %	0.41 %
18		204 *Agricultural Chemicals	0.74 %	1.01 %	0.53 %	1.32 %
19		210 *Petroleum Products	1.26 %	1.55 %	0.98 %	1.78 %
20		309 *Farm Machinery and Equipment	0.66 %	4.06 %	1.81 %	5.97 %
21		433 Railroads And Related Services	0.06 %	0.08 %	0.03 %	0.07 %
22		435 Motor Freight Transportation	0.26 %	0.37 %	0.12 %	0.30 %
23		436 Water Transportation	0.05 %	0.07 %	0.02 %	0.06 %
24		437 Air Transportation	0.01 %	0.01 %	0.00 %	0.01 %
25		438 Pipe Lines, Except Natural Gas	0.02 %	0.02 %	0.01 %	0.02 %
26		447 Wholesale Trade	5.04 %	7.15 %	2.41 %	5.96 %
27		448 AGG OTHER RETAIL	0.00 %	0.00 %	0.00 %	0.00 %
28		450 Food Stores	0.02 %	0.03 %	0.01 %	0.02 %
29		451 Auto	0.50 %	0.67 %	0.07 %	0.17 %
30		455 Miscellaneous Retail	0.04 %	0.06 %	0.02 %	0.05 %
31		479 Automobile Repair And Services	0.55 %	0.78 %	0.26 %	0.65 %
32		482 Miscellaneous Repair Shops	0.78 %	1.11 %	0.37 %	0.92 %
33		2 Margined Total	11.66 %	18.77 %	6.93 %	17.71 %
34		3 Value added				
35		601 *Employee Compensation	14.35 %	18.42 %	5.43 %	8.38 %
36		602 Indirect Business Taxes	0.37 %	0.47 %	1.51 %	2.44 %
37		603 Proprietary Income	34.08 %	8.05 %	60.69 %	22.60 %
38		3 Value added Total	48.80 %	26.94 %	67.63 %	33.42 %
39		5 Imports				
40		606 Total Imports	23.29 %	32.09 %	14.24 %	30.33 %
41		5 Imports Total	23.29 %	32.09 %	14.24 %	30.33 %
42		Grand Total	100.00 %	100.00 %	100.00 %	100.00 %

# What next?

- Adding new production function to underlying accounts vs. software work arounds (i.e. analysis-by-parts)
  - Proprietary software often holds the number of I-O sectors ( $n$ ) constant
  - Often have to remove social accounts from software in order to develop ( $n+1$ ) sectors
  - Software work arounds may not disaggregate new sector from underlying social accounts
- Developing an I-O production function is only half the battle
  - I-O sectors have both a column and a row
  - Column of factor shares developed from enterprise budget
  - Row of demand shares developed from farm marketing survey