Assessing the Economic Impacts of Local Food System Producers by Scale: A Case Study From New York

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Abstract
Policy makers and economic developers are increasingly interested in the impacts of local food systems, yet attempts to obtain accurate estimates are often complicated by a lack of available data. Utilizing a unique data set from producers in New York, the authors examine the extent of differential purchasing and sales patterns for small-scale direct agriculture (SDA) producers. The supplemental data are integrated into a regional input–output model to assess the total effects and distributional implications of equivalent policies targeted to agriculture sectors. The authors demonstrate that SDA producers have different expenditure patterns than other agricultural producers and, for equivalent policy shocks targeted toward agriculture industry expansion, have lower total employment and output impacts but higher effects on labor income and total value added than non-SDA producers. The results underscore the importance of collecting appropriate data for analysis and outline the local economic benefits of small-scale local food system participants.

Keywords
small farms, local food, economic impact, direct sales, input–output analysis

As interest in local food systems continues to grow, policy makers and economic developers grapple with understanding the impacts on local communities and economies (Clancy, 2010; Jensen, 2010; King et al., 2010; Martinez et al., 2010; National Research Committee on Twenty-First Century Systems Agriculture, 2010; O'Hara & Pirog, 2013). Often such interests are driven by efforts focused on improving diet and health outcomes (e.g., increasing consumption of locally produced fresh fruits and vegetables) or improving healthy food access for disadvantaged consumers (e.g., establishing farmers' markets in rural or urban food deserts). On the producers' side, support for expanding local food marketing opportunities often centers on improving profitability and access to markets.

The role of small- and medium-scale producers in developing local and regional food systems has also attracted renewed attention. The strong growth in local food systems' direct-to-consumer (D2C) marketing channels in the United States, such as farmers markets and community-supported agriculture, are dominated by smaller-scale producers (Low & Vogel, 2011). Recent attention toward the development of regional food hubs and values-based supply chains has expanded marketing efforts to retail, wholesale, and institutional channels, and where efforts are often combined with a commitment to buy from small- to medium-sized local producers whenever possible (Barham et al., 2012; Hardesty et al., 2014).[1]

Efforts to develop a better understanding of the purchasing and sales practices by small- and medium-scale producers are a vital step in quantifying their economic impacts. Many economists use input–output (IO) models to measure economic impacts, and the academic and extension literatures are flush with examples. IO models trace the linkages between industries, households, and final demand. Unfortunately, the industries measured are often broad (such as agriculture), and important distinctions in local interindustry linkages because of firm size can be obscured. Conclusions drawn on the broad industry may not apply to all subsectors of the industry. Although more recent growth in local food markets by small- and medium-scale producers has prompted renewed attention to this issue, this basic premise is long-standing. Indeed, in the early 1970s, Heady and Sonka (1974) used IO analysis and mathematical programming techniques to simulate that smaller farms rather than larger farms that were encouraged by agricultural policies could support greater income generation in rural

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communities. However, as Irwin, Isserman, Kilkenny, and Partridge (2010) point out nearly 40 years later, empirical testing of this "intriguing simulation result" has not yet occurred.

Efforts to assess the impacts of local agricultural and food system activities are often complicated by a lack of available data necessary for complete evaluation. Data on interindustry linkages exist for broad commodity sectors (like agriculture) but not for subsectors that would be required for this type of analysis. Data problems are further exacerbated when the analysis depends on information that is differentiated by firm size. Yet analyses that rely on aggregate data may distort the size of the policy impacts, particularly when purchasing and sales patterns of the reference group are distinct.

This study assesses the local economic impact of small- and medium-scale producers with D2C sales relative to other agricultural producers. To accomplish this purpose, we first empirically estimate the extent of differential patterns of purchases and sales between these two groups of producers. We develop estimates of these patterns from a unique set of primary data on purchases and sales transactions collected from interviews with a random sample of small- and medium-scale producers in an 11-county region of New York who use D2C outlets within their marketing portfolios. From these data, we construct the sales and purchase patterns for a D2C agricultural sector of small- and medium-scale firms (henceforth the small direct agriculture sector, or SDA), that are distinct from the data for sales and purchases that are commonly available for an aggregate agriculture sector (henceforth the default agriculture sector), but that do not distinguish purchase and spending patterns by firm size or market channel. Thus, we create two agriculture sectors from the default agriculture sector—the SDA and the non-SDA sectors (NSDA).

Finally, we incorporate the redefined sectors into an IO model framework, derive their distinct economic multipliers, and estimate the economic impacts of exogenous policy shocks to alternative agriculture sectors.[2] We show that the spending patterns between SDA and NSDA sectors differ considerably. The SDA sector relies less on intermediate imports (foreign and domestic) and has greater payments to value added than the NSDA sector, and equivalent policy shocks result in larger labor income and value-added economic impacts (direct + indirect + induced) in the SDA sector relative to the NSDA sector. The results have important implications for economic development initiatives, as expanding the SDA sector may have priority given relatively larger impacts to labor income and total value added.

We review the context of economic impact analysis in relation to recent local food system studies and the research limitations provided with available aggregate data. We then describe the data collected and their use within the IO framework. Finally, we discuss the empirical results, along with their implications and directions for future research.

Economic Impact Analyses and Local Food

To conduct economic impact analyses, one must have information about interindustry linkages both within and among sectors of an economy; that is, as a business or industrial sector buys from and sells goods and services to other sectors of the economy and to final users, the firm stimulates additional economic activity by other businesses and within other industrial sectors. An IO model represents an accounting system that links the economic transactions within an economy among production sectors, factors of production, and institutions (Miller & Blair, 2009). Many economic impact assessments of local food systems are based on IMpact Analysis for PLANning (IMPLAN) data and software from the IMPLAN Group LLC (e.g., Gunter & Thilmany, 2012; Henneberry, Whitacre, & Agustini, 2009; Hughes, Brown, Miller, & McConnell, 2008; Otto & Varner, 2005; Swenson, 2010, 2011a, 2011b). As with any economic impact analysis based on an IO framework, measures of economic multipliers and other impacts are conditioned by the static framework assumed within the model—constant prices, production occurs according to fixed-proportion, linear homogenous production functions, and unlimited production capacity. If the policy changes or if other direct changes in the economy are relatively small compared with the overall size of the local economy, these limitations often are of little consequence.

The one exception that is perhaps critical in the study of local food systems relates to whether the input purchases and output sales patterns of the SDA sector are dissimilar to that of other agriculture sectors. The economic sectors reflect average purchase and sales patterns across all firms in the sector; thus, it is impossible to distinguish differential expenditure patterns of various groups of firms in the default IMPLAN data. For this reason, estimates of the effects of increased local food sales based on existing IMPLAN data may be misleading if the SDA sector has sufficiently different patterns of input expenditures and/or they purchase a different proportion of their inputs from local sources. In a relatively recent study, Hughes et al. (2008) note that IMPLAN data may not reflect the input expenditure patterns of producers likely to participate in local and regional food systems, and they suggest that an area of future research could include making adjustments to default IMPLAN input coefficients to reflect more accurately the behavior of small operations. King et al. (2010) remark that local food system participants assume additional supply chain functions, and though they are not referring to expenditure patterns directly, there are potentially significant expenditure implications. In an earlier study, Lazarus, Platas, and Morse (2002) caution that the aggregation of all types of swine operations into a single sector may be particularly problematic for the purpose of any analysis of the economic impacts for the swine industry at a time of major structural changes in the industry.

By augmenting the IMPLAN database with the primary data to construct a new SDA sector, we can isolate the local economic impacts of these local food system participants. This study builds on previous local food system studies that use primary data to augment or adjust IMPLAN data. Although these studies attempt to quantify the differential aspects of particular local food system supply chains or sectors—such as farmers markets (Henneberry et al., 2009; Hughes et al., 2008; Otto & Varner, 2005), farm-to-school programs (Gunter & Thilmany, 2012), and meat processing (Swenson, 2011a)—none have looked specifically at the issue of differential economic impacts based on firm size. Platas (2000) and Lazarus, Platas, Morse, and Guess-Murphy (2002) estimate the differential economic effects of exogenous shocks to alternative hog sectors differentiated by type of operation and firm size. This study adapts their data collection protocols to collect individual producer data on costs of production and levels of local spending with an application to local food systems effects within a regional economy.

Methodology

A mixed methods approach is used to address the research objectives, in which data from a case study area are collected and combined within an IO modeling framework. We follow with a description of the case study data collected and how it is used within IMPLAN to derive the distinct SDA and NSDA sectors from the default agriculture sector.

Case Study Data

In 2011, data from agricultural producers were collected within an 11-county region in New York referred to as the Capital District (CD) region.[3] Given our case study approach, generalizations of our results to other areas should be guided by the relative similarity of regional characteristics, including agricultural production activities, as well as producers' access to input and output markets. The CD region has a wide diversity of agricultural production activities, but with an emphasis on fruit and vegetable production. Access to output markets may be represented by the nature of the populations within a study area. The CD region is characterized by a large urbanized (metropolitan) core, surrounded by less urbanized (micropolitan) and nonurbanized areas. We expect our results to be reasonably representative of other regions with similar spatial population characteristics.

A team of Cornell Cooperative Extension (CCE) educators in the region identified farmers in each county that utilized D2C outlets as part of their marketing channel portfolio.[4] Based on their knowledge of farming in the region, the team identified 752 farms, a total remarkably consistent with data from the 2007 Census of Agriculture, which reported that there were 797 farms in the region with D2C sales (U.S. Department of Agriculture [USDA], 2007b).

We contacted a total of 130 farm operators (or 17% of the original farm population provided by CCE), each being selected randomly from the CCE population list of farms. The number of farms drawn from each county was based on the percentage of all farms in the region according to farm counts by county from the 2007 Census of Agriculture (USDA, 2007a). Of the 130 farms contacted, 116 participated in interviews during the summer of 2011. A total of 97 interviews contained complete information, from which 82 farms were identified as small- or midscale (i.e., had annual sales less than $500,000). Whereas several farms produced multiple types of commodities based on the sales information collected, respondents were classified into categories by the primary commodity sold. According to this classification scheme, the distribution of farms was 27% vegetables, 23% meat/livestock, 17% other crops, 15% fruit, 12% greenhouse/nursery, and 6% dairy. Given the relatively small sample of dairy producers and their distinct expenditure patterns compared to the rest of the sample, they were excluded from the final sample from which the average expenditure and sales patterns were constructed. Accordingly, the final sample contained 77 farm observations.

The interview protocol was designed to collect detailed information about the amount and location of farm expenditures (inputs) and farm sales (outputs).[5] Farmers were asked to provide their 2010 annual farm operating expenditures by category and the proportion of each expenditure purchased locally; that is, purchased within the 11-county region.[6] Expenditure categories and average expenditures per farm, differentiated by location of expenditure, are shown in Table 1. Although the proportion of local expenditures varied by category, overall, 73% of expenditures reported in the survey were local. To create the SDA sector in IMPLAN, the survey expenditure categories were mapped to appropriate IMPLAN sectors. The mapping protocol is shown in the second column of Table 1 and discussed in more detail below.

In addition to providing farm sales by commodity type, farmers were asked to provide the allocation of sales by marketing channel and the proportion of these sales classified as local. Sales locations should ideally reflect where the products are destined for consumption or processing; however, this is sometimes unknown. Producers were instructed to use the operating location of the buying agent/firm if known (e.g., a food processing plant, a grocery store, or a local food distributor). If the buyer's place of operation or residence was unknown (e.g., consumers at a farmers' market or wholesale auction barn), they were instructed to use the location of where the sales took place. Average sales per farm by marketing channel and location are reported in Table 2. Local sales exceeded nonlocal sales in all channels and, overall, 90% of sales were local. As with expenditures, sales were mapped to relevant IMPLAN sectors (column 2) and are discussed in more detail below.

Table 1. Average Operating Expenses per Farm, Small Direct Agriculture Producers, Capital District Region NYS, by Category and Location of Expenditure, 2010.

Survey category	IMPLAN commodity or value added mapping[a]	Average expenditures per farm			
		Local ($)	Nonlocal ($)	Total ($)	Percent local
Fuel, oil	3326, 3331	5,533	156	5,689	97%
Machine/building repair	3039, 3417	5,687	757	6,444	88%
Machine hire, trucking	3335, 3362, 3365	557	124	680	82%
Recordkeeping/analysis services	3368	856	0	856	100%
Real estate rental/lease	3360	975	0	975	100%
Insurance	3357, 3358	2,965	876	3,841	77%
Utilities	3031, 3032, 3033	4,529	267	4,796	94%
Livestock grain	SDA, NSDA, 3323	946	137	1,083	87%
Livestock forage/bedding	SDA, NSDA	377	0	377	100%
Replacement livestock	SDA, NSDA	252	364	616	41%
Veterinarian	379	272	36	308	88%
Breeding	3019	0	49	49	0%
Livestock professional services	3019	474	0	474	100%
Other livestock expenses	3019	135	6	141	96%
Fertilizer and lime	3323	2,772	383	3,155	88%
Seeds and plants	3323	1,747	5,283	7,030	25%
Spray crop chemical/herbicide	3323	2,334	496	2,830	82%
Crop professional services	3019	390	209	600	65%
Other crop expenses	3019	941	217	1,159	81%
All other operating expenses	3019	5,080	4,244	9,325	54%
Total intermediate purchases		36,824	13,603	50,427	73%
Difference between total sales and total operating expenses[b]	Proprietor income, Other property type income	21,581	0	21,581	100%
Hired labor	Employee compensation	16,792	161	16,953	99%
Taxes	Indirect business taxes	4,656	249	4,905	95%
Total value-added contribution		43,028	410	43,439	99%
Total outlays		79,852	14,014	93,865	85%

[a]Mappings to multiple commodities are assumed to be evenly distributed between them. For example, for livestock grain, we assume that one third of purchases are made from retail farm supply stores (3323), one third from other small direct agriculture producers (SDA), and one third from non–small direct agriculture producers (NSDA). Where purchases are for retail trade commodities, purchases are margined when creating the SDA sector. [b]The relative contributions to proprietor income and other property type income are assumed to be the same as the relative distribution in the default agriculture IMPLAN sector, 73% and 27%, respectively.
Source. Producer survey, Capital District Region, NYS, 2010.

IMPLAN Models

By default, the entire economy is represented by 440 sectors within IMPLAN. Each sector is represented by a single, static production function—a mathematical expression that relates the quantity of inputs required to produce the resulting output (Lazarus, Platas, & Morse, 2002; Liu & Warner, 2009).[7] Total expenditures in each sector are distributed to intermediate purchases (i.e., local purchases of intermediate inputs from other sectors), payments to value added (i.e., employee compensation, proprietor income, other property type income, and indirect business taxes), intermediate imports (i.e., intermediate inputs purchased from outside the local economy, from domestic or foreign markets), and other sources (e.g., institutions, transfers to households, investments).

Using 2010 IMPLAN data, two multicounty models of the CD region were constructed. Model 1 contains a fully disaggregated sector scheme, except for the default agriculture sector, and uses only existing IMPLAN data. The default agriculture sector aggregates the farm production sectors in IMPLAN consistent with the types of commodities produced by the final sample of surveyed SDA producers. This includes grains (IMPLAN sector [2], vegetables [3], fruit [4], greenhouse and nursery [6], other crops [10], nondairy cattle [11], poultry [13], and other nondairy animal production [14]). It excludes dairy (12) and oilseeds (1) production that are left separate, as well as tree nuts (5), tobacco (7), cotton (8), and sugarcane and sugar beets (9), which do not exist in the study area. Model 2 follows from Model 1 in which the default agriculture sector is separated into two customized sectors—the SDA sector

Table 2. Average Sales per Farm, Small Direct Agriculture Producers, Capital District Region NYS, by Channel and Location of Sales, 2010.

Survey channel	IMPLAN sector mapping	Average sales per farm			
		Local ($)	Nonlocal ($)	Total ($)	Percent local
Direct-to-consumer	Households	65,579	3,715	69,294	95%
Other farmers[a]	SDA, NSDA	5,763	97	5,860	98%
Restaurants	413	3,729	351	4,079	91%
Retail grocers[b]	324, 329, 330	8,767	2,309	11,077	79%
Wholesalers/ processors[c]	43, 54, 59	1,189	2,367	3,556	33%
Total		85,027	8,839	93,865	90%

Note. SDA = small direct agriculture sector; NSDA = non–small direct agriculture sector.
[a]Sales to SDA based on level of intrasector purchases (Table 1), with balance of sales to NSDA. [b]The distribution of total sales to alternative retail trade sectors is proportional to the sectors' gross output levels in the study area. Sales are subsequently margined by national retail trade margins in IMPLAN and the retail sector production functions are edited to reflect purchases from SDA distinct from NSDA. [c]Given near-zero purchases by the wholesale sector (319) of agriculture production commodities in the default IMPLAN data, wholesale/processor sales are fully allocated to processing sectors (43, 54, 59) based on the distribution of comparable producer types (other crops [21%], fruit and vegetable [51%], and meat products [28%]) in the survey data.
Source. Producer survey, Capital District Region, NYS, 2010.

and the NSDA sector—utilizing the expenditure patterns and local spending shares from the survey data.

To create the SDA sector and apportion it from the default agriculture sector, we first determine the total size of the SDA sector in the study area. Because Tables 1 and 2 provide estimates of average expenditures and sales per farm, averages can be scaled up by the estimated number of SDA farms in the region. The original population of farms identified with D2C sales in the CD region irrespective of farm size or primary commodity was 752 (see above), and 77 of the 97 farms sampled (79.4%) were classified as small- or medium-scale, nondairy/nonoilseed farms. Multiplying this percentage by the gross number of D2C farms determines the estimated number of SDA farms in the region: 752 × 0.794 = 597. Note that the size (gross output) of the SDA sector ($93,865 × 597 = $56,037,405) is approximately 28% of the total default agriculture sector in the study area. Whereas this ratio exceeds the ratio of D2C sales to total agricultural sales in the study area from census data, sales in the SDA sector include both D2C and other non-D2C sales.

Farm survey expenditure categories were mapped to their corresponding IMPLAN sector (Table 1), and expenditure shares were computed (i.e., dollars of intermediate input expense [local and nonlocal] per dollar of output, or gross absorption coefficients [GAC] in IMPLAN language). Purchases of retail trade commodities were "margined" using national trade margins available in IMPLAN. Because total gross output for retail trade sectors within IMPLAN reflects only their gross margin (revenue less cost of goods sold), we must accordingly only allocate the equivalent gross margin of total retail trade purchases to the respective retail sector, with the balance (nonretail portion) reported in the supporting industry in which the product is manufactured or produced.[8]

Note that some expenditure categories were mapped to the SDA sector itself and represent purchases SDA producers made from other SDA producers in the region. Hired labor expenses (survey) were mapped to employee compensation (IMPLAN) and taxes (survey) were allocated to indirect business taxes (IMPLAN), both components of value added. Because total outlays must equal the total value of outputs in the model, the difference between total sales and total expenditures ($21,581/farm) was mapped to a combination of proprietor income (73%) and other property-type income (27%), following the same relative distribution existing in the default agriculture sector (Model 1).

The SDA sector was created in IMPLAN by first customizing the study area data. In particular, the tobacco farming sector (with zero activity in the region) was transformed into the SDA sector. Total sector estimates of employment, output, and value added were inserted, with the same amounts deducted from the default agriculture sector, thereby creating the NSDA sector. With a lack of sufficient employment (i.e., jobs) data from the survey, total SDA sector employment (631 jobs) was computed by dividing the total estimated employment compensation for the SDA sector ($16,953/farm × 597 farms) by the ratio of employment compensation to employment in the default agriculture sector ($16,037).

The next step involves customizing the expenditure pattern, or industry production function, for the SDA sector. The GACs for each commodity purchased (including margined sectors) were entered into IMPLAN for the SDA sector. In addition, GACs for each of the industries buying SDA commodities (Table 2) were edited to reflect the differential purchases between SDA and NSDA commodities (formerly combined purchases from the default agriculture sector). For SDA sales to retail trade sectors, sales were margined (as discussed above) prior to estimating the revised GACs.[9]

Table 3. Aggregated Summary of Expenditures per Dollar of Output for the Default Agriculture, Non–Small Direct Agriculture (NSDA), Small Direct Agriculture (SDA) Sectors, Capital District Region, NYS, 2010[a,b].

	Value of outlays per dollar of output		
Category of outlays	Default (Model 1)	NSDA (Model 2)	SDA (Model 2)
All agriculture production (1-14)[c]	0.043	0.059	0.027
Support activities for agriculture & forestry (19)	0.050	0.048	0.059
Mining (20-30)	0.002	0.002	0.000
Utilities (31-33)	0.015	0.016	0.031
Construction (34-40)	0.005	0.005	0.030
Manufacturing (41-318)	0.066	0.070	0.017
Wholesale trade (319)	0.019	0.020	0.000
Retail trade (320-331)	0.001	0.001	0.039
Transportation and warehousing (332-340)	0.018	0.019	0.001
Information services (341-353)	0.001	0.001	0.000
Finance and insurance (354-359)	0.038	0.040	0.032
Real estate and rental (360-366)	0.066	0.069	0.012
Professional services (367-380)	0.007	0.007	0.012
Administrative and waste services (382-390)	0.001	0.001	0.000
Educational services (391-393)	0.002	0.002	0.000
Accommodations (411-413)	0.001	0.001	0.000
Other services (414-426, 433-436)	0.001	0.001	0.016
Government (427-432, 437-440)	0.005	0.006	0.017
Total intermediate purchases	0.341	0.367	0.295
Employee compensation	0.229	0.248	0.181
Proprietor income	0.106	0.082	0.167
Other property type income	0.039	0.030	0.062
Indirect business taxes	0.018	0.005	0.052
Total payments to value added	0.393	0.365	0.462
Institutional purchases	0.009	0.009	0.013
Intermediate imports (foreign and domestic)	0.257	0.259	0.231
Total outlays	1.000	1.000	1.000

[a]The defined agricultural production sector is an aggregation of production sectors in IMPLAN consistent with the types of commodities produced by the surveyed SDA producers. This includes grains (2), vegetables (3), fruit (4), greenhouse and nursery (6), other crops (10), nondairy cattle (11), poultry (13), and other nondairy animal production (14). It excludes dairy (12) and oilseeds (1) production that are left separate, as well as tree nuts (5), tobacco (7), cotton (8), and sugarcane and sugar beets (9) that do not exist in the study area. [b]Expenditure patterns are aggregated to the two-digit NAICS level (but for the agriculture and agricultural support sectors). Categories of indirect purchases for which all agriculture sectors have zero purchases are excluded. The default agriculture expenditure pattern uses default IMPLAN data prior to splitting the sector into the SDA and NSDA subsectors (Model 1). The NDSA and SDA expenditure patterns are based on survey-derived gross absorption coefficients and regional purchase coefficients (Model 2). [c]Values represent purchases for all agricultural sectors, including dairy and oilseed farming. For the SDA and NSDA patterns, they include combined local purchases from SDA, NSDA, oilseed, and dairy farming.

Customizing the commodity production data for the SDA sector followed. Commodities are produced by industries, some of which produce multiple commodities, generally a primary commodity and one or more by-products. Given the data collected, we assume that the SDA sector produces only one SDA commodity.

The final step involves customizing trade flows to reflect the portion of commodities purchased by the SDA sector from local sources; that is, customizing IMPLAN's regional purchase coefficients (RPCs). By default, IMPLAN RPCs for each commodity are indifferent across all sectors that purchase it. For Model 2, we edit the RPCs for each of the commodities purchased by the SDA sector following the local spending percentages in Table 1. After making the customizations above for Model 2, the model was reconstructed in IMPLAN.

Results

The differences in local spending patterns between the default agriculture sector (Model 1) and the SDA and NSDA sectors (Models 2) can now be assessed, along with the differential economic impacts from alternative exogenous shocks supporting agriculture industry expansion.

Local Purchasing Patterns

Table 3 provides a summary of local expenditure patterns for the default agriculture sector (Model 1) and the SDA and NSDA sectors derived from it (Model 2). For ease of exposition, we aggregate the individual model sectors to the two-digit NAICS level in the table and exclude categories of

expenditures in which the intermediate purchases are zero for all of the agriculture sectors. As one would expect, the local purchasing patterns are similar for the default and NSDA sectors because the SDA sector represents a relatively small proportion of the total default agriculture from which it was extracted. Accordingly, our attention will concentrate on differences between the NSDA and SDA sectors.

In addition, all local intermediate agriculture purchases are included in the All Agriculture Production row. Specifically, for Model 1, All Agriculture Production includes purchases of the default agriculture sector from itself, as well as from oilseed and dairy farming. For Model 2, the NSDA and SDA purchases from All Agriculture Production include purchases from SDA, NSDA, and oilseed and dairy farming. As shown, the SDA sector has a lower level of local intermediate purchases from agriculture per unit of output ($0.027) than the NSDA sector ($0.059).

It is clear that the intermediate purchase patterns differ considerably between the SDA and NSDA sectors, with total local intermediate purchases per dollar of output by SDA at $0.295 compared to $0.367 for NSDA. In particular, SDA has higher local purchases for agricultural support activities, construction (repairs), utilities, and retail trade per dollar of output, whereas lower purchases are most apparent from manufacturers, transportation and warehousing, and real estate and rental. Differences in these spending patterns ultimately affect the level and distribution of multiplier effects (discussed further below). Without more detailed data from both SDA and NSDA producers, it is difficult to more precisely quantify what the differences in expenditures imply about differences in (average) production practices between the two types of farms. That said, a higher reliance on support activities may imply less relative availability of appropriately skilled labor on SDA farms, whereas a trade-off of direct purchases of manufactured goods to purchases from downstream retailers may be tied to access issues for smaller scale producers. Lower transportation and warehousing purchases may also imply that these types of activities are more fully taken on by SDA producers. Fewer purchases per dollar of output on real estate and rental for SDA farms is also consistent with intensive and multicrop production systems on many SDA-style farms, particularly for fruits and vegetables. It is less clear that these differences reflect trade-offs in labor for capital between the two types of farms, particularly given that the total labor income (employee compensation and proprietor income) per dollar of output is relatively similar across the two farm types, on average.

SDA contributes more to total value added per dollar of output ($0.462) than NSDA ($0.365). SDA producers in the sample rely less on hired labor given that proportionately more labor is provided by owner operators, which is reflected in higher payments to proprietor income and other property-type income. More specifically, employee compensation per dollar of output is lower for the SDA sector ($0.181) than the NSDA sector (0.248), or inversely, output per dollar of

Table 4. Multipliers for the Default Agriculture, Small Direct Agriculture (SDA), and Non–Small Direct Agriculture (NSDA) Sectors[a].

Multiplier	Model 1	Model 2	
	Default	NSDA	SDA
Employment	1.53	1.50	1.73
Labor income	1.76	1.81	1.84
Total value added	2.32	2.47	2.12
Output	1.90	1.94	1.87

[a]Capital District Region, New York State, 2010.

employee compensation is higher for SDA farms in our sample. By assuming the same level of wages per job across SDA and NSDA sectors (which is reasonable), it must be that output per job is also higher in the SDA sector. Although the labor-intensive nature of smaller scale farming may be greater, this is not necessarily seen only through paid labor. Indeed, smaller operations likely contribute a relatively higher share of the total labor required by the owner operators and unpaid family labor. To this point, total labor income per dollar of output is more similar but larger for the SDA sector, or, inversely, output per dollar of total labor income is lower for the SDA sector. Higher business taxes per unit of output were also reported by the SDA producers in the region.[10] Finally, the SDA sector imports less per unit of output than the NSDA sector ($0.231 vs. $0.259).

Multipliers

Multipliers examine the relative size of an exogenous change in final demand (i.e., the value of goods and services produced and sold to final users) to the total effects of that change. Given an initial (direct) change in final demand, indirect industry effects accumulate as backward-linked industries respond to increased demands for goods and services (inputs) needed by the directly affected industries to satisfy the initial change in final demand. In addition, induced effects accumulate from increased expenditures of new household income generated from the direct and indirect industry effects, as well as increases in interinstitutional transfers (for a Type-SAM or Social Accounting Matrix, multiplier).[11] Multipliers are specific to a particular geographic location (i.e., the defined regional economy) and dependent of the level of local purchases. In this sense, each geography has a unique multiplier depending on what businesses and industries are available to capture the supply chain spending, and any spending outside of the regional economy does not contribute to the multiplier.

The estimated (Type-SAM) multipliers for the alternative agricultural sectors in the defined CD region (Table 4) demonstrate the consequences of the differential expenditure and sales patterns. For completeness, we include the multipliers from the default agriculture sector but prioritize our attention

to the disaggregate agriculture sector results. Consistent with a higher level of intermediate input purchases per dollar of output, the output multiplier for the NSDA sector (1.94) is above that for SDA (1.87). Labor income multipliers are more similar and are consistent with the similar levels of outlays per unit of output to labor income (employee compensation + proprietor income) across the SDA and NSDA sectors.

The size of the employment multiplier varies inversely with the direct employment coefficient; that is, the amount of employment needed to produce one dollar of goods. Accordingly, the lower employee compensation per dollar of output in the SDA sector (Table 3) and (by assumption) equivalent wage rates in the SDA and NSDA sectors (see above) imply a higher SDA employment multiplier (Table 4). The result may at first appear counterintuitive, but it is as it should be: the smaller the direct employment coefficient, the larger the direct change in output per additional job in that sector. Thus, there is a larger direct change in output for each additional job created to generate indirect and induced changes throughout the economy.

The logic of the employment multiplier extends directly to the notion of the total value-added multiplier. In this case, the higher total value-added contributions per dollar of output for the SDA sector result in a lower total value-added multiplier (2.12 vs. 2.47).

The individual multipliers can be decomposed into their indirect and induced components and by industry sector, which demonstrates the distributional impacts of a potential exogenous policy shock. These multiplier impacts depend not only on the interindustry linkages between the agriculture and other sectors but also on the composite of all interindustry linkages between the sectors in the economy, as well as the induced impacts between sectoral changes and household consumption. Figures 1 and 2 show sector-specific contributions (indirect and induced effects) for the output and employment multipliers for the SDA and NSDA sectors, respectively. For output, Figure 1A orders the combined indirect and induced effects by industry from highest to lowest for the SDA sector (the sum of all the columns will equal 0.87; see Table 4). Then, to help show differences in component contributions, the same order of industries is retained for Figure 1B but now for the NSDA sector (the column sum here will equal 0.94; see Table 4). Consistent with Table 3, Figure 1A and B reveals clearly different multiplier contribution patterns; that is, different related sector impacts. Figure 2A and B is similarly constructed, but now for the employment multipliers.

For output, comparisons across the distribution of multiplier effects show higher indirect and induced effects for the NSDA sector in the real estate and rental, manufacturing, and composite agriculture production sectors relative to the SDA sector, as well as for wholesale trade and transportation and warehousing (Figure 1A and B). Lower indirect effects from wholesale trade and transportation and warehousing for the SDA sector may well be the result of SDA producers taking on more of the functions of these sectors themselves. In addition, higher purchases from retail trade for the SDA sector also support higher multiplier contributions from this sector. For employment, higher contributions to the SDA multiplier come particularly from the agricultural support activities and retail trade sectors (Figure 2A and B).

Impact Results

To understand the overall extent of differential economy-wide impacts from expansion in alternative agriculture sectors, we imagine separate hypothetical scenarios in which an exogenous shock (e.g., federal government spending to support agricultural economic development efforts) increases final demand by $1 million in the targeted agriculture sector. By shocking each sector separately, we can assess the differences in total economic impacts. As the initial stimulus is hypothetical, the specific magnitude of the shock is less important to our analysis than the relative impacts across the affected sectors. However, relatively large changes in final demand may induce changes in the production function profiles of the industries affected. In our case, the SDA and NSDA sectors have (preshock) annual total output of $56 million and $141 million in the multicounty region, respectively. Accordingly, a $1 million direct shock to these sectors is only 1.8% and 0.7% of the preshock sector output levels, respectively.[12]

The impact summary of equivalent policy shocks (i.e., $1 million increase in final demand) is shown in Table 5. For completeness, we include total estimated effects for the default agriculture sector of the $1 million shock, but focus our comparisons on the differences in the SDA and NSDA results. To interpret the results, consider those for the shock to the SDA sector. Here, a $1 million shock contributes $1.872 million to total output when the indirect and induced effects are considered. Similarly, the total effects on employment, labor income, and total value added are 19.4 jobs, $0.641 million, and $0.982 million, respectively. Total employment effects for the SDA sector are 16.6% lower compared to an equivalent NSDA sector shock, which is consistent with the lower reliance (per unit of output) for hired labor. Lower intermediate purchases for the SDA sector are also revealed in a 3.6% lower total output effect.

In contrast, the total effects for labor income (employee compensation and proprietor income) and total value added are 7.3% and 8.7% higher, respectively, for the SDA sector. These results reflect, in part, the higher contributions to total value added per unit of output for the SDA sector (the direct effect), as well as larger indirect and induced impacts from the agricultural support activities sector, a sector with high labor requirements per unit of output.
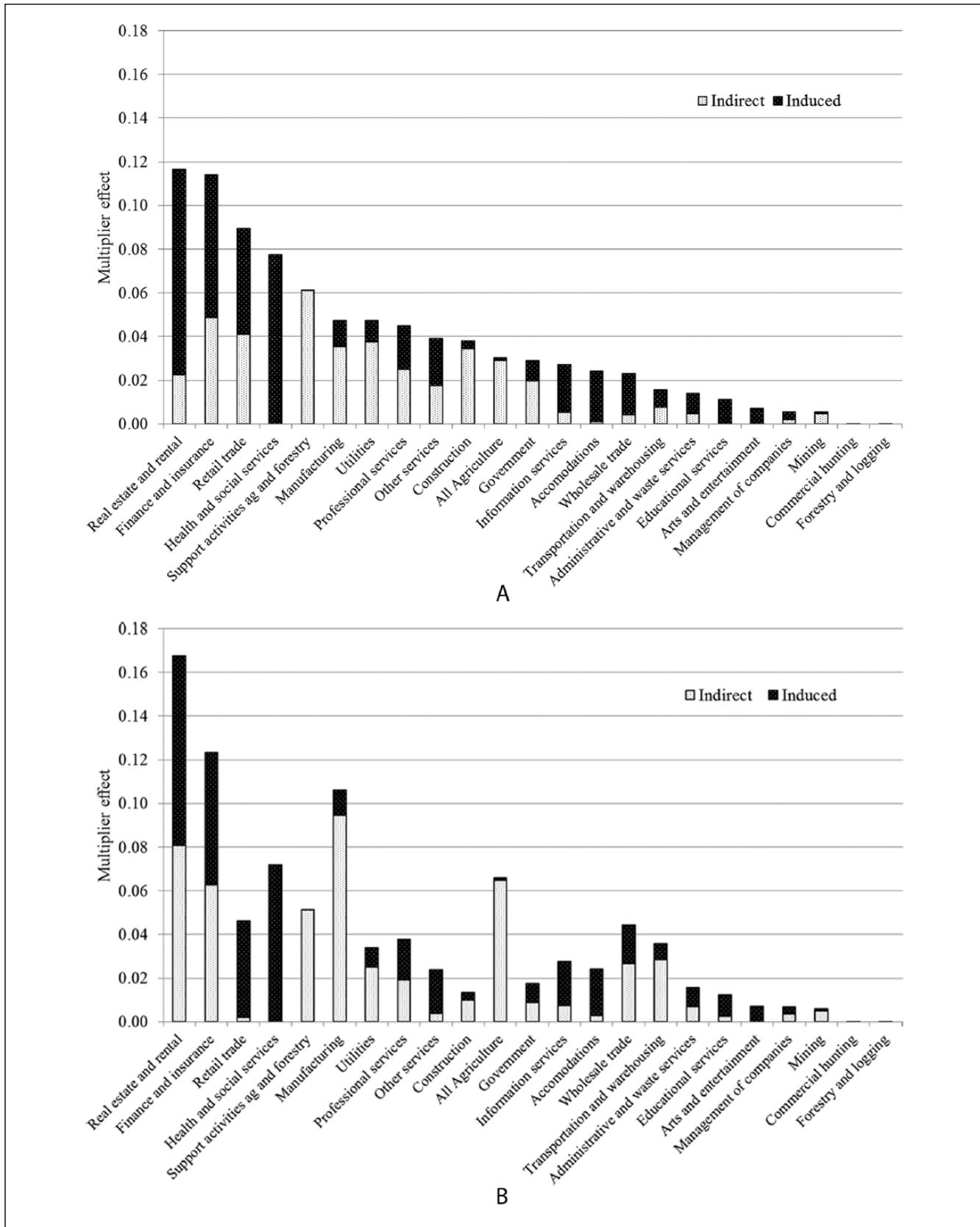
Figure 1. Decomposition of output multiplier for (A) small direct agriculture and (B) non–small direct agriculture sectors.
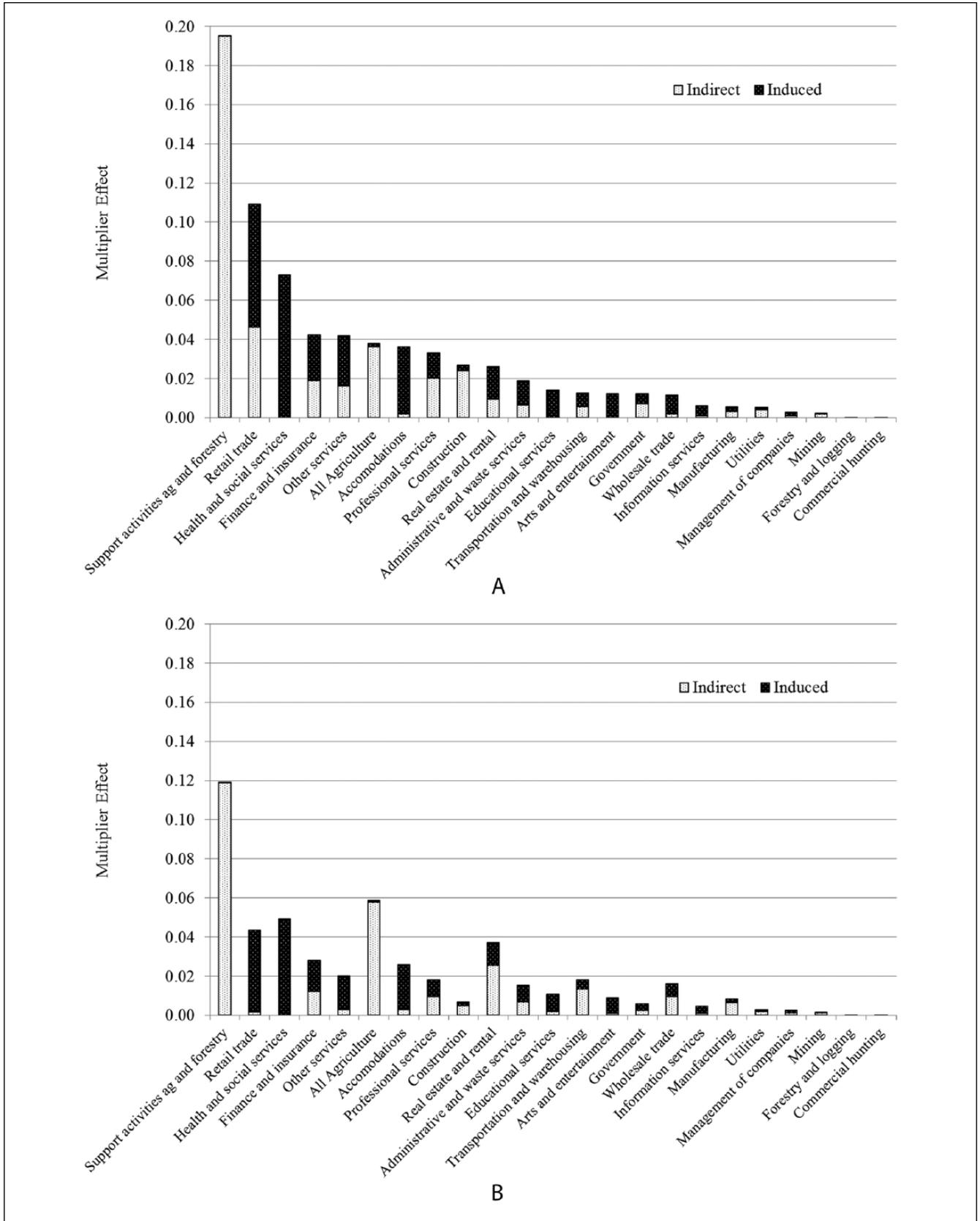
Figure 2. Decomposition of employment multiplier for (A) small direct agriculture and (B) non–small direct agriculture sectors.

Table 5. Impact Summary of $1 Million Shock to Alternative Agriculture Production Sectors, 2010 Dollars[a].

Impact type	Employment	Labor income	Total value added	Output	Employment	Labor income	Total value added	Output
Model 1[b]		Default agriculture						
Direct effect	14.3	$335,711	$392,871	$1,000,000				
Indirect effect	4.2	$121,915	$249,783	$471,572				
Induced effect	3.4	$134,223	$268,614	$428,993				
Total effect	21.8	$591,848	$911,268	$1,900,565				
Model 2[c]		Non–small direct agriculture (NSDA)				Small direct agriculture (SDA)		
Direct effect	15.5	$330,655	$365,119	$1,000,000	11.3	$348,446	$462,776	$1,000,000
Indirect effect	4.4	$131,264	$267,927	$510,696	4.5	$146,372	$226,934	$406,015
Induced effect	3.4	$135,129	$270,432	$431,964	3.7	$145,935	$292,077	$466,458
Total effect	23.3	$597,048	$903,479	$1,942,660	19.4	$640,753	$981,787	$1,872,472

[a]The defined agricultural production sector is an aggregation of production sectors in IMPLAN consistent with the types of commodities produced by the surveyed SDA producers. This includes grains (2), vegetables (3), fruit (4), greenhouse and nursery (6), other crops (10), nondairy cattle (11), poultry (13), and other nondairy animal production (14). It excludes dairy (12) and oilseeds (1) production that are left separate, as well as tree nuts (5), tobacco (7), cotton (8), and sugarcane and sugar beets (9) that do not exist in the study area. [b]The results from Model 1 use the agriculture sector as described above, prior to splitting the sector into the SDA and NSDA subsectors. [c]The results from Model 2 separate the default agriculture sector into the SDA and NSDA sectors based on the survey data.

Discussion and Conclusions

The results of our analysis have significant implications for policies promoting local economic development. First, the results confirm that existing secondary data are ill-equipped to adequately describe the spending patterns for SDA producers in the CD region; therefore, caution is advised in utilizing default secondary data to accurately estimate economic impacts from stimuli or policy shocks aimed at expanding the SDA sector. Intermediate purchase patterns are distinctly different from those assumed in existing secondary (IMPLAN) sources, in terms of both technical input (production function) coefficients and local spending parameters (regional purchase coefficients). Furthermore, the SDA sector relies less on intermediated imports and has greater payments to value added. This is a significant result, as studies relying on default IMPLAN agriculture sectors that attempt to calculate the impact of local and regional food systems do not reflect an accurate picture of impact of the small- and midscale farms that dominate D2C sales channels.

Second, studies that calculate the impact of local food systems utilizing default IMPLAN agriculture sectors will either under- or overestimate the true magnitude of the local economic impact from the expansion of these sectors, depending on the metric under consideration. From equivalent policy shocks, we show that the SDA sector has lower total economic impacts than the NSDA sector for employment and output, but higher impacts for labor income and total value added. Understanding these differential impacts will guide policy development aimed at industry expansion in which policy objectives may be ill-defined. In particular, the larger impacts on total value added—that is, differential contributions to an economy's gross domestic product—may be particularly useful in justifying spending of public monies to support the changes in final demand in the SDA sector. Policy goals and objectives of resource-limited entities, however, may not be this simple. If policy makers are more concerned with the jobs enhancement or total economic (output) activity, alternative recommendations to the NSDA sector arise.

Future Research

This study presents information based on one case study, and the expandability of its recommendations will clearly benefit from additional research and data collection. Determining, for example, the specific types of input markets that promote additional local purchases by the agricultural sector is important in devising and prioritizing economic development strategies for business recruitment and retention.

Although important, this type of economic impact assessment does not provide insight into the long-run impacts of a particular policy shock. Input–output models provide a snapshot of the economy at a given point in time. To provide a longer-term perspective, it may be important to determine the extent to which the small direct agricultural producers' purchases of local inputs affect their profitability—is it more profitable to purchase inputs from a nonlocal source? Based on USDA survivability data, Platas (2000) and Lazarus, Platas, Morse, and Guess-Murphy (2002) note that small- and midscale hog operations are less likely to be in operation 5 years into the future than large-scale operations. Thus, an assessment of how increased local purchases by the small direct agricultural sector may contribute to or impede profitability is a key point for future research. The answers may have significant repercussions for selecting appropriate policies.

This study also does not address the within-sector distributional impacts among particular agricultural production industries. Because of data limitations and disclosure concerns for individual agricultural production sectors (e.g., fruits and vegetables, livestock, dairy), we could not investigate policies targeted to specific agricultural production sectors. Given distinct differences in agricultural production activity across regions, a more microlevel approach would help identify effective sector-based policies.

Finally, the design of appropriate survey instruments should not be overlooked. Translating traditional income statement categories of more familiarity to producers is less convenient when mapping to IMPLAN sectors. Surveys should be designed to better elucidate from whom the farm operators are purchasing products (retailers, manufacturers, etc.), as well as allocations to components of value added (e.g., proprietor income or other property type income) and the locality of where the purchases were made.

Notes

1. The U.S. Department of Agriculture defines a regional food hub as "a business or organization that actively manages the aggregation, distribution, and marketing of source-identified food products primarily from local and regional producers to satisfy wholesale, retail, and institutional demand" (Barham et al., 2012, p. 4).

2. Technically, we incorporate our analysis into a regional IMPLAN Social Accounting Matrix (SAM). A typical SAM provides a mapping into a functional category for households, usually based on household income class; however, the IMPLAN SAM does not serve this purpose except under very restricted conditions (see Alward & Lindall, 1996).

3. The Capital District region in New York State includes the counties of Albany, Columbia, Fulton, Greene, Montgomery, Rensselaer, Saratoga, Schenectady, Schoharie, Warren, and Washington.

4. Note that the many of the farms also used other types of (non-D2C) market outlets in their portfolios (see Table 2).

5. A copy of the interview protocol is available on request from the corresponding author.

6. Note that capital expenditure data were not available in the survey; however, their absence does not affect our multiplier estimates. Within an IO framework, intermediate transactions do not include capital purchases (Horowitz & Planting, 2009). Capital expenses instead are treated as investments. This type of expense is distinct from intermediate expenses, which are part of the producer budget that has been earmarked for current production of output. Investments, on the other hand, are motivated by the desire to enhance future capacity. Because of the intertemporal nature of investments (the costs are incurred today but the reward is realized in the future), the capital account is rendered exogenous in all our models. The exogeneity assumption means that capital expenses have no bearing on the multiplier estimates.

7. For an in-depth discussion of how production functions are constructed within IMPLAN, see Lazarus, Platas, and Morse (2002).

8. For example, total purchases of fuel and oil ($5,533) were assumed to be evenly allocated to retail trade gasoline (IMPLAN commodity 3326) and retail nonstore (3331) purchases. Accordingly, the allocated purchases from retail trade gasoline were multiplied by the retail trade gasoline margin (15.0%) and applied to 3326, with the balance allocated to petroleum refineries (3115). Purchases of wholesale trade commodities would also need to be margined, but no wholesale trade purchases were included in the survey data (Table 1).

9. Our mapping procedure for the SDA sector transactions follows IMPLAN's sector mapping documentation to the fullest extent possible, including the use of the "440 IMPLAN from NAICs lookup" file (http://www.implan.com/index.php?option=com_content&view=article&id=215:215&catid=222:222#440-sectoring-2012-2007). However, the procedure does introduce some room for error between the SDA and NSDA expenditure profiles given that different individuals are doing the mapping; that is, the researcher (based on the survey data) and IMPLAN (based on the data they collect from federal and state sources).

10. Indirect business taxes consist of excise taxes, property taxes, fees, licenses, and sales taxes paid by businesses (IMPLAN Group LLC, 2012).

11. IMPLAN computes both Type I multipliers (considering direct and indirect effects) and Type SAM multipliers (considering direct, indirect, and induced effects). See Miller and Blair (2009, chapters 6 and 11) for a more detailed derivation and discussion of alternative multipliers.

12. As pointed out by a reviewer, modelling an increase in federal support of $1 million would also require modelling a corresponding decrease in household expenditures because of households paying additional taxes to cover the increased cost of the program. However, given the relatively small level of

increased costs incurred to households, and the fact that households would face the same cost whether the program supported either SDA or NSDA producers, we omit this technical detail from the analysis.

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