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### How 'Bout Them Apples?

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The apple industry is an important sector in the New York state (NYS) farm and food economy. In 2016, over 1,300 farms operated 46,860 acres to harvest 1.2 billion pounds of apples valued at \$317 million. The crop is split approximately 50-50 between fresh market and processed uses; however, an increasing portion of the crop has migrated to higher-value fresh markets in recent years (i.e. 56% in 2016). In 2016, 80% of apple receipts were from fresh market sales. The apple industry represents production inputs at the farm level, storage, transportation, processing and sales to wholesalers, retailers or directly to consumers.

The 2014-15 *New York Apple Shipper, Wholesale Cider, & Fresh Fruit Directories* list 28 farms, distributors, and cold storage facilities with the ability to ship apples for export or gift cartons. The 2015 *New York State Processing Apple Buyer Directory* lists 6 businesses that purchase processing apples. Processors provide a variety of services, including freezing or drying, slices, branded or private label apple sauce, juice and cider, shelf stable juice, apple cider blends, apple fiber, pulp, and pomace. Four businesses are listed as apple processors and dealers. These businesses purchase apples for both in-state processors, such as Mott's, as well as processing apples for companies located out-of-state, including Pennsylvania and Michigan.

Hard cider and distilled spirits are receiving increased attention in the press. The directory lists 16 businesses that provide fresh or hard cider, flavored ciders, organic, or certified kosher cider. The NYS Liquor Authority listed 24 licensed farm cideries in 2014. Some orchardists with on-farm cideries are investigating and planting new and heirloom apple varieties to improve product quality. Other cidery operators are interested in purchasing unique apple varieties from apple farmers. The New York Cider Map and Directory lists 76 cideries within the state (West 2017).

The economic impact of production agriculture and the food processing sector can be difficult to quantify and may even appear small relative to other sectors as investment in mechanization may reduce the number of jobs and payroll. The NYS Apple Association asked the question, "What does the apple industry contribute to the NYS economy?" Todd Schmit, Associate Professor, Cornell University with a team of researchers worked together to answer the question.

The researchers used IMPLAN software, which uses Input-Output analyses, to conduct the analysis. The Input-Output (I-O) method focuses on and measures the activities needed to produce a good and is an analytical technique for explaining the interconnectedness of an economic system.

The following metrics are used to describe an industry's contributions to the economy. This article presents only output and employment results; however, the results for labor income and value added are included in the full report.

- Output
  - The value of industry production in producer prices; for manufacturers = sales + changes in inventory, for service sectors = sales
- Employment
  - The average annual number of jobs, both full and part time. Not full-time equivalents.
- Labor Income
  - All employment income; employee compensation (total payroll cost) + proprietor income (self-employed+ unincorporated business owners).
- Value Added
  - Gross regional product derived from income paid to owners of the factors of production. Output - cost of intermediate inputs. Includes labor income, other property type income, and taxes.

*Source: IMPLAN (2016)*

To estimate the economic contribution of the apple industry to the NYS economy, researchers combine the “direct” economic effects from apple production and processing with the ripple effects they have across the economy. The direct effect is measured using apple and apple product sales and adds purchasing patterns of all the products and supplies used directly in the apple supply chain. The direct effect for processed apple products, however does not include the farm value of its apple ingredients, because it is measured under apple sales at the farm level. Thus, the value of the apples is only counted once across the entire analysis.

If we use the analogy that direct effects are the “splash” of the apple industry activity and that indirect effects are the subsequent ripples of purchases by the suppliers in reaction to providing goods or services to the apple industry, induced effects are the ripples of wages and proprietor income being spent in the NYS economy.

The results show \$1.3 billion in direct contributions (total gross output) from the apple supply chain (Table 1). The apple supply chain also created an additional \$441.3 million and \$314.3 million in indirect and induced effects, respectively. When the direct, indirect, and induced contributions are combined, we see that the apple supply chain contributed \$2.1 billion to the industrial sales in NYS in 2016.

Contributions from specific apple supply chain sectors (i.e., for farm production, services, processing, marketing and public research and extension) are also shown in Table 1. Note that the direct contributions from each industry sector can be added together to get a total direct value, but neither the indirect nor the induced impacts can be summed across sectors. For example, when looking at the processing (frozen, canned, and dehydrated) sector in isolation, a portion of the \$318.5 million in indirect output includes backward-linkages to apple farm production sector already accounted for in processor purchases of local apples from apple farms.

The output contribution multiplier for the aggregate apple supply chain in NYS (i.e., the sum of the direct, indirect, and induced effects divided by the direct effect) is 1.58, meaning that for every dollar generated in the apple industry (broadly speaking), an additional \$0.58 is generated from inputs into the apple supply chain (Table 1).

**Table 1. Economic Contribution of the Apple Industry in New York State, by Sector, 2016 dollars**

<b>Contribution Metric by Industry Sector</b>	<b>Direct Effect<sup>1</sup></b>	<b>Indirect Effect<sup>2</sup></b>	<b>Induced Effect<sup>3</sup></b>	<b>Total Effect<sup>4</sup></b>	<b>Contribution Multiplier<sup>5</sup></b>
<b>Output (\$ million)</b>					
Agricultural support services	11.9	1.6	5.7	19.2	1.62
Fruit and nursery stock	7.1	0.6	2.9	10.6	1.49
Farm production	317.0	116.0	141.0	574.0	1.81
Processing (frozen, canned, dehydrated)	838.8	318.5	149.8	1,307.1	1.56
Hard cider and apple wine	129.8	52.9	36.2	218.9	1.69
New York Apple Association	3.1	0.8	1.2	5.2	1.65
Public R&D - Apples (Cornell, CCE)	2.2	1.1	0.3	3.6	1.65
<b>Total</b>	<b>1,309.9</b>	<b>441.3</b>	<b>314.3</b>	<b>2,065.5</b>	<b>1.58</b>
<b>Employment (average annual number of jobs)</b>					
Agricultural support services	265	7	36	308	1.16
Fruit and nursery stock	81	5	18	104	1.28
Farm production	5,605	525	886	7,016	1.25
Processing (frozen, canned, dehydrated)	1,635	1,441	940	4,016	2.46
Hard cider and apple wine	425	252	228	905	2.13
New York Apple Association	6	5	8	19	3.19
Public R&D - Apples (Cornell, CCE)	16	6	2	24	1.49
<b>Total</b>	<b>8,033</b>	<b>1,849</b>	<b>1,989</b>	<b>11,872</b>	<b>1.48</b>
Source: IMPLAN (2016), author calculations					
<sup>1</sup> Direct effects represent total activity (sales, employment, labor income, value added) by respective industry					
<sup>2</sup> Indirect effects represent all activity by the backward-linked supply chain industries.					
<sup>3</sup> Induced effects represent additional industry activity due to consumption out of labor income.					
<sup>4</sup> For each industry, the sum of the direct, indirect, and induced effects equal the total effect. Summing the direct effects across industries will equal the total shown; however, summing the indirect and induced effects across industries will not as we account for existing inter-industry linkages within the apple supply chain.					
<sup>5</sup> The implicit multiplier is calculated as the total effect divided by the direct effect.					

Table 1 also displays the contribution employment metrics. The economic contributions from employment in the apple industry supply chain in NYS are estimated at 11,872 jobs, 8,033 jobs through direct employment and an additional 3,839 through non-apple, indirect and induced industry

effects. (Note that jobs are not full time equivalents) In total, for every job generated by the apple industry, another 0.48 jobs are supported in backward-linked non-apple industry sectors.

As with industry output, most of the indirect and induced jobs are generated by agricultural manufacturing activity. Indeed, the apple processing industries each have employment multipliers that exceed two, well above the apple farming multiplier of 1.25. The result illustrates the strong linkages processors have to the farm sector as part of the indirect effects for processing include on-farm employment.

The general objectives of this research were to better understand the apple supply chain's total economic contributions to the NYS economy and to demonstrate the strong ripple (multiplier) effects the industry has. Readers are directed to the [\*Economic Contributions of the Apple Industry Supply Chain in New York State, Cornell University, Charles H. Dyson School of Applied Economics and Management, Extension Bulletin \(EB 18-03\)\*](#) for further understanding of the analysis and, importantly, to learn more about the distribution of the indirect and induced effects, by industry, generated by all apple industry supply chain activities.

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