

A BID ADJUSTMENT ALGORITHM INCORPORATING MULTIPLIER IMPACTS TO
SUPPORT LOCAL FOOD PROCUREMENT BY PUBLIC AGENCIES

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ABSTRACT

This paper presents an innovative adjusted bid price mechanism that incorporates economic multiplier effects in public food procurement processes, using New York State (NYS) as a case study. Recognizing the role public procurement plays in fostering sustainable local food systems and economic development, our proposed mechanism adjusts bid prices for local vendors based on the local economic activity generated through direct, indirect, and induced effects. This approach provides a more comprehensive view of the true cost to the state, allowing agencies to make better-informed procurement decisions and contribute to the overall resilience of the regional economy. The transparent and easy-to-implement adjustment method offers significant implications for policy debates surrounding public food procurement, local competitiveness, and sustainable food systems. The paper derives an economic model for the adjusted bid prices, applies it to an empirical case using detailed food purchase data from NYS, and concludes with potential future research directions.

BIOGRAPHICAL SKETCH

Xiaoyan Liu is a second-year master's student at the Dyson School of Applied Economics and Management at Cornell University with a focus on food and agricultural economics. She received Bachelor of Science degrees in Math and Economics from the Ohio State University.

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TABLE OF CONTENTS

Biographical Sketch.....iv
Acknowledgements.....v
Table of Contents.....vi
List of Tables.....vii

Introduction..... 1
Economic Model.....5
Empirical Applications.....18
Conclusions26
References.....29
Appendix31

LIST OF TABLES

Table1. Food product mapping and IMPLAN Regional Purchase Coefficients (RPC).....9

Table2. Processed food product category spending pattern disaggregation.....11

Table3. Output multipliers (M) and tax coefficients (t) by sector.....13

Table4. Actual (B) and adjusted (B*) bid costs by OGS bid class and vendor.....23

Table5. Actual (B) and adjusted (B*) bid costs for locally produced foods across all vendors in the Food bid, by mapping category.....25

Appendix A. Example product for each mapping category.....31

Appendix B. Actual (B) and adjusted (B*) bid costs for locally produced foods across all vendors in the Food bid, by OGS category.....34

A Bid Adjustment Algorithm Incorporating Multiplier Impacts to Support Local Food Procurement by Public Agencies

Introduction

There is a growing recognition of the role public procurement can play in promoting sustainable local food systems and strengthening local economies. Indeed, a wide literature suggests that growing local food systems can contribute to economic development, job creation, and community resilience (e.g., Peters & Thilmany. 2022; Schmit et al. 2021; McFadden et al. 2016; Hughes & Boys 2015; Pinchot 2014). Public agencies around the world are increasingly utilizing their purchasing power to support local food producers, foster economic development, improve food security, and enhance environmental sustainability (Hawkes & Ruel 2006). This is evidenced by the growing number of public institutions, such as schools, hospitals, and government agencies, that are actively integrating local food procurement strategies into their operations (European Commission 2016).

While traditional public food procurement law in the United States generally limits awards to the lowest cost bidder, several states (and substate municipal authorities) are implementing revisions to food procurement law that provide geographic preferences when awarding contracts, including tie-breaker preferences, price percentage allowances, and local food purchase quotas (CFSAC 2021). Similar amendments to New York State (NYS) law consider allowances for "Best Value"¹, local purchasing preferences², and prioritizing food contractors selling NYS food products³, among others. In line with state amendments, New York City (NYC) has their own local law to promote the purchase of local food products.⁴

¹ N.Y. STATE FIN. LAW § 163(1)(j). (McKinney 2022).

² N.Y. GEN. MUN. LAW § 103(8-a)(a). (McKinney 2022).

³ N.Y. STATE FIN. LAW § 165(4)(b)(iv); N.Y. GEN. MUN. LAW § 103(8-a)(c)(iii). (McKinney 2022).

⁴ 2011 N.Y.C. Local Law No. 50, N.Y.C. ADMIN. CODE § 6-130.

Beyond public procurement law, recent policy levers to increase demand for locally produced and/or grown products and support business development in NYS have established minimum percentages (i.e., quotas) of local spending to qualify for a particular benefit. For example, the establishment of the NYS Farm Brewery License in 2013 allowed farm brewers to produce beer and/or cider if a minimum percentage of ingredients are procured from NYS sources (e.g., 60% of hops for beer and 100% of apple/pome fruits for cider).⁵ To the consideration of public procurement, the 30% Farm to School Initiative was established in 2018 and provides an additional reimbursement of \$0.19 per lunch meal to school food authorities (a 316% increase) if at least 30% of food procurement dollars are spent on NYS food products (Bilinski et al., 2022).⁶

While the 30% Farm to School Initiative has been shown to have a net benefit to the state in the short run (Krasnoff et al. 2022), quota systems on procurement have an unintended consequence of restricting competition among suppliers. Suppliers benefiting from these protections can raise their prices and, hence, the cost of local food procurement without any incentive to improve practices. For agencies with fixed budgets, this necessarily means serving fewer people. Reduced competition also diminishes suppliers' incentive to innovate to enhance product quality, efficiency, or both. The resulting loss of competitiveness means that anti-competitive policies like quotas often do long-run harm to the very firms they aim to help in the short-run. Furthermore, to the degree that local spending quotas face supply constraints in the quantity or quality of inputs, business expansion and/or innovation may be impeded and, therefore, limit the favorable economic impacts promoted by the quotas in the first place.

⁵ The law also mandates that the use of local inputs increases over time, but with clauses that allow for exemptions in years with limited supply).

⁶ Other examples of recent programs supporting public procurement of local foods include Farm to Institution New York State (FINYS), which aims to create a more robust market for NYS grown products by connecting farmers with institutional buyers (American Farmland Trust 2021), and the Good Food Purchasing Program (GFPP), which establishes procurement guidelines for public institutions to prioritize local, sustainable, and fair food purchasing (Center for Good Food Purchasing 2021).

An alternative approach to achieve the same desired outcome of boosting the competitiveness of local vendors in state procurement processes is to require that agencies take into account the economic multiplier effects. Multiplier effects are generated when local dollars recirculate through an economy due to backward-linked local industry input purchases and local spending by local employees and business owners via households. This follow-on spending generates additional, subsequent tax revenues for NYS. Adjusting the bid price of a vendor for these fiscal impacts resolves a dynamic externality, the fact that there are spillover effects from current procurement on future fiscal revenues and spending. Put differently, while the bid price represents a gross cost to the state, the true (net) cost to the state accounts for added state tax revenues vis a vis the multiplier effects.

Love et al. (2020) argue that significant policy interventions are necessary to shift public procurement purchasing behavior towards more local and resilient supply chains, given that the current market structure has been developed to prioritize efficiency and cost-effectiveness. Food procurement law that allows for price percentage preferences for local food products at least indirectly, albeit inadequately, encompasses the concept of economic multiplier benefits, however with price percentages (i.e., allowable increases in costs if the products are local) that are defined as a result primarily of political debate rather than sound science.

We contribute significantly to this policy debate by developing an adjusted bid price mechanism whereby procurement bids are adjusted formulaically and transparently for multiplier differences among vendors. Such an exercise requires care and expertise since estimating multiplier effects attributable to specific suppliers for bid adjustment depends on firm-level spending patterns and to the degree to which that spending is local, rather than by utilizing average industry spending patterns from which most multiplier effect estimation originates (Rickard et al.

2016). We provide a clear approach to estimate precise bid adjustments so that it is a transparent and easy to implement adjustment method rooted in corrected market pricing rather than ad hoc regulatory or statutory restrictions on trade. Ultimately, our proposed framework will allow NYS agencies to compare the adjusted bid prices across bidders when making procurement decisions.

We continue with the derivation of the economic model that defines adjusted bid prices, followed by a restricted empirical application using detailed food purchase data from state bid contracts. We close with conclusions and implications of our work and directions for future research.

Economic Model

Input-Output (IO) models distinguish the effects of a shock by the economic sectors of a geographically defined economy (NYS in our case). IO methods estimate the extent of these impacts and trace how the changes impact different sectors of the economy. The analytical strength of this methodology is its ability to estimate indirect and induced economic effects stemming from the direct expenditures that lead to additional purchases by final users in an economy.

The direct effects are the initial set of expenditures applied to the IO multipliers; in our case, they represent the bid value (B) for one or a collection of food products sold by a vendor to public agencies in NYS through a bid process. The indirect effects are the additional business-to-business purchases that take place up the supply chain within the region stemming from the initial input (i.e., the direct effect). Induced effects are values of industry activity that stem from household spending of increased labor income that result from the initial input purchases and follow-on indirect effects.

For any individual sector, call it sector j , the sales or output multiplier is defined as the direct plus indirect plus induced sales throughout the economy resulting from a one dollar increase in sales to final demand in sector j . By comparing these multipliers across sectors, one can identify those sectors in which a change in sales to final demand generate the largest combined direct plus indirect plus induced change in sales in all sectors of the economy.⁷

Technically, our analysis utilizes IMPLAN's Social Accounting Matrix (SAM) model as our starting point, rather than an IO model. A SAM incorporates not only economic data for an economy, but social data as well, including national and household income statistics (Van Wyk et al., 2015). Accordingly, the SAM has an input-output model at its core but has additional capacity

⁷ Final demand is the value of goods and services produced and sold to final users during the calendar year. Final use means that the good or service will be consumed and not incorporated into another product.

to disaggregate households, firms, and other institutions such that the impacts and multipliers based on the SAM reflect ripple effects throughout the economy with somewhat greater precision than do those based on an IO model alone (Miller & Blair 2009, Chapter 11).⁸

As introduced above, common bid processes for food procurement in NYS use a request for bid (RFB) process that follows a competitive offering to procure the best “price” for the public agency for specific products.^{9,10} Our proposed procurement process explicitly accounts for NYS economic multiplier effects of food procurement when selecting winning bidders based on level of local economic activity of the direct, indirect, and induced effects. The additional economic activity has value to the state, that we measure as the additional state tax revenues generated. In other words, the cost of the bid is a gross cost (B) to the state (i.e., paid by the state agency procuring the food with public dollars), while the net cost (B^*) is B less the tax revenues accruing from local business activity through the direct, indirect, and induced effects. As such, determining “winning” bidders based on B^* (but still paying B) provides a more complete picture of costs to the state and incentivizes local firm participation in public food procurement.

Industry spending patterns in IMPLAN depict gross intermediate input purchases per dollar of output that are invariant across defined local economies (e.g., fruit farming in Washington State has an identical intermediate input spending pattern as in New York). Furthermore, the percentages of inputs purchased locally (i.e., Regional Purchase Coefficients or RPCs) are based on gravity

⁸ A typical SAM provides a mapping into a functional category for households usually based on household income class. The IMPLAN SAM serves this purpose with nine household income categories; however, with a shortcoming in the SAM accounts that restricts the full evaluation of income distribution effects (Alward & Lindall 1996).

⁹ Technically, there are additional terms and conditions for vendors to qualify for selection, such as product specifications, food safety and insurance requirements, and delivery specifications, among others. None of these conditions change as part of the alternative bid selection process proposed.

¹⁰ A “Request for Proposal” (RFP) is allowed under certain circumstances and for particular agencies (e.g., school food authorities) that provides a competitive offering process to procure the best “value” for the public agency for specific products and evaluation criteria (e.g., points awarded based on geographic preference); i.e., price is one but not the only consideration.

flow models that restrict all purchasers (industries and institutions) to source identical local proportions; e.g., a school food authority and private processor procure the same percentage of fresh (raw) apples locally (IMPLAN 2020). The combination of spending patterns and to the degree that spending accrues locally defines the size of the industry multipliers.

The challenge in estimating economic impacts of food product purchases is in the proper delineation of specific expenditures and value added outlays that can differ by firm. Collecting primary data for each food product and firm may result in differences in impact; however, the ability to and extent of such model customization is infeasible by the cost of primary data collection (McFadden et al. 2016; Schmit et al. 2019; Jablonski et al. 2016). Further, numerous food products are contained within aggregated industry production functions in IMPLAN; e.g., the canned fruits and vegetables manufacturing industry in IMPLAN encompasses many different food products. To appropriately account for the local production of food products procured by public agencies, we margin all expenditures back to the raw food product level and require additional input from vendors to incorporate specific RPCs for food product and food product ingredients. In so doing, we customize both the production function for each food product and the respective RPCs following a standardized process using supplemental vendor supplied information.

Disaggregating Food Product Spending

To develop our model, we first define the spending patterns to produce food products; i.e., their intermediate inputs and value added allocations. Value added is gross regional product derived from the income paid to owners of the factors of production. It consists of employee compensation, proprietor income, other property type income, and net taxes on production and imports. For a particular product i , the value of its output (Y_i) equals the sum of the cost of

intermediate inputs and the value added allocations. Consider one dollar of output of product i expressed as:

$$(1) Y_i = TAV_i + VA_i,$$

where TAV_i is the total absorption value (or cost of all intermediate inputs) to produce one dollar of output i , VA_i is total value added per dollar of output, and $TAV_i + VA_i = 1$.¹¹ Allocations to TAV and VA vary across industry. To estimate economic impacts accruing acutely to local food products, we disaggregate TAV to its food product ingredient (FPI_i) and nonfood product ingredient ($NFPI_i$) components, or:

$$(2) Y_i = FPI_i + NFPI_i + VA_i,$$

where $FPI_i + NFPI_i = TAV_i$.¹² Since food manufacturing sectors in IMPLAN encompass multiple food products, the spending pattern for product i is an industry average among them. The current version of IMPLAN has 57 food product sectors. For practical application of our algorithm, food bidders are asked to map food products to one of 29 aggregated sectors (Table 1) and provide the percent of that product that is produced or grown in NYS.

For practical implementation, if product i is a processed food product, bidders are also asked to classify the top two food product ingredients ($i1$ and $i2$) that make up food product i by the same aggregated commodity sectors (Table 1) and give the percentage of each of them in product i that is produced or grown in NYS. We assign portions of FPI_i to the two food product ingredients by weights W_{i1} and W_{i2} (where $W_{i1} + W_{i2} = 1$).¹³ Substituting into equation (2) reveals:

$$(3) Y_i = W_{i1}FPI_i + W_{i2}FPI_i + NFPI_i + VA_i .$$

¹¹ For example, consider the food product $i =$ pizza with $TAV_i = 0.77$ and $VA_i = 0.23$.

¹² For example, for food product $i =$ pizza, TAV_i is composed of $FPI_i = 0.56$ and $NFPI_i = 0.21$.

¹³ For food product $i =$ pizza, consider the primary food product ingredients as $i1 =$ cheese with $W_{i1} = 0.67$ and $i2 =$ tomato paste with $W_{i2} = 0.33$. Then, $W_{i1}FPI_i = 0.38$ and $W_{i2}FPI_i = 0.18$.

Table 1. Food product mapping and IMPLAN Regional Purchase Coefficients (RPC).

Food product category (second round mapping)^a	Implan Sectors	Mapped Sector^b	RPC^c
Oilseeds	1	1F	14.71
Grains	2	2F	22.81
Vegetables & melons	3	3F	20.55
Fruit	4	4F	14.31
Tree nuts	5	5F	0.15
Greenhouse/nursery products	6	6F	19.82
Sugar cane/sugar farming	9	7F	0.00
Other crops	10	8F	37.23
Beef cattle	11	9F	32.68
Milk from farms	12	10F	88.54
Poultry & eggs	13	11F	17.47
Other animals from farms	14	12F	21.62
Fresh fish	17	13F	10.59
Flour, rice, malt, wet corn, breakfast cereals (2)	65-68, 71	14P	16.86
Processed & blended oils and oilseeds (1)	69-70	15P	3.38
Sugars and confectioneries (9)	72-76	16P	11.13
Frozen & canned fruits, juices, & vegetables (3, 4)	77, 79	17P	12.23
Frozen & canned specialty foods (1-6, 9-14)	78, 80	18P	16.84
Dehydrated food products (non-meat/dairy) (3, 4)	81	19P	8.08
Cheese, fluid milk, butter, ice cream/frozen desserts, dry/condensed/evaporated dairy products (12)	82-86	20P	33.00
Frozen cakes & pastries, bread & bakery products, cookies & crackers, dry pastas, doughs, tortillas (1, 2)	87, 93-96	21P	34.31
Poultry & processed poultry meat products (13)	88	22P	4.19
Meat & processed meat products (nonpoultry) (11, 14)	89-91	23P	11.24
Processed fish and seafood products (17)	92	24P	8.38
Roasted nuts, nut butters, & snack foods (1-6, 9-14)	97-98	25P	28.84
Flavorings, dressings, sauces, spices, & extracts (1-6, 9-14)	100-102	26P	8.27
Coffee & tea, soft drinks & water beverages, ice	99, 104-105	27P	24.08
Other manufactured food products (1-6, 9-14)	103	28P	24.06
Alcoholic beverages	106-108	29P	15.74

^a IMPLAN sectors in parentheses are additional aggregated sectors used in second round margining of food products. Since this involves food margins of already margined food products, the degree of variation of adjusted bid prices will be minimal regardless of the particular aggregations chosen at this level.

^b Mapped sectors 1F through 13F represent raw/minimally processed food products, while 14P through 29P represent processed food products.

^c Default RPCs from IMPLAN for the aggregated food product sectors based on their gravity model (IMPLAN 2020). RPCs are adjusted within the adjusted bid algorithm based on vendor supplied estimates.

If $i1$ and $i2$ are also processed food products, further food product margining is necessary. For practical agency implementation, each of these products is automatically mapped in our algorithm to one raw (farm) food product category depending on the processed food product category of the ingredient defined by the vendor. Since some processed food product categories do not map uniquely to an individual farm sector, aggregated second round food product mapping rules are applied (Table 1).¹⁴ Accordingly, we have:

$$(4) Y_i = W_{i1}FPI_i(FPI_{i1} + NFPI_{i1} + VA_{i1}) + W_{i2}FPI_i(FPI_{i2} + NFPI_{i2} + VA_{i2}) + NFPI_i + VA_i.$$

Combining the nonfood components of the spending pattern (i.e., $NFPI$ and VA) and rearranging terms, the final distribution of the spending pattern for Y_i is:

$$(5) Y_i = FPI_i[W_{i1}(FPI_{i1} + NFPIVA_{i1}) + W_{i2}(FPI_{i2} + NFPIVA_{i2})] + NFPIVA_i.$$

The breakdown of all processed food product category spending patterns into their food and nonfood components is shown in Table 2.

Output Multipliers and Tax Coefficients.

In deriving multipliers, theoretically one can internalize any institution (i.e., households, government, and capital), but the standard practice (and the default in IMPLAN) is to internalize only households; i.e., to capture household spending out of labor income but not the spending of tax revenues by governments or returns to capital. Payroll taxes and personal income taxes are already part of the multiplier with households internalized; however, taxes on production and imports (e.g., sales taxes, property taxes, licenses, fees) represent one of the most important sources of income for local and state governments.

¹⁴ Consider the food product i = pizza (18P in Table 1) whose primary food product ingredients are $i1$ = cheese (20P) and $i2$ = tomato paste (17P). The algorithm automatically maps the second round margining to milk from farms (10F) and fruits and vegetables from farms (IMPLAN 3 and 4), respectively. See Table 1 for all second round mapping allocations.

Table 2. Processed food product category spending pattern disaggregation

Category	TAV	FP	NFPI	VA	NFPVA
14P	0.87	0.54	0.33	0.13	0.46
15P	0.94	0.71	0.23	0.06	0.29
16P	0.83	0.38	0.45	0.17	0.62
17P	0.82	0.39	0.43	0.18	0.61
18P	0.77	0.56	0.21	0.23	0.44
19P	0.76	0.47	0.29	0.24	0.53
20P	0.86	0.59	0.27	0.14	0.41
21P	0.61	0.29	0.32	0.39	0.71
22P	0.80	0.59	0.21	0.20	0.41
23P	0.84	0.62	0.22	0.16	0.38
24P	0.74	0.52	0.22	0.26	0.48
25P	0.77	0.32	0.45	0.23	0.68
26P	0.81	0.41	0.40	0.19	0.59
27P	0.72	0.26	0.46	0.28	0.74
28P	0.79	0.43	0.36	0.21	0.57
29P	0.54	0.15	0.39	0.46	0.85

Source: IMPLAN, NYS model year = 2019.

Note: TAV + VA = 1, FP + NFPI = TAV, NFPVA = NFPI + VA.

Internalizing local and state government spending assumes that these institutions will re-spend each dollar of local revenues collected locally for local programs. In a state model this makes sense since state budgets are required to be balanced. Internalizing local and state government also involves other property type income (OPTI), which is mostly corporate profits, as corporate taxes are an important source of government income. We internalize local and state government spending, including both non-education (i.e., hospital, health, and other services) and education sectors. In IMPLAN, the non-education sector collects the money, with education funded through an appropriation. Local and state government investment are not internalized since operational capital goods (e.g., trucks, computers) and large projects (e.g., highways, buildings) are often funded through bonding and are not necessarily related to the current state of the economy.

To estimate industry multipliers that also internalize local and state spending, supplemental modeling is required. Specifically, we apply the total local and state tax revenues generated per

dollar of output in each food product sector to the local and state government spending pattern in IMPLAN. The additional output impacts accruing through this spending are added to the impacts with only households internalized to compute the new multipliers, M_i , (Table 3).

With households and local and state government endogenized, total local and state tax revenues associated with \$1 of direct impact in each food sector i are estimated. The estimated revenues accrue from the direct, indirect, and induced effects. Total revenue is divided by the total economic impact generated by the \$1 of direct activity to compute industry-specific tax coefficients (t) as shown in Table 3.

Following from equation 5, comparable multipliers (M^*) and tax coefficients (t^*) are estimated separately for the nonfood portion of the spending pattern for each food sector (Table 3). To estimate these multipliers, we model the same direct impact as described above, but set the RPCs in the spending pattern for food product ingredients to zero. By treating that portion of spending as leakage, the resulting multipliers (M^*) represent only the effects of local nonfood intermediate input spending and value added allocations (*NFPIVA*). The tax coefficients (t^*) are computed as above but now representing tax revenues generated only from *NFPIVA* spending.

*Deriving B^**

The RPCs supplied in the bid are applied to their respective margined components to compute total impact (TI), which is then multiplied by the respective tax coefficient (t). The sum of tTI across all margined components reveals the amount of the bid price adjustment. Bids are awarded based on the value of B^* across bidders, and the agency pays the respective B .

Table 3. Output multipliers (M) and tax coefficients (t) by sector.^a

Sector	M_h	M	t	M*	t*
W398 ^b	1.959	2.116	0.055		
W400 ^b	1.750	2.080	0.129		
T417 ^b	1.808	1.973	0.062		
1F	1.158	1.241	0.049		
2F	1.462	1.497	0.016		
3F	1.523	1.641	0.053		
4F	1.289	1.390	0.054		
5F	1.343	1.458	0.059		
6F	1.570	1.697	0.056		
7F ^c	1.000	1.000	0.000		
8F	1.649	1.749	0.042		
9F	1.573	1.696	0.054		
10F	1.879	2.013	0.049		
11F	1.868	2.023	0.058		
12F	1.265	1.375	0.060		
13F	1.656	2.028	0.154		
14P	1.580	1.641	0.026	1.481	0.027
15P	1.391	1.447	0.028	1.373	0.027
16P	1.684	1.779	0.039	1.700	0.039
17P	1.647	1.735	0.037	1.654	0.037
18P	1.533	1.607	0.033	1.461	0.033
19P	1.493	1.571	0.036	1.499	0.035
20P	2.041	2.156	0.038	1.469	0.035
21P	1.741	1.893	0.060	1.787	0.062
22P	1.522	1.603	0.037	1.443	0.035
23P	1.588	1.679	0.039	1.471	0.038
24P	1.493	1.585	0.042	1.553	0.041
25P	1.604	1.693	0.038	1.618	0.038
26P	1.605	1.693	0.037	1.579	0.037
27P	1.613	1.721	0.046	1.671	0.046
28P	1.698	1.791	0.038	1.657	0.037
29P	1.551	1.951	0.185	1.907	0.188

^a M_h are multipliers with only households internalized, M also internalizes local and state government. t is local and state tax revenues per dollar of total impact associated with \$1 of direct impact. M* and t* are multiplier and tax coefficients for only nonfood and value added portions of the spending pattern.

^c W398 and W400 are wholesale sectors associated with food and nonalcoholic beverage products and alcoholic beverages, respectively. T417 is the truck transportation sector. The multipliers and tax coefficients are used for wholesale and transport margins of products supplied by wholesale distributors.

^b Sector 17F represents sugarcane and sugarbeet farming zero economic activity in NYS, hence multipliers of one and a tax coefficient of zero.

For completeness, we consider four types of food products: (i) processed food products produced from two processed food product ingredients, (ii) processed food products produced from one raw food product ingredient and one processed food product ingredient, (iii) processed food products produced from two raw food product ingredients, and (iv) raw food products. In the first case, consider a food product i (e.g., pizza) bid by a producer that is primarily made from two processed food products $i1$ (e.g., cheese) and $i2$ (e.g., tomato paste) and where those food product ingredients are mapped to $i11$ (milk from farms) and $i21$ (e.g., tomatoes from farms), respectively. The adjusted bid price $B^* = B - tTI$ is expressed as:

$$(6) B^* = B - B(FPI_i W_{i1} RPC_{i1} FPI_{i1} M_{i11} t_{i11} + FPI_i W_{i1} RPC_{i1} NFPIVA_{i1} M_{i1}^* t_{i1}^* + FPI_i W_{i2} RPC_{i2} FPI_{i2} M_{i21} t_{i21} + FPI_i W_{i2} RPC_{i2} NFPIVA_{i2} M_{i2}^* t_{i2}^* + NFPIVA_i RPC_i M_i^* t_i^*),$$

where $NFPIVA_i$ is the sum of the gross absorption value of nonfood product ingredients in the production of i and the value-added coefficient, RPC_i is the regional purchase coefficient for food product i (i.e., a number on $[0,1]$, where 0 = none of the food product is produced in NYS and 1 = all the food product is produced in NYS), M_i^* is the output multiplier of product i associated with only $NFPIVA_i$ spending, t_i^* is the local and state tax revenues generated only from $NFPIVA_i$ spending per dollar of economic impact (direct+indirect+induced) associated with \$1 of direct impact in industry i (the industry associated with commodity i), FPI_i is the gross absorption value of food product ingredients in the production of i , W_{i1} is the proportion of FPI_i allocated to $i1$ (0.67 by default), M_{i11} is the full output multiplier of product $i11$, and t_{i11} is the local and state tax revenues generated from all intermediate input and value-added spending per dollar of economic impact (direct+indirect+induced) associated with \$1 of direct impact in industry $i11$ (the industry associated with commodity $i11$). Combining like terms equation (6) can be expressed as:

$$(7) B^* = B[1 - NFPIVA_i RPC_i M_i^* t_i^* - FPI_i \{W_{i1} RPC_{i1} (FPI_{i1} M_{i11} t_{i11} + NFPIVA_{i1} M_{i1}^* t_{i1}^*) + W_{i2} RPC_{i2} (FPI_{i2} M_{i21} t_{i21} + NFPIVA_{i2} M_{i2}^* t_{i2}^*)\}]$$

If, instead, a product is made from one processed and one raw product ingredient B^* simplifies. Specifically, consider a food product i (e.g., applesauce) bid by a producer that is primarily made from one raw/minimally processed food product $i1$ (e.g., apple) and one processed food product $i2$ (e.g., high fructose corn syrup) and where the processed food product is mapped to $i21$ (e.g., corn from farms), respectively. The adjust bid price (B^*) here is:

$$(8) B^* = B[1 - NFPIVA_i RPC_i M_i^* t_i^* - FPI_i \{W_{i1} RPC_{i1} (M_{i1} t_{i1}) + W_{i2} RPC_{i2} (FPI_{i2} M_{i21} t_{i21} + NFPIVA_{i2} M_{i2}^* t_{i2}^*)\}].$$

Further simplifying, consider a food product i (e.g., apple oatmeal) bid by a producer that is primarily made from two raw/minimally processed food product $i1$ (e.g., oats) and $i2$ (e.g., apples). The adjust bid price (B^*) is now:

$$(9) B^* = B[1 - NFPIVA_i RPC_i M_i^* t_i^* - FPI_i \{W_{i1} RPC_{i1} (M_{i1} t_{i1}) + W_{i2} RPC_{i2} (M_{i2} t_{i2})\}]$$

And even further simplifying, consider a food product i (e.g., apples) bid by a producer that is itself a raw/minimally processed food product. The adjust bid price (B^*) is:

$$(10) B^* = B[1 - \{RPC_i (M_i t_i)\}].$$

Finally, consider a food product sold by a wholesaler instead of directly by a producer. Considering the food product from equation (7), but now bid by a wholesaler, requires application of wholesale, producer, and transport margins.¹⁵ The adjust bid price (B^*) is now computed as:

¹⁵ Output for wholesale industries represent only the wholesale margin not total sales. Doing prevents double counting of the producer value in the multiplier effects.

$$\begin{aligned}
(11) \quad B^* = & B[1 - (MGN_{WH,i}RPC_{WH}M_{WH}t_{WH}) - (MGN_{TR,i}RPC_{TR}M_{TR}t_{TR}) \\
& - MGN_{PR,i}(NFPIVA_iRPC_iM_i^*t_i^* \\
& + FPI_i\{W_{i1}RPC_{i1}(FPI_{i1}M_{i11}t_{i11} + NFPIVA_{i1}M_{i1}^*t_{i1}^*) \\
& + W_{i2}RPC_{i2}(FPI_{i2}M_{i21}t_{i21} + NFPIVA_{i2}M_{i2}^*t_{i2}^*)\})],
\end{aligned}$$

where $MGN_{WH,i}$ is the wholesale margin associated with food product i , $MGN_{PR,i}$ is the producer margin associated with food product i , $MGN_{TR,i}$ is the transport margin associated with food product i , $MGN_{WH,i} + MGN_{PR,i} + MGN_{TR,i} = 1$. Equation (11) adds the wholesale and transport margin components and reduces the producer contribution by $MGN_{PR,i}$. Other food product examples above follow similarly when incorporating wholesale and transport margins.

Vendor Input Requirements

As described above, to provide an adjusted bid price procurement process that is both scientifically defensible and practically implementable at the agency level, a limited set of information must be provided by the bidding vendors. Some information is already provided as part of the bidding process that can be directly applied into the bid adjustment algorithm, such as business type for margining (i.e., wholesaler or producer) and location of business establishment to populate some RPCs. However, supplemental information on food product and food product ingredient categorizations and their respective RPCs denoting the percentage of them grown or produced in NYS are required. To assist vendors selecting food product categories for the bid item(s), a template, such as provided in Appendix A, is suggested.

For ease of exposition, we propose the format of the food product questions below for incorporation into bid pricing sheets. The questions proposed represent the set of questions for a processed food product made from two processed food products. Depending on the answers to the first question, the remaining questions may not be relevant.

1. Select the food product category from the list that most closely matches the bidded product (select one from drop down list):
 - Fresh/minimally processed food product category (1F - 13F): ____ OR
 - Processed food product category (14P - 29P): ____
2. What percent of the bidded product was made or grown in New York State? Enter a number between 0 and 100.
 - ____% Enter number 0 to 100
3. Select two food product categories from the list that most closely matches the top two food product ingredients in the bidded product (choose two):
 - First ingredient (select one from the drop down list)
 - Fresh/minimally processed food product category (1F - 13F): ____ OR
 - Processed food product category (14P - 29P): ____
 - Second ingredient (select one from the drop down list)
 - Fresh/minimally processed food product category (1F - 13F): ____ OR
 - Processed food product category (14P - 29P): ____
4. What percent of the of the first food product ingredient was made or grown in New York State? Enter a number between 0 and 100.
 - ____% Enter number 0 to 100
5. What percent of the of the second food product ingredient was made or grown in New York State? Enter a number between 0 and 100.
 - ____% Enter number 0 to 100

A forthcoming agency dashboard tool will extract the applicable information from the submitted bid documents for automated calculation of B^* .

Empirical Application

For our empirical application, we evaluate spending by NYS public agencies on state bid food procurement for calendar year 2022. Individual public agencies (e.g., a school district or municipality) can also administer their own bid processes as allowed by law. The NYS Office of General Services (OGS) manages three classes of food products put out on state bid: Fluid Milk (23239), Fresh Bread (23146), and Food (23199). Bid awards are on five year contracts, with the option to extend up to five and two additional years for the Food and Fresh Bread bids, respectively. The solicitation processes are highly structured with specific eligibility requirements for bidders and alternatively defined regions of the state by bid class.¹⁶

The Fluid Milk and Fresh Bread solicitations involve submitting prices for defined market baskets of goods that include estimated quantities of products needed by region based on historical usage. Bidders on the Fluid Milk solicitation must submit prices for all milk products listed in the market basket (i.e., Required Milk Products) and are encouraged to provide prices for other products (i.e., Desirable Milk Products) they can offer. Awards are made by region to the lowest total cost (i.e., price times estimated quantity) based on the required market basket of goods. Given existing state and federal milk marketing orders, prices are indexed over time based on market order prices. Similarly, bidders must bid on all items in the market basket for the Fresh Bread solicitation for each region bid. The market basket requirements in the Fluid Milk and Fresh Bid solicitations effectively limit feasible bidders to fluid milk and fresh bread processors, respectively.

The Food solicitation is disaggregated into three Lots: Commercial, Retail, and Bulk Fresh Produce.¹⁷ The Commercial Lot generally refers to products that are sold in bulk size, while the

¹⁶ OGS defines eighteen multi-county regions for the Fluid Milk bid, and four multi-county regions for the Fresh Bread and Food Bids. The regions are identical for the Fresh Bread and Food Bids. Bidders may choose to bid on one or more regions.

¹⁷ Lots 1 and 2 cover all regions of the state, while Lot 3 covers only the Food Production Center Plant of the NYS Department of Corrections and Community Supervision (ODCCS) in Rome, NY.

Retail Lot generally refers to products sold in grocery size packaging. Bidders may bid on any combination of Lots and regions. For the Commercial and Retail Lots, no market baskets of goods are specified; however, bidders must provide supplier costs (i.e., cost of goods sold) and markup percentages for products in all seven OGS categories and be capable of supplying all categories to all authorized users in such region.¹⁸ For the Bulk Fresh Produce Lot, a market basket is provided and bidders must bid on all items listed within it. The requirement to bid on products that cover all seven OGS categories in the Commercial and Retail Lots and/or all bulk produce categories in the Bulk Fresh Produce Lot effectively limits feasible bidders to large wholesale vendors.¹⁹

Vendors

Quarterly contract usage reports for 2022 from all awarded vendors for the Fluid Milk, Fresh Bread, and Food bids were collected from OGS. All submitting vendors for the most recent Food solicitation were found minimally qualified by OGS and with pricing that demonstrates the products offered will be delivered at “reasonable” prices. As such, all submitting vendors were awarded contracts, including Sysco Albany LLC (Halfmoon, NY), Sysco Long Island LLC (Central Islip, NY), Sysco Syracuse LLC (Warners, NY), Renzi Food Service (Watertown, NY), H. Schrier and Company Inc. (Brooklyn, NY), Driscoll Foods Eastern (Amsterdam, NY), and Driscoll Foods Downstate (Clifton, NJ).²⁰ As expected, all are relatively large wholesale food distributors.

The most recent Fresh Bread solicitation bid had only one bidder and who was awarded the state contract: Bimbo Bakeries USA Inc. (Albany, NY). The most recent Fluid Milk bid

¹⁸ The product categories include (i) ambient/canned/dry, (ii) baked goods, (iii) dairy, (iv) frozen, (v) meat/poultry/fish, (vi) produce, and (vii) nonfood.

¹⁹ As provided in the “Responses to Bidder Inquiries” for the latest Food solicitation, average annual historical spending on the Commercial, Retail, and Bulk Fresh Produce Lots are \$65.1, \$9.0, and \$1.3 million, respectively.

²⁰ Ace Endico Inc. (Brewster, NY) was also awarded a contract but listed as canceled in May 2022. No sales reports are available for them (<https://online.ogs.ny.gov/purchase/spg/awards/0245023199CAN.HTM>).

included four bidders: Cream-O-Land Dairies LLC (Florence, NJ), Derle Farms Inc. (Bethpage, NY), Hudson Valley Fresh Dairy LLC (Poughkeepsie, NY), and Upstate Niagara Cooperative Inc (Lancaster NY). All but Derle Farms were awarded contracts for one or more regions.²¹ As expected, all winning bidders are food processors.

Applying the Bid Adjustment Algorithm

Our empirical application serves as a retrospective example, as in practice, the computation of B^* occurs as part of the contract awarding process. However, to assess the extent of deviation in bid (B) and adjusted bid (B^*) costs, we apply our algorithm to contract usage data for 2022. Since agencies pay B , assessing the difference in costs also presents an estimate of the increase in potential agency costs if the bidders represent new awarded contracts as a result of B^* .²²

We obtain detailed quarterly food purchase contract usage data from OGS by vendor for the Food, Fresh Milk, and Fresh Bread bids. Data come in a standardized (Excel) format based on OGS's contract reporting requirements that include such things as date of purchase, state and sub-state public agency buyer, product name and description, price of the product, and, in the case of wholesale vendors, the supplier's name, supplier product number, and wholesale markup (margin). Nonfood products included in the Food contracts were excluded from our analysis.

Given our algorithm application to historical data, information on producer RPCs and detailed food product information are not available. Accordingly, our restricted form application utilizes default IMPLAN industry spending patterns and RPCs (Table 1). Accordingly,

²¹ Specifically, Cream-O-Land was awarded contracts for eight regions (generally downstate), Hudson Valley Fresh was awarded the contract for region nine (Dutchess, Sullivan, and Ulster counties), and Upstate Niagara Cooperative was awarded contracts for seven regions (generally upstate).

²² Arguably, a more pointed application would evaluate if contract awards would have changed based on all submitting bidders (i.e., winners and losers). However, since all bidders on the state Food and Fresh Bread solicitations were awarded contracts; and the only bidder not awarded a contract on the Fluid Milk bid had costs nearly 70% above their competitors, contract award decisions would not have changed. We leave such an application to sub-state bids to future research.

distinguishing *TAV* into its *FPI* and *NONFPI* components is unnecessary, as is the distinction of primary food product ingredients (*i1* and *i2*) and alternative multiplier (*M* and *M**) and tax revenue (*t* and *t**) coefficients. Since contract usage data for Food vendors provides vendor- and product-specific wholesale markups, we do not margin part of the total food cost to transport (equation 10), instead full costs are margined to producer ($MGN_{PR,i}$) and wholesale ($MGN_{WH,i}$) components.²³

Depending on specific product information, these restrictions could result in more or less economic impact than our detailed algorithm would suggest. Even so, default industry spending patterns and state-level RPCs provides a reasonable *ex post* analysis when evaluating spending across a range of products, producers, and vendors.

The restricted computations of B^* from equation (11) for Food wholesalers and equation (7) for Fluid Milk/Fresh Bread producers are, respectively:

$$(12) B^* = B(1 - MGN_{WH,i}RPC_{WH}M_{WH}t_{WH} - MGN_{PR,i}RPC_iM_it_i) \text{ and}$$

$$(13) B^* = B(1 - RPC_iM_it_i).$$

where $MGN_{WH,i}$ is the margin reported by wholesalers for each product *i*, $MGN_{PR} = 1 - MGN_{WH}$. RPC_i is set to one or zero based on whether the supplier has a manufacturing location in NYS or not.²⁴ $RPC_{WH,i}$ is set to one or zero based on whether or not the “ship from” zip code for product *i* (i.e., the location of the wholesale distribution facility) is a NYS zip code. Each food product *i* was assigned to a food product category (Table 1) to which M_i and t_i are applied (Table 3).²⁵

²³ The average industry transport margin for food products in IMPLAN is small, about \$0.02 per dollar of output.

²⁴ Approximately 2,500 unique food product suppliers are included in the contract usage reports across all vendors. A Google search on each supplier determined whether they have at least one NYS manufacturing facility ($RPI_i = 1$).

²⁵ Approximately 21,000 unique food products are included in the contract usage reports across all vendors. Food categories (Table 1) were applied based on the product name, description, and supplier.

Results

Actual (B) and net (B^*) food costs are summarized in Table 4 by bid class and vendor. For the Food bid, all wholesalers are considered local ($RPC_{WH} = 1$) except for Driscoll Foods Downstate ($RPC_{WH} = 0$) based on their primary distribution facility location. Food costs are summed over all food products by whether they are produced outside ($RPC_{PR} = 0$) or inside ($RPC_{PR} = 1$) NYS.

Considering locally produced products ($RPC_{PR} = 1$) on the Food bid, the percent reduction from B to B^* ranges from 6.56% (Driscoll Foods Downstate) to 9.66% (Sysco Albany). The former makes sense as this vendor is the only one classified as a nonlocal wholesaler (i.e., no multiplier effects of the wholesale margin). Differences across vendors reflect differences in the distribution of products sold and in the multiplier and tax coefficients associated with them. The percentage changes for $RPC_{PR} = 0$, reflect only the wholesale margin component of sales. Across all vendors and locally produced products on the Food bid, B^* drops approximately 8%

Since all dairy products map to the same food category sector (i.e., 20P) the multiplier and tax coefficients are identical across vendors with $RPC_{PR} = 1$ yielding a 9.05% reduction in costs from B to B^* (Table 4) for locally produced products.²⁶ The higher percent reduction relative to all food in the Food bid is consistent with dairy processing's higher multiplier effect (the RPC for milk from farms in NYS is over 84%) and mid-range tax coefficient. In fact, only 21P (0.114) and 29P (0.361) have higher Mt combined influences relative processed dairy products (0.083). While much of this difference is due to higher tax coefficients (Table 3), the relatively strong multiplier for 21P is also a reflection of higher labor income per dollar of output required in these industries; i.e., through the induced effects (Table 2). The 12.89% change on the Fresh Bread bid is similarly a result of all products within it mapping to 21P.

²⁶ Cream-O-Land Dairies is a milk processor located in New Jersey that sources milk from farms in multiple states. Likely some is from NYS farms but since the origins of the raw milk supplied are unknown, we assume all is nonlocal.

Table 4. Actual (B) and adjusted (B*) bid costs by OGS bid class and vendor.^a

State Bid Type/Vendor	RPC _{PR}	B	B*	B -B*	%Change
Food (2319)					
Driscoll Foods Eastern (RPC _{WH} = 1)	0	9,356,182	9,293,271	62,911	0.68
	1	3,778,787	3,504,960	273,827	7.81
	Total	13,134,969	12,798,231	336,738	2.63
Driscoll Foods Downstate (RPC _{WH} = 0)	0	6,990,890	6,990,890	0	0.00
	1	2,653,453	2,490,169	163,284	6.56
	Total	9,644,342	9,481,059	163,284	1.72
Sysco Albany (RPC _{WH} = 1)	0	3,453,886	3,430,496	23,390	0.68
	1	663,025	604,626	58,399	9.66
	Total	4,116,911	4,035,122	81,789	2.03
Sysco Long Island (RPC _{WH} = 1)	0	3,720,649	3,695,444	25,205	0.68
	1	548,387	504,528	43,859	8.69
	Total	4,269,036	4,199,972	69,064	1.64
Sysco Syracuse (RPC _{WH} = 1)	0	24,015,164	23,852,539	162,625	0.68
	1	6,168,844	5,695,889	472,955	8.30
	Total	30,184,008	29,548,428	635,580	2.15
Renzi Food Service (RPC _{WH} = 1) ^b	0	1,969,226	1,953,108	16,118	0.83
	1	1,246,858	1,154,291	92,566	8.02
	Total	3,216,084	3,107,399	108,684	3.50
Schrier and Company (RPC _{WH} = 1)	0	6,175,604	6,119,423	56,182	0.92
	1	554,599	511,715	42,884	8.38
	Total	6,730,203	6,631,137	99,066	1.49
All Food (23199)	0	55,681,602	55,335,171	346,431	0.63
	1	15,613,951	14,466,178	1,147,773	7.93
	Total	71,295,553	69,801,349	1,494,204	2.14
Fluid Milk (23239)					
Upstate Niagara Cooperative	1	7,129,389	6,537,817	591,572	9.05
Hudson Valley Fresh	1	1,131,174	1,037,313	93,861	9.05
Cream-O-Land ^c	0	4,925,232	4,925,232	0	0.00
All Fluid Milk (23239)	0	4,925,232	4,925,232	0	0.00
	1	8,260,564	7,575,131	685,433	9.05
	Total	13,185,796	12,500,363	685,433	5.48
Fresh Bread (23146)					
Bimbo Bakery	1	3,176,944	2,814,216	362,727	12.89

^a For vendors on Food contracts(23199), B and B* are the sum of all products classified as produced (RPC_{PR} = 1) and not produced (RPC_{PR} = 0) in NYS, respectively.

^b Renzi Food Service includes contract usage for only the first three quarters of 2022.

^c Cream-O-Land Dairies is a milk processor located in New Jersey who sources milk from farmers in multiple states in the Northeast U.S. While some milk from farms likely originates from NYS farms, since the origins of the raw milk supplied are unknown, we assume all is nonlocal for our application.

Table 5 summarizes B and B^* by food mapping category for the Food bid where $RPC_{PR} =$

1. Five categories exceeded \$1.0 million by dollar volume: 21P (bakery, \$2.40 million), 17P (frozen and canned fruits and vegetables, \$2.38 million), 20P (nonfluid dairy products, \$1.71 million), 22P (poultry products, \$1.06 million), and 15P (processed oilseeds, 1.03 million). Difference in percentages are defined by the respective multiplier (M) and tax coefficients (t) in Table 3. As expected, the highest percentage changes from B to B^* are in categories with the highest tax coefficients, although fresh fish (13F) and alcoholic beverages (29P) have limited local availability and procured in small volumes on state bid.

Those categories with the highest cost changes ($B - B^*$) represent priority industries for increasing state tax revenues as they reflect both the level of demand in these products and the multiplier effects that accrue to their local procurement; e.g., bread and bakery products (\$270 thousand), canned and frozen fruits and vegetables (\$153 thousand), and nonfluid milk dairy products (\$142 thousand). Combining $B - B^*$ for the Fluid Milk (20P) and Fresh Bread (21P) state bids (Table 4) increases their category totals to \$827 thousand and \$633 thousand, respectively. For ease of exposition, we relegate similar results on the Food bid but across OGS food product category to Appendix B for the interested reader.

Table 5. Actual (B) and adjusted (B*) bid costs for locally produced foods across all vendors in the Food bid, by mapping category.^a

Category	B	B*	B -B*	%Change
2F	199,331	193,472	5,858	3.03
3F	938,622	859,417	79,205	9.22
4F	274,902	255,337	19,566	7.66
5F	817	755	61	8.12
6F	7,523	6,853	671	9.79
8F	1,461	1,380	81	5.87
13F	10,712	7,779	2,934	37.71
14P	469,028	448,222	20,805	4.64
15P	1,032,582	986,849	45,733	4.63
16P	249,410	232,151	17,259	7.43
17P	2,380,084	2,227,246	152,838	6.86
18P	419,569	396,880	22,689	5.72
19P	179,932	165,816	14,116	8.51
20P	1,708,632	1,566,704	141,929	9.06
21P	2,404,747	2,134,891	269,856	12.64
22P	1,063,557	1,001,274	62,282	6.22
23P	824,188	771,171	53,017	6.87
24P	157,661	147,942	9,718	6.57
25P	1,025,209	955,166	70,043	7.33
26P	982,409	918,462	63,947	6.96
27P	719,144	662,472	56,673	8.55
28P	564,274	525,837	38,437	7.31
29P	158	102	56	55.17
Total	15,613,951	14,466,178	1,147,773	7.93

^a Locally produced products only ($RPC_{PR} = 1$) for the Food state bid. Food categories include products sold by nonlocal ($RPC_{WH} = 0$) and local ($RPC_{WH} = 1$) wholesalers.

Conclusions

We propose an innovative algorithm that adjusts bid prices in public food procurement processes by incorporating economic multiplier effects. Based on recent contract usage for New York State (NYS) food bids, our algorithm demonstrates average impacts on the state and public agencies when considering local economic activity generated through direct, indirect, and induced effects. For locally produced products in the Food bid, net food costs (B^*) decrease between 7% and 10% across vendors. This reduction highlights the economic benefits of considering ripple effects when making procurement decisions. We also show that bakery products, frozen and canned fruits and vegetables, and dairy products have the highest cost changes, indicating priority industries for increasing state tax revenues. Overall, the results emphasize the importance of incorporating economic externalities in public food procurement processes to promote local competitiveness and sustainable food systems.

Our algorithm serves as a theoretical foundation of geographic preference policies by directly calculating the economic impact of local purchasing. The algorithm is also pragmatically implementable at the agency and/or state level and an improvement on current ad hoc approaches prioritizing local procurement through quotas and/or pricing preferences. Since we quantify the externality effect of buying locally, computed differences between B and B^* also presents an upward bound of additional subsidization the state could provide for local food procurement and be just as well off in terms of net state spending. The supplemental state revenue could be used (in whole or in part) to further incentivize local food procurement and support local agriculture and food systems growth. Furthermore, as implementation of the algorithm continues over time, public agencies can evaluate specific differences in B and B^* per dollar of output by food product, industry,

and/or vendor to inform subsequent local food procurement choices that have the most benefit to the state.

Our algorithm provides a conceptual framework for analyzing externalities in local purchasing decisions. The algorithm can be replicated and adapted for any geographic area with sufficient baseline industry information (like that available in IMPLAN) and for which similar customizations are applied to compute local multiplier and tax coefficients (i.e., M , t , M^* , t^*). Understanding spatial differences in cost savings in local public procurement, accounting for differences in local farm and food production and consumer demand, is a compelling area for future research study that further informs state and federal food procurement policy.

Our algorithm considers one externality associated with including multiplier effects for public food procurement decisions. Other externalities related to food procurement include environmental and health impacts of foods based on their location or mode of production, processing, and transport. Modifying procurement practices can be a cost-effective policy proposition to reduce fiscal expenditures on curative health care, environmental remediation, and social safety nets. Recent literature estimates that the current food costs omit two-thirds of costs arising from the health and environmental costs (Hendriks et al. 2021; Rockefeller Foundation 2021).

Externalities arising from greenhouse gas emissions in transport are a function of distance and thus are commonly greater for external vendors than for NYS suppliers. Other externalities relate to differences among jurisdictions in environmental, food security, occupational safety, and other relevant laws and regulations affecting firms' employment, production, processing, manufacturing, storage, and transport practices, such that the standards NYS sets for its producers add costs that competitors facing weaker standards do not incur.

A bid adjustment mechanism that incorporates these additional externalities further levels the playing field for NYS producers, processors, and manufacturers and to fully reflect the full true costs NYS faces from food procurement. In so doing, bid adjustment can create incentives for improved practices – a ‘race to the top’ – among in-state suppliers, obviating the current ‘race to the bottom’ incentives in which vendors face incentives to reduce private costs, potentially shifting those costs to the state through environmental, health and social justice externalities. Enumerating such spillover costs requires further study to understand which externalities have a strong scientific basis to support price adjustments, are manageable (and desirable) to include, and would not impose unreasonable data demands on prospective bidders or state agencies. A careful examination of these issues is a top priority for our continuing research.

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Appendix

Appendix A: Example products for each mapping category.

Mapping Category	Food Product Category	Example Product
1F	Oilseeds	oilseed (before processing)
2F	Grains	lentil, pea, quinoa, rice
3F	Vegetables & melons	cabbage, carrot, cauliflower, celery, cucumber, green bean, kale, lettuce, romaine lettuce, onion, pepper, potato, radish, spinach, squash, tomato
4F	Fruit	apple, banana, grape, grapefruit, kiwi, lemon, mandarin, cantaloupe, honeydew, watermelon, nectarine, orange, peach, pear, pineapple, plum, strawberry
5F	Tree nuts	pecan without processing, almond without processing
6F	Greenhouse/nursery products	herb (basil, bay leaf, cilantro, oregano, parsley), mushroom
7F	Sugar cane/sugar farming	sugar
8F	Other crops	tea
9F	Beef cattle	cow, cattle
10F	Milk from farms	raw milk from farms
11F	Poultry & eggs	eggs before cleaning and disinfection
12F	Other animals from farms	honey
13F	Fresh fish	fresh fish from commercial fishing
14P	Flour, rice, malt, wet corn, breakfast cereals (2)	corn starch, cornmeal, cereal bar, granola bar, cereal, grits, oat
15P	Processed & blended oils and oilseeds (1)	margarine, oil
16P	Sugars and confectioneries (9)	syrup, variety fruit snack

Appendix A Continued: Example products for each mapping category.

Mapping Category	Food Product Category	Example Product
17P	Frozen & canned fruits, juices, & vegetables (3, 4)	applesauce, canned bean, frozen/canned carrot, sliced pickle, canned pimento, canned relish, canned corn, breaded eggplant, French fry, fruit cocktail canned, fruit cup, canned fruit, garlic chopped in oil, vegetarian gravy, canned green bean, juice cup, juice, onion ring, frozen potato, canned pumpkin, canned salsa, barbecue sauce, tomato sauce, frozen spinach, hummus spread, jelly spread, canned tomato, canned tomato paste
18P	Frozen & canned specialty foods (1-6, 9-14)	baby food, egg roll, breaded fish patty, pizza, frozen sliced plantain, canned beef ravioli, soup, waffle
19P	Dehydrated food products (non-meat/dairy) (3, 4)	raisin
20P	Cheese, fluid milk, butter, ice cream/frozen desserts, dry/condensed/evaporated dairy products (12)	butter, cheese, cream cheese, whipping cream, half and half creamer, fruit ice, milk, plant milk, yogurt
21P	Frozen cakes & pastries, bread & bakery products, cookies & crackers, dry pastas, doughs, tortillas (1, 2)	bagel, biscuit, bread, bun, cookie, cracker, cake, flatbread, French toast, loaf, muffin, croissant, roll, pasta bowl, pancake, pasta, tortilla
22P	Poultry & processed poultry meat products (13)	chicken, chicken dumpling, chicken leg, chicken patty, roasted chicken, chicken tender, chicken bite, goose bottom, omelet, chicken slider, turkey

Appendix A Continued: Example products for each mapping category.

Mapping Category	Food Product Category	Example Product
23P	Meat & processed meat products (nonpoultry) (11, 14)	beef, lamb, meatball, beef patty
24P	Processed fish and seafood products (17)	fish patty, salmon, sardine, tilapia, tuna
25P	Roasted nuts, nut butters, & snack foods (1-6, 9-14)	potato chip, tortilla chip, peanut butter, roasted sunflower, pretzel snack
26P	Flavorings, dressings, sauces, spices, & extracts (1-6, 9-14)	baking soda, hot sauce, ketchup, mayonnaise, mustard, balsamic dressing, blue cheese dressing, chipotle ranch dressing, French dressing, honey mustard dressing, low sodium dressing, ranch dressing, sesame dressing, salt, browning sauce, Italian sauce, duck sauce, soy sauce, spaghetti sauce, sweet and sour sauce, tartar sauce, teriyaki sauce, Worcestershire sauce, seasonings, spices, vinegar
27P	Coffee & tea, soft drinks & water beverages, ice	coffee, variety electrolyte drink, nutrition assorted drink, soda, iced tea, water, sparkling water
28P	Other manufactured food products (1-6, 9-14)	burrito, macaroni, meal kit, salad, sandwich, sugar substitute, taco shell, tofu
29P	Alcoholic beverages	distilled spirits, beer, wine

Appendix B: Actual (B) and adjusted (B*) bid costs for locally produced foods across all vendors in the Food bid, by OGS category.^a

Category	B	B*	B -B*	%Change
AMBIENT, CANNED, DRY	7,101,546	6,586,864	514,682	7.81
BAKED GOODS	13,184	11,848	1,336	11.28
DAIRY	2,867,216	2,675,465	191,751	7.17
FROZEN	4,189,154	3,849,333	339,821	8.83
MEAT, POULTRY, FISH	811,696	758,777	52,919	6.97
PRODUCE	631,155	583,891	47,264	8.09
Total	15,613,951	14,466,178	1,147,773	7.93

^a Locally produced products only ($RPC_{PR} = 1$) for the Food state bid. Food categories include products sold by nonlocal ($RPC_{WH} = 0$) and local ($RPC_{WH} = 1$) wholesalers.