WESTERN WASHINGTON UNIVERSITY
CENTER OF ECONOMIC AND BUSINESS RESEARCH

Economic Impacts of Food Banks

Why was this study conducted?

To understanding the economic benefits that Neighbors in Need & Helping Hands Food Bank provide to the Skagit county communities.

Findings

Direct Spending Impacts of Food Distributions:

By distributing food (worth some amount of money), a food bank essentially introduces new income to a community by freeing up income that would otherwise be spent on food. Direct impacts are the immediate effects of adding income to the community.

Neighbors in Need Food Bank of Skagit County — Food • Help • Hope

Serving 667 households per week with **transfer payment values** of food distributed to each family at **70 percent deflation:**

- $45 per family per week
- $194 per family per month
- $2330 per family per year
- Total Yearly Impact on Industry Allocation: **$1,553,843**

HELPING HANDS Food Bank | Skagit County

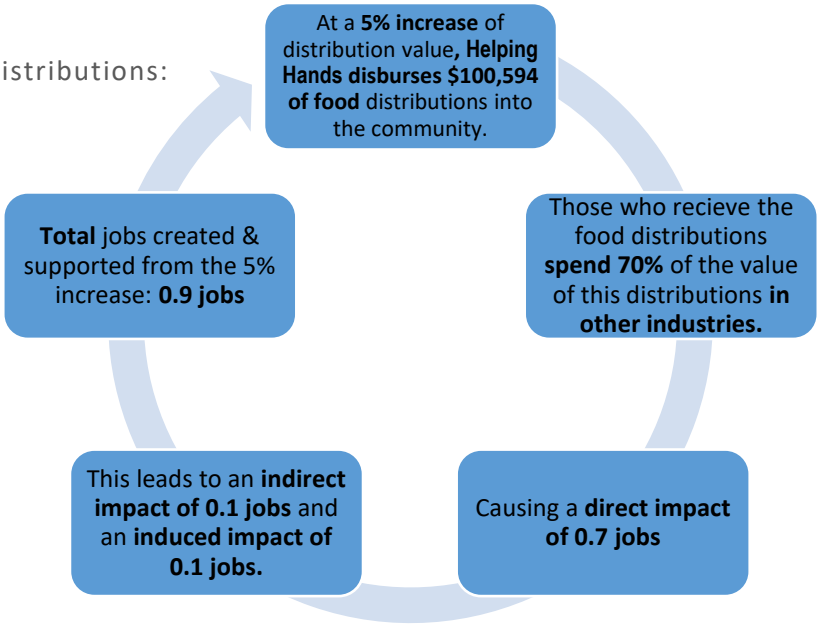
Serving 730 households per week with **transfer payment values** of food distributed to each family at **70 percent deflation:**

- $37 per family per week
- $161 per family per month
- $1,929 per family per year
- Total Yearly Impact on Industry Allocation: **$1,408,316**

Indirect and Induced Impacts of Food Distributions:

*The idea is that goods and services that are bought or consumed have **additional economic impacts** beyond their purchase value.*

***Increased distributions of food** by Helping Hands and Neighbors in **Need has an indirect and induced impact on economic factors**, such as employment and income.*



THE ECONOMIC IMPACTS OF FOOD BANKS IN SKAGIT COUNTY PART I

November 3, 2017

Prepared for:
Helping Hands Food Bank

&

Neighbors in Need Food Bank

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WESTERN WASHINGTON UNIVERSITY
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About the Authors

The Center for Economic and Business Research is an outreach center at Western Washington University located within the College of Business and Economics. The Center connects the resources found throughout the University to assist for-profit, non-profit, government agencies, quasi-government entities and tribal communities in gathering and analyzing useful data. We use a number of collaborative approaches to help inform our clients so that they are better able to hold policy discussions and craft decisions.

The Center employs students, staff and faculty from across the University as well as outside resources to meet the individual needs of those we work with. Our work is based on academic approaches and rigor – this not only provides a neutral analysis perspective, but also provides applied learning opportunities. We focus on developing collaborative relationships with our clients and facilitating meaningful discussions, instead of simply delivering an end product.

The approaches we utilize are insightful, useful, and are all a part of the debate surrounding the topics we explore. However, none are absolutely fail-safe. Data, by nature, are challenged by how it is collected and leveraged with other data sources; following only one approach without deviation is ill-advised. We provide a variety of insights within our work – not only on the topic at hand but the resources (data) that inform that topic.

We are always seeking opportunities to bring the strengths of Western Washington University to fruition within our region. If you have a need for analysis work or comments on this report, we encourage you to contact us at 360-650-3909. To learn more about CEBR visit us online at https://cbe.wwu.edu/cebr/center-economic-and-business-research.

The Center for Economic and Business Research is directed by Hart Hodges, PhD and James McCafferty.

About this Study

This study seeks to understand the economic impacts of a food bank or network of food banks, both within the traditional definition and a more macro view. This study will have three main parts: first we will analyze the direct spending impacts of the food distributions, estimating the amount that food banks return to the local economy via these transfer payments. Secondly, we will model the indirect and induced impacts of those distributions on factors such as local employment and sales. Finally, we will use econometric techniques to analyze what factors make a community more likely to have a food bank, and what impact that food bank has on the community in terms of crime and health.

The entire study will be carried out in two separate documents – Part I and Part II. This document, Part I, will deal with the direct, indirect, and induced impacts of the distributions of food by Helping Hands and Neighbors in Need food banks in Skagit County, Washington on their immediate communities. The econometric models are contained in a separate report, Part II.

Understanding Food Banks

"Food bank" is a catchall term used to describe organizations, usually local non-profits, which distribute food at little or typically no cost to community members who are otherwise unable to purchase or obtain food. Food banks often take on multiple roles within a community: inspecting, storing, and distributing food to individuals or other organizations (governmental and/or private) that then distribute that food to individuals. Food banks are often attached to other services or organizations, such as food pantries, soup kitchens, shelters, orphanages, schools, or religious institutions. Many also provide other services, such as counseling, vocational training, temporary shelter, or employment services. The role of a food bank within a community varies widely between individual food banks and communities; in some areas, food banks may be stop gaps for those in temporary need, while in others, food banks may be a main source of nutrition for an entire community as well as a center of activity.

In this study, "food banks" will refer to local community services that distribute food at little to no cost to residents in need of food assistance that may also provide the services listed above. The North American Industrial Classification System (NAICS) has its own code for "Community Food Services" (624210) that follows this same definition that we will use in this study.

The Food Distribution Process

Food banks acquire food and other grocery items in several ways:

- From grocery stores or food producers of recently or nearly expired goods at greatly reduced prices or as donation;
- Individual donations from community members, food drives, etc.;
- Government contributions and subsidies
- Purchased food from suppliers at a large discount

The food bank then inspects the food acquired, to make sure that it is fit for consumption, before distributing it to community members. Most food banks have a physical distribution space, or "store front," typically referred to as food pantry, where individuals and households can either pick out food for a given week or receive a bundle with necessities and food intended to last until the next day of distribution. Many also have additional distribution methods, including but not limited to, "back packs" for food insecure children, school lunch supplies, soup kitchens, and homeless and migrant community outreach programs.

A common misconception is that food banks rely primarily on donations of food by community members or businesses. Because food banks buy in bulk and usually obtain food by "rescuing" it from grocery stores that could not otherwise sell it, they are able to obtain large amounts of food at very low prices (around $0.10/lb.). A community member buying food for a food bank will likely pay much more than this, while that money would have gone much further as a direct donation to the food bank instead. By far the most effective way to contribute to a food bank is through donation of time (by volunteering to help with sorting, distribution, etc.) or money.

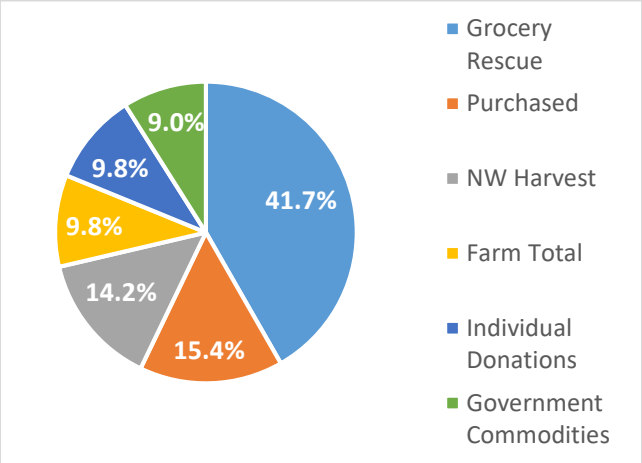
Helping Hands

Helping Hands Food Bank (located at 610 Cook Road, Sedro Wooley, WA) is Skagit County's largest direct emergency food provider, supplying over 2.2 million pounds of food to around 14,000 individuals in 2016. The market value of this food was approximately $2 million. Helping Hands obtains this food from a variety of sources, "rescuing" an average of 3,000 pounds of food daily from grocery stores that would otherwise be thrown out. They also obtain food through purchase at an average of$0.04/lb. from Food Lifeline of Seattle, as well as from organizations such as Northwest Harvest, and through community donations and drives.

The food bank has many distribution programs, all of which can be donated to individually:

- Wednesday Distribution Day: from 10 am to 4 pm, serving around 710 families per week;
- Food4Kids: supplies over 125 at need children at Mary Purcell and Evergreen Elementary with 35 lbs. of fresh produce, milk, bread, peanut butter, and more weekly;
- Mobile Food: designed for community members with difficulty reaching distribution day or with limited mobility, delivers 30 lb. boxes of food to roughly 100 community members per week

Figure 1: Sources of food for Helping Hands food bank



Additionally, Helpings Hands has recently begun to fund the building of a "Forever Home" for its operations. This will include an expansion of services, workshops, and nutritional outreach programs, a work study vocational training program, a community garden, and a "grocery" model of food assistance.

Neighbors in Need

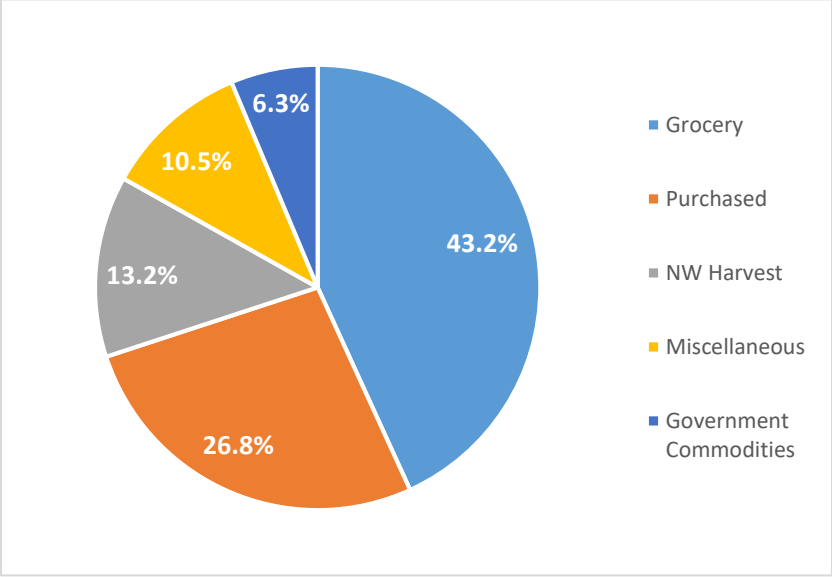
Mission: "To provide food to those in the community who may be food insecure, no questions asked."

Neighbors in Need is the second largest food bank in Skagit County, distributing about 1.1 million pounds of food annually to the Mount Vernon community. Per month, they serve around 2,000 families, or 8,000 individuals, half of whom are under 18. A typical week for Neighbors in Need includes:

- Tuesday Distribution Day: supplying food assistance to around 500 families per week;
- Backpack Distribution: mostly to school-aged children, of around 132 families per week;
- Mobile Deliveries: serving mobility challenged community members, around 35 families per week

They further estimate that in an average week, they serve around 35 migrant families, 51 families with school aged children (outside of the distribution day), and 8 survivors of domestic violence referred by other programs.

Figure 2: Sources of food for Neighbors in Need food bank



Direct Spending Impacts

Overview

This section of our study proposes to put a dollar figure on the *direct impact* of the Helping Hands Food Bank and the Neighbors in Need Food Bank on the surrounding community through their distributions of food. In theory, because Helping Hands and Neighbors in Need are supplying families with food, the money they would otherwise have spent on food is now free to be spent on other goods and services, such as housing, transportation, health care, entertainment, and recreation. Using the market price of food distributions, we can estimate the amount of money each family incrementally adds to their discretionary spending budget.

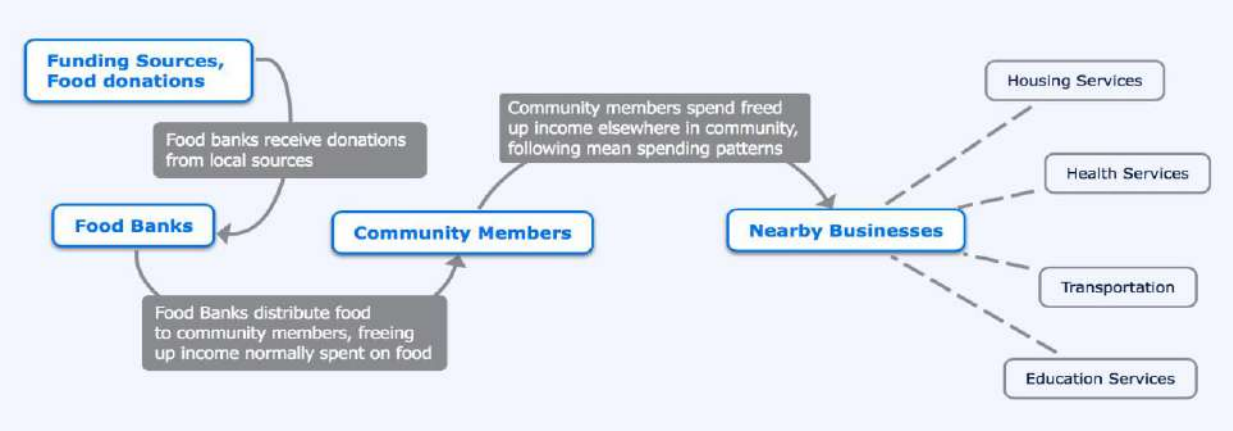
> ***Direct impacts:***
>
> By distributing food (worth some amount of money), a food bank essentially introduces new income to a community by freeing up income that would otherwise be spent on food. Direct impacts are the immediate effects of adding income to the community.

Then, using IMPLAN – an econometric modeling software – to predict the spending patterns of families in Skagit County, we extrapolate what portion of that additional discretionary spending would be devoted to certain goods and services. It is important to note that our analysis of Skagit County is not generalizable to other regions. The model and statistics we are using for this study are specific to Skagit County, and hence the same analysis performed on a different region's data may be drastically different.

Methodology

By distributing food to households in need, Helping Hands and Neighbors in Need are transferring the market value of the food they would have otherwise bought to each household. In other words, the food bank is essentially gifting a given household's normal weekly food budget to that household. Each household is then free to spend this money elsewhere in the community – on housing, transportation, recreation, and other goods (See Figure 3). In economics, this sort of gift is known as a transfer payment. Therefore, we use the market value of the total annual food distributions for each food bank as an estimate of the total spending a food bank allows within a community. We will proceed using this method in this section (Part I) of our study.

Figure 3: Assumed distribution process for direct spending impacts, modeling distribution as a transfer payment worth the market value of household food expenditure (created with: Mindomo)



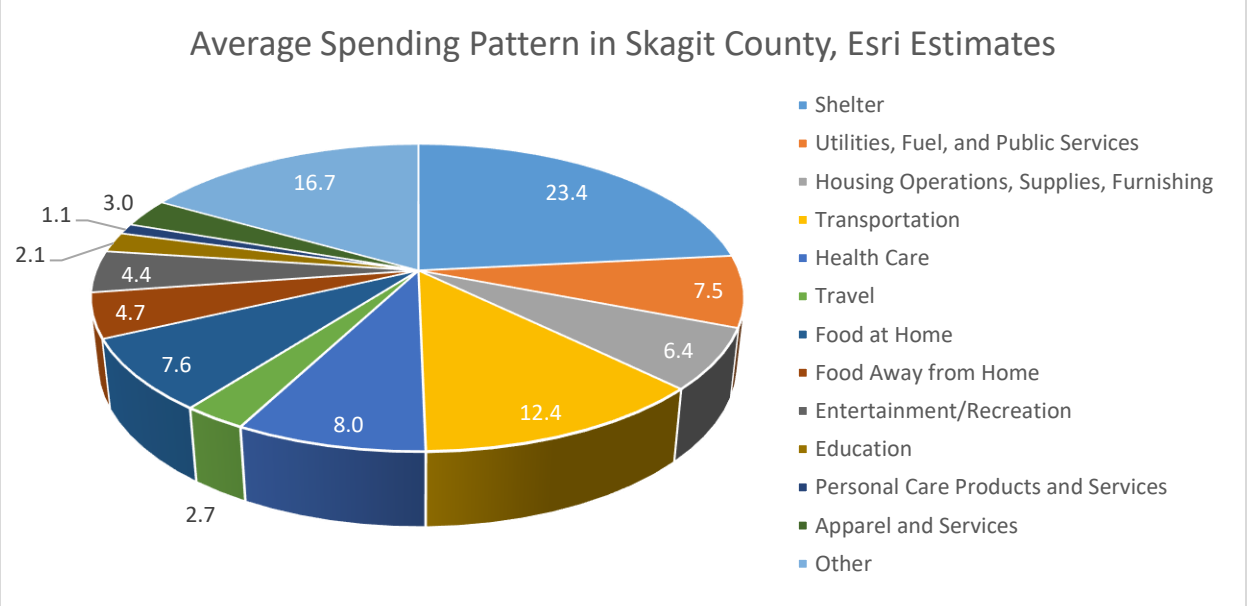
EXAMPLE: If consumers in the county on average spend 15% of their income on transportation, and a food bank distributes $1,000 worth of food annually to a specific household, then transportation services receive $150 of income per year as a direct impact of the food bank's distributions to that household ($\$1{,}000 \times 15\% = \$150$). If there are 100 families, then the total annual distribution by the food bank is $100,000, and the total contribution to transportation services is $15,000.

The allocation of transfer payments to different industry sectors is based off the consumption patterns of the average Skagit County household. This allocation of household spending reflects similar percentages to the Bureau of Labor Statistics - *Monthly Labor Review* in September 2013, and the PEW Charitable Trust - *House Hold Expenditures and Income* analysis in March 2016. Based on these results, we believe that the underlying consumption patterns of the average Skagit County household are statistically representative of households who are visiting local food banks.

We use this to estimate the impact of food distributions and transfer payments on specific industries. Since those who receive food from Helping Hands and Neighbors in Need spend according to the mean pattern of the county, then each household will spend its annual transfer payment amount in roughly the same way. Thus, we can simply allocate the total market value of annual food distributions of each food bank as does the average consumer in the county. Of course, not all community members will choose to spend in the same way. A census to obtain this data would be impossible and unnecessary; we reason that any outliers (those who spend relatively more or less of their in-kind transfer payment) cancel each other out in the aggregate.

We begin by estimating the spending patterns of families in Skagit County. To do this we begin by using Esri's forecasts for 2016 and 2021 combined with Consumer Spending data derived from the 2013 and 2014 Consumer Expenditure Surveys from the Bureau of Labor Statistics. Figure 4 represents Esri's predictions for household budgets in the Skagit Region.

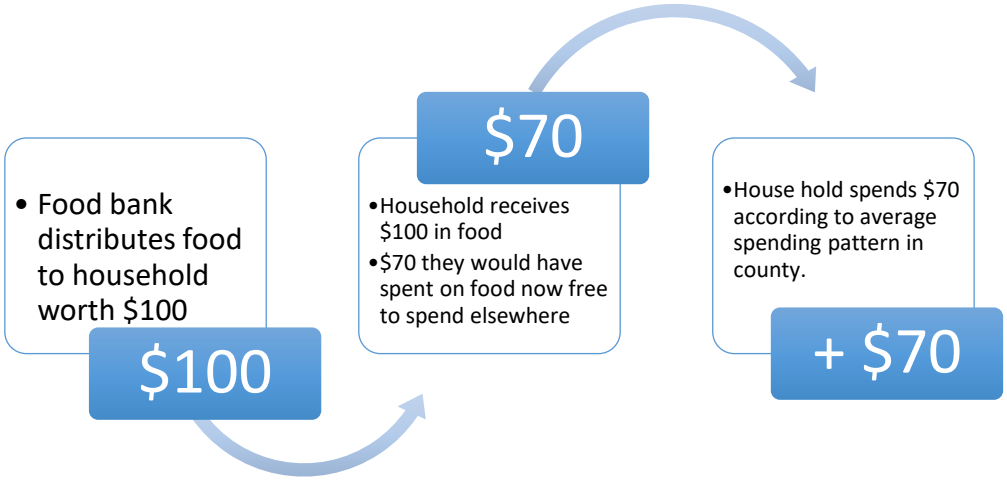
Figure 4: Esri's GIS estimations of spending allocations for Skagit County (Bureau of Labor Statistics)



Before analyzing the diversion of discretionary income into goods and services, we must make a few assumptions. First, we assume that families that visit Helping Hands follow the mean budget expenditure patterns for the general population of Skagit County. This also means that families receiving food from Helping Hands spend money on additional food items to supplement distributions.

We also note that families in need of food assistance may not be able to devote the entire value of a given distribution to other consumption choices. As an example, suppose a family in need spends $70 per week on food, but were given a gift of $100 worth of food. This gift of food would therefore not free up its entire value ($100 dollars) for consumption elsewhere, only what the household would have spent without the food given to them ($70 dollars). Under this scenario, we would therefore need to "deflate" the value of the transfer payment by 70% ($70\% \times \$100 = \$70$ to spend elsewhere, see Figure 5). We of course do not know the exact deflation value to use, but offer a potential range of possible values (30%, 50%, and 70%). This will provide a more realistic estimate of the impact of food distributions.

Figure 3: Process of transfer payment and deflation from above example.



Helping Hands and Neighbors in Need have provided the Center with distribution values for a recent month, thus determining the average distribution value per family served by each food bank. The average distribution value will not be the same for every family served, however it serves as a sufficient measurement of distribution value for our analysis.

The various food stamp and subsidy programs may play a role in the overall impact possible from a recipient. In essence, food stamps or other subsidies free up dollars for further household spending. While these programs should not be minimized, their overall impact should be considered as part of the deflation strategy since it is unlikely that these recipients are able to secure an excess of subsidies from their expenses.

According to the United States Department of Agriculture (USDA), 12.3 percent of households in the US were food insecure in 2016. The phrase "Food insecure" refers to households that have low or very low food security. Low food security households maintain regular eating habits, but in turn, may have

diminished variation in diet or acquired food from a food bank. Some or all of the members of a very low food secure house often reduce their food consumption below typical levels because of inability to access food due to insufficient funds (USDA 2016). Food stamps alone don't change a household's food security (Pan 2008). A mixture of government programs like Woman, Infants, and Children (WIC), Supplemental Nutrition Assurance Program (SNAP, formerly the Food Stamp Program), work in conjunction with food pantries and food banks to improve household food security. (Kicinski 2012).

Finally, we will assume that those visiting Helping Hands and Neighbors in Need are not saving any of the transfer payment received through food distribution. Savings and investment are luxury that many food bank visitors do not have. In the case of those who do, much of the variation in savings rates will be accounted for by the deflation process.

Results

Neighbors in Need

Table 1 describes the direct spending impacts per household using Neighbors in Need's estimations of a typical week's distributions. Measured at standard retail price, distributions average roughly $64 per family per week, or $277 per month, $3328 per year. This amount constitutes the transfer payment value of the food distributed to each family. We note that it is possible for a family to visit more than one food bank in a week; this could mean that these numbers potentially overestimate the direct spending impact at a given deflation level. However, it is reasonable to assume that the true direct impact will lie somewhere in between the deflation levels, meaning that the data still provides an accurate *range* of impacts.

Table 1: Estimates of allocation of additional spending from food distributions, per family per year (Neighbors in Need)

Allocation	Percent of expenditure	100% Deflation	70% Deflation	50% Deflation	30% Deflation
Total	100%	$3328.00	$2329.60	$1664.00	$998.40
Housing	30.9%	$1028.35	$719.85	$514.18	$308.51
Shelter	23.4%	$778.75	$545.13	$389.38	$233.63
Utilities, Fuel, Public Serv.	7.5%	$249.60	$174.72	$124.80	$74.88
Housing Operations, Supplies, Furnishing	6.4%	$212.99	$149.09	$106.50	$63.90
Transportation	12.4%	$412.67	$288.87	$206.34	$123.80
Health Care	8%	$266.24	$186.37	$133.12	$79.87
Travel	2.7%	$89.86	$62.90	$44.93	$26.96
Food	12.2%	$406.02	$284.21	$203.01	$121.80
Food at Home	7.6%	$252.93	$177.05	$126.46	$75.88
Food Away from Home	4.7%	$156.42	$109.49	$78.21	$46.92
Entertainment/Recreation	4.4%	$146.43	$102.50	$73.22	$43.93
Education	2.1%	$69.89	$48.92	$34.94	$20.97
Personal Care Products and Services	1.1%	$36.61	$25.63	$18.30	$10.98
Apparel and Services	3%	$99.84	$69.89	$49.92	$29.95

Neighbors in Need estimate that food is handed out to an average of 667 households per week. The following describes how this is divided amongst categories of distribution:

- Tuesday Distribution Day—500 families/week
- Mobile Deliveries—35 families/week
- Backpack Distribution—132 families/week

Neighbors in Need distribute roughly the same amount of food to each of these categories therefore we have included all of them in the analysis. Table 2 gives the total impact of Neighbors in Need on Skagit County in a representative year based on industry allocation.

Table 2: Total yearly financial impacts of Neighbors in Need food distribution by allocation

Allocation	Percent of expenditure	100% Deflation	70% Deflation	50% Deflation	30% Deflation
Total	100%	$2,219,776	$1,553,843	$1,109,888	$665,932
Housing **Shelter** **Utilities, Fuel, Public Serv.**	30.9% 23.4% 7.5%	$685,910 $519,427 $166,483.	$480,137 $363,599 $116,538	$342,955 $259,713 $83,241	$205,773 $155,828 $49,944
Housing Operations, Supplies, Furnishing	6.4%	$142,065	$99,445	$71,032	$42,619
Transportation	12.4%	$275,252	$192,676	$137,626	$82,575
Health Care	8%	$177,582	4124,307	$88,791	$53,274
Travel	2.7%	$59,933	$41,953	$29,966	$17,980
Food **Food at Home** **Food Away from Home**	12.2% 7.6% 4.7%	$270,812 $168,702 $104,329	$189,568 $118,092 $73,030	$135,406 $84,351 $52,164	$81,243 $50,610 $31,298
Entertainment/Recreation	4.4%	$97,670	$68,369	$48,835	$29,301
Education	2.1%	$46,615	$32,630	$23,307	$13,984
Personal Care Products and Services	1.1%	$24,417	$17,092	$12,208	$7,325
Apparel and Services	3%	$66,593	$46,615	$33,296	$19,977
Other	16.8%	$372,922	$261,045	$186,461	$111,876

Helping Hands

We follow a similar procedure for Helping Hands Food Bank, considering the same factors as above. Helping Hands estimates that a typical week of distribution entails distributions valued at market cost around $53 per family. This amounts to $2,756 per family per year. Individual family allocations of these funds are given by Table 3.

As above, we use Helping Hand's mean number of families served per week (730) to estimate total contributions of food to the local economy based on industry sector and estimated spending allocation. Estimates are given by Table 4.

Table 3: Estimates of allocation of additional spending from food distributions, per family per year (Helping Hands)

Allocation	Percent of expenditure	100% Deflation	70% Deflation	50% Deflation	30% Deflation
Total	100%	$2,756	$1,929	$1,378	$826
Housing	30.9%	$852	$596	$426	$255
Shelter	23.4%	$645	$451	$322	$233.63
Utilities, Fuel, Public Serv.	7.5%	$207	$145	$103	$75
Housing Operations, Supplies, Furnishing	6.4%	$176	$123	$88	$64
Transportation	12.4%	$342	$239	$171	$124
Health Care	8%	$220	$154	$110	$80
Travel	2.7%	$74	$52	$37	$27
Food	12.2%	$336	$235	$168	$123
Food at Home	7.6%	$209	$147	$105	$76
Food Away from Home	4.7%	$130	$91	$65	$47
Entertainment/Recreation	4.4%	$121	$85	$61	$44
Education	2.1%	$58	$41	$29	$21
Personal Care Products and Services	1.1%	$30	$21	$15	$11
Apparel and Services	3%	$82.68	$57.88	$41.34	$29.95

Table 4: Total yearly financial impacts of Helping Hands food distribution by allocation

Allocation	Percent of expenditure	100% Deflation	70% Deflation	50% Deflation	30% Deflation
Total	100%	$2,011,880	$1,408,316	$1,005,940	$603,564
Housing	30.9%	$621,671	$435,170	$310,835	$186,501
Shelter	23.4%	$470,780	$329,546	$235,390	$141,234
Utilities, Fuel, Public Serv.	7.5%	$150,891	$105,624	$75,446	$45,267
Housing Operations, Supplies, Furnishing	6.4%	$128,760	$90,132	$64,380	$38,628
Transportation	12.4%	$249,473	$174,631	$124,737	474,842
Health Care	8%	$160,950	$112,665	$80,475	$48,285
Travel	2.7%	$54,321	$38,025	$27,160	$16,296
Food	12.2%	$245,449	$171,815	$122,725	$73,635
Food at Home	7.6%	$152,903	$107,032	$76,451	$45,871
Food Away from Home	4.7%	$94,558	$66,191	$47,279	$28,368
;;p3Entertainment/Recreation	4.4%	$88,523	$61,966	$44,261	$26,557
Education	2.1%	$42,249	$29,575	421,125	$12,675
Personal Care Products and Services	1.1%	$22,131	$15,491	$11,065	$6,639
Apparel and Services	3%	$60,356	$42,249	$29,575	$20,702
Other	16.8%	$337,996	$236,597	$168,998	$101,399

Analysis of Direct Impacts

Based on our findings, we estimate that the combined food distributions of Helping Hands and Neighbors in Need contribute between $1.3 million and $3 million annually to the local economy in direct spending (estimates obtained by 30% and 70% deflation, respectively). This estimate, while not precise, is a reasonable assessment of the direct economic impact of the two food banks; without their distributions of food, this spending would not otherwise occur.

Again, it is important to note that these are the direct spending impacts – they do not consider the effects of that spending, such as job creation, health savings, etc. These *indirect* and *induced* effects will be covered in the following section.

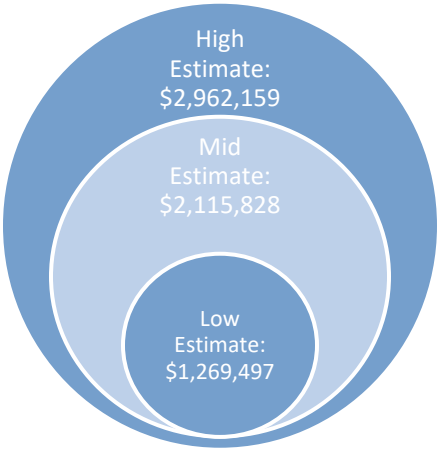


Figure 4: Annual estimates for total direct impacts of both food banks on local economy in spending that would not otherwise occur.

Indirect and Induced Impacts

Overview

In this section we will analyze the *indirect* and *induced* effects of food distribution via Helping Hands and Neighbors in Need. We demonstrate the effects of increased distributions of food by Helping Hands and Neighbors in Need on the surrounding community using Minnesota Implan Group's IMPLAN modeling software. IMPLAN is an input-output region specific economic modeling software designed by Minnesota Implan Group, Inc (MIG). Based on these simulations, we estimate the impact of the food banks on employment, income, and other macroeconomic factors. In addition to the direct spending impacts, this will allow us to study the total impact of the food banks on the regional economy. Again, it is important to reiterate that our analysis of Skagit County does not generalize to other geographic areas; our results are driven by region specific spending statistics and multipliers that may not be true for other counties, municipalities, or areas.

Indirect Impacts:

When a sector experiences growth (or contraction), it will demand more goods and services from sectors that support it, encouraging those sectors to also grow.

EXAMPLE: Raspberry prices increase steadily over several years, prompting more farms to enter the market. These farms purchase specific equipment, prompting suppliers of that equipment to hire more employees to meet demand. Producers of the raw materials that go into making that equipment (steel, copper, etc.) also see growth.

Induced Impacts:

When a job is created in one sector, new income is introduced into a community in the form of wages paid to that employee. That employee takes that income and spends it on goods and services in other industries, in turn promoting growth and job creation in those industries as well.

EXAMPLE: A steel mill opens, hiring 100 workers at $60,000 per year. Each worker spends some portion of this on groceries, increasing demand for food on local grocers, and inducing them to hire more workers.

Methodology

In this model, we force portions of the increases in distribution value as spending increases in those sectors detailed in the direct spending impacts section. This better allows us to determine industry specific multiplier effects (see below for definition), as well as compute the induced effects of the direct spending impacts we estimated in the previous section.

To analyze the effects of Helpings Hands and Neighbors in Need on the greater Skagit region, we will use MIG's IMPLAN modeling software. It uses social accounting matrices (models of transactions between producers and intermediate and final consumers), multiplier effect models (accounting for direct, indirect, and induced effects), and zip-code specific statistics to quantify present economic structures and extrapolate the economic impacts of potential actions/projects. IMPLAN can help examine questions regarding the functioning of local economies, economic consequences of projects, and the effects of a given business on a community.

The most intuitive way to analyze the impact of local food banks may seem to be to model their removal from the community. However, this could have unintended consequences that would skew our model's results because the local economy has developed in the presence of the effects of these food banks, and would have developed differently in their absence. To suddenly remove them from that economy (a rather unrealistic event to simulate) would therefore not be a reliable gauge of their total economic impact. Additionally, since our handle on the food banks' impact is based on the additional spending they allow families in need, their removal would equate to large decreases in aggregate spending in the region ($1.3 million to $3 million, as estimated). Because IMPLAN accounts for transactions between entities within the county, this could trigger sudden changes in spending patterns, deflation, and other unrealistic outcomes.

Therefore, the best way to study the indirect and induced impacts of the food banks studied is to look at the effects of *marginal changes* in their distributions – the change in an outcome for each unit of change of the dependent variable, in this case distribution amount. We model this as increases in demand within the community equal to a fixed percent of their distribution value. For instance, suppose one food bank increased its food distributions by $100,000; this would translate into a gross transfer payment between $30,000 and $70,000 to community members (after deflating by 30% and 70% respectively). We can then model this contribution to the community by allocating it as shown above in the direct impact tables. This increase in spending in those patterns will generate effects on employment, community health, and other macro-factors within the existing economic structures of the county.

To understand how Helping Hands and Neighbors in Need impact their immediate communities, we will focus on so-called multiplier effects. Multipliers are a standard item of analysis throughout economics. The underlying idea is that

Multipliers:

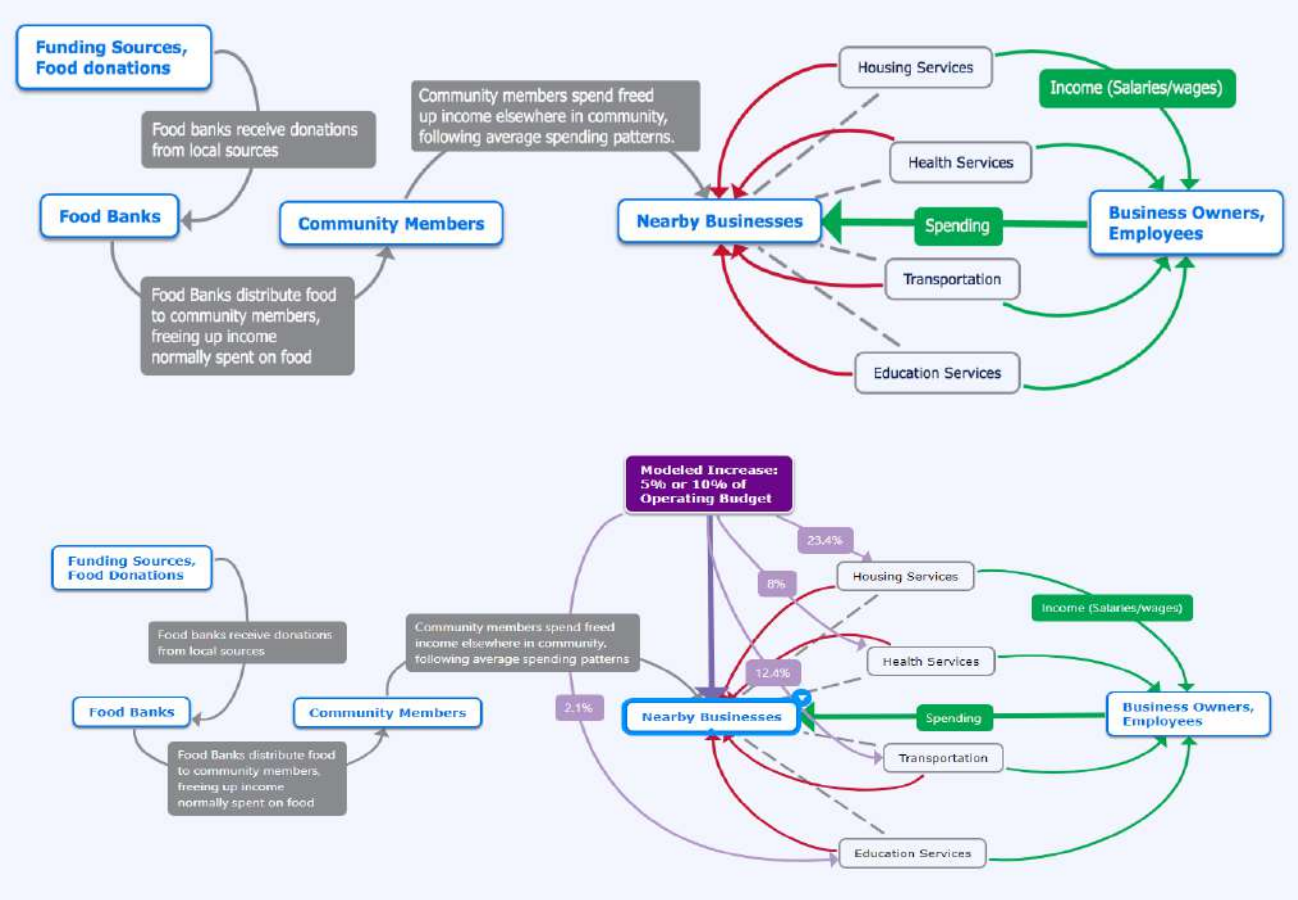
The total effect had on one factor (usually employment) resulting in a one unit increase in another. In our study, a multiplier will be the sum of the direct, indirect, and induced effects.

EXAMPLE: A major construction project prompts the hiring of 20 workers. Each worker spends enough to support 0.25 other jobs in the community in retail, groceries, etc. Additionally, the construction company requires more equipment for each worker hired, enough to support 0.15 additional jobs locally. The total job multiplier for a construction job will be:
1 (the construction job)
+ 0.25 (the induced effects)
+ 0.15 (the indirect effects)

goods and services that are bought or consumed have additional economic impacts beyond their purchase value. For instance, a job created in one industry gives that new employee new income to spend as they desire, and hence support jobs in other industries in the region (an *induced effect*). Additionally, other businesses that supply the sector that added a job also see demand for their services increase, creating more jobs (an *indirect effect*). Multiplier effects of this sort are found in many variables of interest, such as government spending (extra commerce encouraged per dollar spent), consumption of healthcare (dollars saved per dollar spent), and crime. These effects are important in decision making processes as they report on the "return" of certain contingencies or undertakings, and suggest the connectedness of industries and entities within a region. We will report on them as they relate to our study of food banks. IMPLAN accounts for these effects when generating its predictions.

We use IMPLAN to model increasing demand by 5% and 10% of the value of the food bank's annual distribution values in sectors of the Skagit economy. We will use our results from the direct spending impacts section to model these increases as changes in demand along the specified sectors, allowing IMPLAN to allocate the increase as it would be predicted by its matrices and input-output models. We will "inject" the increased sales predicted by the direct spending impacts section in each of these sectors. Each sector will receive a percent of the total increase in income corresponding to its share of consumption spending in the county. IMPLAN will then be able to model the effects of that increase on the regional economy.

Figure 5: Assumed food bank distribution process, both direct spending processes (grey), indirect (red), and induced impacts (green). (created with: Mindomo)



We begin by using the direct impact allocation tables as a proxy for the spending patterns, as before. We modeled two scenarios – increases to both food banks amounting to roughly 5% and 10% of total food distributions reported above (Table 5).

Table 5: Modeled increases in distribution value by food bank

Food bank	Helping Hands	Neighbors in Need
Total food distributions	$2,011,880	$2,219,776
5% Increase	$100,600	$110,989
10% Increase	$201,200	$221,978

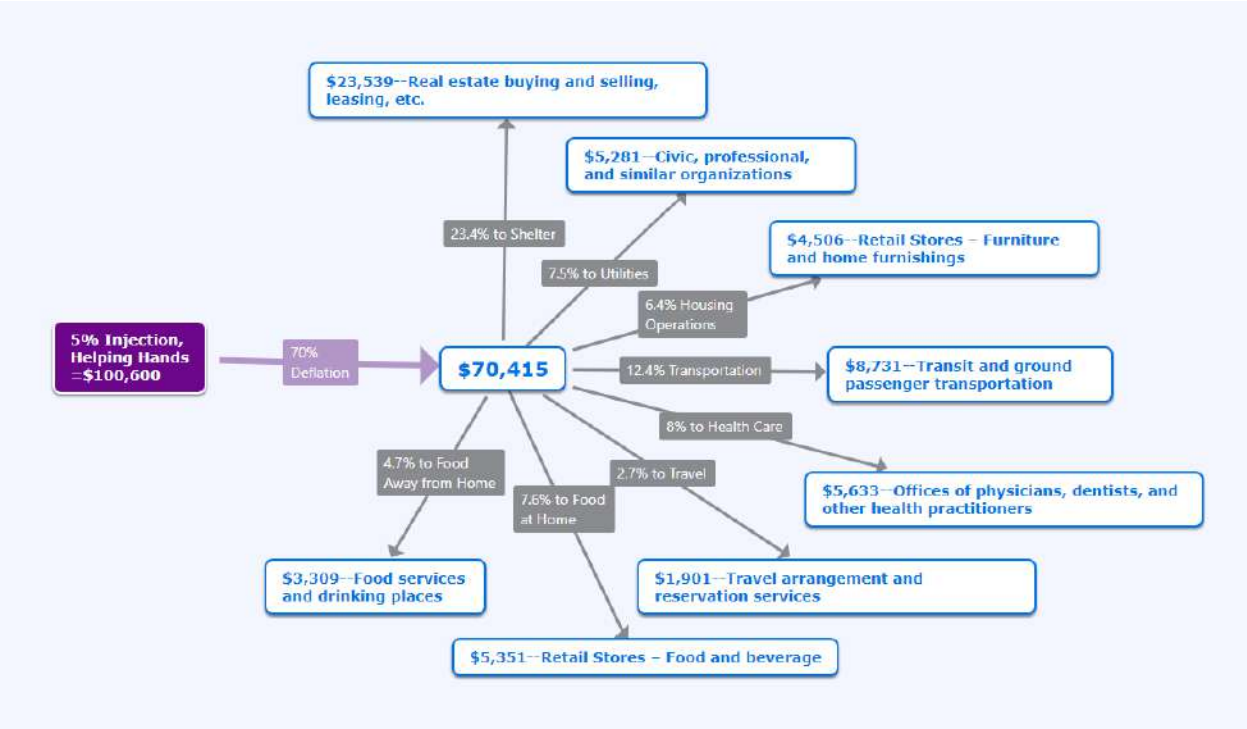
In terms of defining industry categorization, spending on "shelter" could mean spending on rent (real estate, leasing, etc.), construction of new housing, or other such categories. IMPLAN differentiates between these industries when modeling changes in demand. One cannot increase demand for "housing" by $20,000; instead one must increase demand for "real estate establishments" or "construction of other new residential sites". To model increases in demand in the specific sectors we're interested in, we must choose relatively representative industries to receive the increase in spending. The sectors studied in the direct impacts section are paired with their representative IMPLAN sector in Table 6.

Table 6: Representative sectors for IMPLAN "forced" increased demand model.

Allocation	Percent of expenditure	IMPLAN Code, Sector	NAICS Code, Sector
Shelter	23.4%	3360—Real estate buying and selling, leasing, etc.	531110—Apartment building rental or leasing
Utilities, Fuel, and Public Services	7.5%	3425—Civic, professional, and similar organizations	813910—Public utility associations
Housing Operations, Supplies, Furnishing	6.4%	3450—Retail Stores – Furniture and home furnishings	442299—Home furnishings stores
Transportation	12.4%	3336—Transit and ground passenger transportation	485113—Bus transit systems (except mixed mode)
Health Care	8%	3394—Offices of physicians, dentists, and other health practitioners	621111—Walk-in physicians' offices (e.g., centers, clinics)
Travel	2.7%	3383—Travel arrangement and reservation services	561591—Visitor bureaus
Food at Home	7.6%	3324—Retail Stores – Food and beverage	445110—Food (i.e., groceries) stores
Food Away from Home	4.7%	3413—Food services and drinking places	722210/722211—Restaurants
Entertainment/Recreation	4.4%	3039—Maintenance and repair construction of nonresidential structures	23—Recreational Facilities
Education	2.1%	3330—Retail stores - Miscellaneous	453210—Office supply stores
Personal Care Products and Services	1.1%	3329—Retail stores – General Merchandise	452111—Department Stores (except discount)
Apparel and Services	3%	3327—Retail Stores – Clothing and clothing accessories	448150—Apparel accessory stores

Again, we assume that the households that use the two food banks follow the same spending profile as the rest of Skagit County, including in their allocations for food. Therefore, we can divide corresponding portions of the increases in distributional value as increases in commodity demand for those goods and services. The allocations of the increase in demand at the 5% and 10% levels for each food bank are given in Tables 12 and 13 in the Appendix.

Figure 6: Example of process for modeling technique (Helping Hands, 5% increase at 70% deflation).



Results

Tables 7 and 8 give the IMPLAN predicted outcomes of simulated increases.[1] The top ten most impacted sectors are displayed, ordered by impact on employment.

Table 7: IMPLAN predicted regional outcomes for 5% and 10% distribution-increases to Helping Hands

5% Increase

70% Deflation

Sector	Description	Employment	Labor Income	Value Added	Output
425	Civic, social, professional, and similar organizations	0.1	$3,986	$1,462	$5,568
430	State and local government passenger transit	0.1	$14,400	($18,388)	$7,511
360	Real estate establishments	0.1	$1,403	$12,504	$16,056
324	Retail Stores - Food and beverage	0.1	$3,340	$4,235	$5,809
413	Food services and drinking places	0.1	$1,946	$2,699	$4,921
394	Offices of physicians, dentists, and other health practitioners	0.1	$3,655	$3,736	$6,814
321	Retail Stores - Furniture and home furnishings	0.1	$1,765	$2,481	$4,592
330	Retail Stores - Miscellaneous	0	$759	$1,254	$1,663
327	Retail Stores - Clothing and clothing accessories	0	$836	$1,397	$2,379
39	Maintenance and repair construction of nonresidential structures	0	$1,823	$2,485	$3,945

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	0.7	$33,117	$13,462	$58,425
Indirect Effect	0.1	$4,570	$8,516	$24,926
Induced Effect	0.1	$4,945	$9,909	$16,323
Total Effect	0.9	$42,632	$31,887	$99,674

50% Deflation

Sector	Description	Employment	Labor Income	Value Added	Output
425	Civic, social, professional, and similar organizations	0.1	$2,847	$1,044	$3,977
430	State and local government passenger transit	0.1	$10,286	($13,134)	$5,365
360	Real estate establishments	0.1	$1,002	$8,932	$11,469
324	Retail Stores - Food and beverage	0.1	$2,386	$3,025	$4,149
413	Food services and drinking places	0.1	$1,390	$1,928	$3,515
394	Offices of physicians, dentists, and other health practitioners	0	$2,610	$2,668	$4,867
321	Retail Stores - Furniture and home furnishings	0	$1,261	$1,772	$3,280
330	Retail Stores - Miscellaneous	0	$542	$896	$1,188
327	Retail Stores - Clothing and clothing accessories	0	$597	$998	$1,699
39	Maintenance and repair construction of nonresidential structures	0	$1,302	$1,775	$2,818

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	0.5	$23,655	$9,616	$41,732
Indirect Effect	0.1	$3,264	$6,083	$17,804
Induced Effect	0.1	$3,532	$7,078	$11,659
Total Effect	0.7	$30,451	$22,776	$71,196

30 % Deflation

Sector	Description	Employment	Labor Income	Value Added	Output
425	Civic, social, professional, and similar organizations	0.1	$1,708	$627	$2,386
430	State and local government passenger transit	0.1	$6,142	($7,843)	$3,204
360	Real estate establishments	0	$601	$5,359	$6,881
324	Retail Stores - Food and beverage	0	$1,431	$1,815	$2,489
413	Food services and drinking places	0	$833	$1,156	$2,108
394	Offices of physicians, dentists, and other health practitioners	0	$1,566	$1,600	$2,919
321	Retail Stores - Furniture and home furnishings	0	$756	$1,063	$1,968
330	Retail Stores - Miscellaneous	0	$325	$537	$712
327	Retail Stores - Clothing and clothing accessories	0	$358	$599	$1,019
39	Maintenance and repair construction of nonresidential structures	0	$781	$1,065	$1,690

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	0.3	$14,162	$5,806	$25,022
Indirect Effect	0	$1,954	$3,642	$10,649
Induced Effect	0.1	$2,115	$4,237	$6,980
Total Effect	0.4	$18,231	$13,685	$42,651

10 % Increase

70% Deflation

Sector	Description	Employment	Labor Income	Value Added	Output
425	Civic, social, professional, and similar organizations	0.3	$7,973	$2,924	$11,137
430	State and local government passenger transit	0.2	$28,800	($36,776)	$15,022
360	Real estate establishments	0.2	$2,806	$25,010	$32,114
324	Retail Stores - Food and beverage	0.2	$6,681	$8,471	$11,618
413	Food services and drinking places	0.1	$3,891	$5,399	$9,843
394	Offices of physicians, dentists, and other health practitioners	0.1	$7,309	$7,471	$13,628
321	Retail Stores - Furniture and home furnishings	0.1	$3,530	$4,961	$9,183
330	Retail Stores - Miscellaneous	0.1	$1,519	$2,509	$3,325
327	Retail Stores - Clothing and clothing accessories	0.1	$1,673	$2,794	$4,758
39	Maintenance and repair construction of nonresidential structures	0.1	$3,646	$4,971	$7,889

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	1.4	$66,249	$26,947	$116,880
Indirect Effect	0.2	$9,141	$17,034	$49,856
Induced Effect	0.3	$9,893	$19,822	$32,653
Total Effect	1.9	$85,283	$63,803	$199,389

50% Deflation

Sector	Description	Employment	Labor Income	Value Added	Output
425	Civic, social, professional, and similar organizations	0.2	$5,695	$2,089	$7,955
430	State and local government passenger transit	0.2	$20,572	($26,269)	$10,730
360	Real estate establishments	0.1	$2,004	$17,864	$22,938
324	Retail Stores - Food and beverage	0.1	$4,772	$6,051	$8,298
413	Food services and drinking places	0.1	$2,779	$3,856	$7,030
394	Offices of physicians, dentists, and other health practitioners	0.1	$5,221	$5,336	$9,734
321	Retail Stores - Furniture and home furnishings	0.1	$2,521	$3,544	$6,560
330	Retail Stores - Miscellaneous	0.1	$1,085	$1,792	$2,375
327	Retail Stores - Clothing and clothing accessories	0	$1,195	$1,996	$3,399
39	Maintenance and repair construction of nonresidential structures	0	$2,604	$3,551	$5,635

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	1.4	$47,309	$19,232	$83,465
Indirect Effect	0.2	$6,528	$12,166	$35,609
Induced Effect	0.3	$7,065	$14,155	$23,319
Total Effect	1.9	$60,902	$45,553	$142,392

30% Deflation

Sector	Description	Employment	Labor Income	Value Added	Output
425	Civic, social, professional, and similar organizations	0.1	$3,417	$1,253	$4,772
430	State and local government passenger transit	0.1	$12,284	($15,685)	$6,407
360	Real estate establishments	0.1	$1,203	$10,717	$13,762
324	Retail Stores - Food and beverage	0.1	$2,863	$3,630	$4,978
413	Food services and drinking places	0.1	$1,667	$2,312	$4,215
394	Offices of physicians, dentists, and other health practitioners	0.1	$3,131	$3,201	$5,838
321	Retail Stores - Furniture and home furnishings	0	$1,513	$2,126	$3,936
330	Retail Stores - Miscellaneous	0	$651	$1,075	$1,425
327	Retail Stores - Clothing and clothing accessories	0	$717	$1,197	$2,039
39	Maintenance and repair construction of nonresidential structures	0	$1,562	$2,130	$3,380

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	0.6	$28,325	$11,611	$50,044
Indirect Effect	0.1	$3,908	$7,285	$21,298
Induced Effect	0.1	$4,230	$8,475	$13,961
Total Effect	0.8	$36,463	$27,371	$85,303

[1] Numbers in red represent losses

Table 8: IMPLAN predicted regional outcomes for 5% and 10% distribution-increases to Neighbors in Need.

5% Injection

70% Deflation

Sector	Description	Employment	Labor Income	Value Added	Output
425	Civic, social, professional, and similar organizations	0.1	$4,398	$1,613	$6,144
430	State and local government passenger transit	0.1	$15,888	($20,288)	$8,287
360	Real estate establishments	0.1	$1,548	$13,797	$17,716
324	Retail Stores - Food and beverage	0.1	$3,686	$4,673	$6,409
413	Food services and drinking places	0.1	$2,147	$2,978	$5,430
394	Offices of physicians, dentists, and other health practitioners	0.1	$4,032	$4,121	$7,517
321	Retail Stores - Furniture and home furnishings	0.1	$1,947	$2,737	$5,066
330	Retail Stores - Miscellaneous	0.0	$838	$1,384	$1,835
327	Retail Stores - Clothing and clothing accessories	0.0	$923	$1,542	$2,625
39	Maintenance and repair construction of nonresidential structures	0.0	$2,011	$2,742	$4,352

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	0.8	$36,539	$14,854	$64,464
Indirect Effect	0.1	$5,042	$9,396	$27,502
Induced Effect	0.1	$5,456	$10,933	$18,010
Total Effect	1.0	$47,038	$35,183	$109,976

50% Deflation

Sector	Description	Employment	Labor Income	Value Added	Output
425	Civic, social, professional, and similar organizations	0.1	$3,142	$1,152	$4,388
430	State and local government passenger transit	0.1	$11,348	($14,491)	$5,919
360	Real estate establishments	0.1	$1,106	$9,855	$12,654
324	Retail Stores - Food and beverage	0.1	$2,633	$3,338	$4,578
413	Food services and drinking places	0.1	$1,533	$2,127	$3,878
394	Offices of physicians, dentists, and other health practitioners	0.0	$2,880	$2,944	$5,370
321	Retail Stores - Furniture and home furnishings	0.0	$1,391	$1,955	$3,619
330	Retail Stores - Miscellaneous	0.0	$598	$988	$1,310
327	Retail Stores - Clothing and clothing accessories	0.0	$659	$1,101	$1,875
39	Maintenance and repair construction of nonresidential structures	0.0	$1,437	$1,959	$3,109

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	0.6	$26,099	$10,610	$46,045
Indirect Effect	0.1	$3,601	$6,711	$19,644
Induced Effect	0.1	$3,897	$7,809	$12,864
Total Effect	0.7	$33,597	$25,131	$78,552

30% Deflation

Sector	Description	Employment	Labor Income	Value Added	Output
425	Civic, social, professional, and similar organizations	0.1	$1,880	$690	$2,627
430	State and local government passenger transit	0.1	$6,810	($8,695)	$3,552
360	Real estate establishments	0.0	$663	$5,912	$7,592
324	Retail Stores - Food and beverage	0.0	$1,580	$2,003	$2,747
413	Food services and drinking places	0.0	$920	$1,276	$2,327
394	Offices of physicians, dentists, and other health practitioners	0.0	$1,728	$1,766	$3,222
321	Retail Stores - Furniture and home furnishings	0.0	$835	$1,173	$2,171
330	Retail Stores - Miscellaneous	0.0	$359	$593	$786
327	Retail Stores - Clothing and clothing accessories	0.0	$396	$661	$1,125
39	Maintenance and repair construction of nonresidential structures	0.0	$862	$1,175	$1,865

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	0.3	$15,655	$6,363	$27,621
Indirect Effect	0.0	$2,160	$4,026	$11,785
Induced Effect	0.1	$2,338	$4,684	$7,717
Total Effect	0.4	$20,154	$15,073	$47,122

10 % Injection

70% Deflation

Sector	Description	Employment	Labor Income	Value Added	Output
425	Civic, social, professional, and similar organizations	0.3	$8,797	$3,226	$12,288
430	State and local government passenger transit	0.3	$31,777	($40,577)	$16,575
360	Real estate establishments	0.2	$3,096	$27,594	$35,432
324	Retail Stores - Food and beverage	0.2	$7,371	$9,347	$12,819
413	Food services and drinking places	0.2	$4,294	$5,957	$10,860
394	Offices of physicians, dentists, and other health practitioners	0.1	$8,064	$8,243	$15,035
321	Retail Stores - Furniture and home furnishings	0.1	$3,895	$5,474	$10,132
330	Retail Stores - Miscellaneous	0.1	$1,676	$2,768	$3,670
327	Retail Stores - Clothing and clothing accessories	0.1	$1,846	$3,083	$5,250
39	Maintenance and repair construction of nonresidential structures	0.1	$4,022	$5,484	$8,704

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	1.6	$73,079	$29,708	$128,928
Indirect Effect	0.2	$10,084	$18,792	$55,005
Induced Effect	0.3	$10,913	$21,866	$36,020
Total Effect	2.1	$94,076	$70,365	$219,953

50% Deflation

Sector	Description	Employment	Labor Income	Value Added	Output
425	Civic, social, professional, and similar organizations	0.2	$6,283	$2,304	$8,777
430	State and local government passenger transit	0.2	$22,696	($28,982)	$11,838
360	Real estate establishments	0.2	$2,212	$19,710	$25,309
324	Retail Stores - Food and beverage	0.1	$5,265	$6,676	$9,157
413	Food services and drinking places	0.1	$3,066	$4,254	$7,756
394	Offices of physicians, dentists, and other health practitioners	0.1	$5,761	$5,888	$10,740
321	Retail Stores - Furniture and home furnishings	0.1	$2,782	$3,910	$7,238
330	Retail Stores - Miscellaneous	0.1	$1,197	$1,976	$2,620
327	Retail Stores - Clothing and clothing accessories	0.1	$1,318	$2,202	$3,750
39	Maintenance and repair construction of nonresidential structures	0.0	$2,874	$3,918	$6,218

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	1.1	$52,198	$21,221	$92,090
Indirect Effect	0.2	$7,203	$13,423	$39,287
Induced Effect	0.2	$7,795	$15,618	$25,728
Total Effect	1.5	$67,195	$50,261	$157,105

30% Deflation

Sector	Description	Employment	Labor Income	Value Added	Output
425	Civic, social, professional, and similar organizations	0.1	$3,761	$1,379	$5,254
430	State and local government passenger transit	0.1	$13,619	($17,391)	$7,104
360	Real estate establishments	0.1	$1,327	$11,825	$15,184
324	Retail Stores - Food and beverage	0.1	$3,159	$4,006	$5,494
413	Food services and drinking places	0.1	$1,840	$2,553	$4,654
394	Offices of physicians, dentists, and other health practitioners	0.1	$3,456	$3,533	$6,444
321	Retail Stores - Furniture and home furnishings	0.0	$1,669	$2,346	$4,342
330	Retail Stores - Miscellaneous	0.0	$718	$1,186	$1,572
327	Retail Stores - Clothing and clothing accessories	0.0	$791	$1,321	$2,250
39	Maintenance and repair construction of nonresidential structures	0.0	$1,724	$2,350	$3,730

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	0.7	$31,311	$12,727	$55,241
Indirect Effect	0.1	$4,321	$8,051	$23,569
Induced Effect	0.1	$4,676	$9,368	$15,433
Total Effect	0.9	$40,307	$30,146	$94,243

Analysis of Indirect and Induced Impacts Model

Again, in a macroeconomic analysis, the most important sections of Tables 7 and 8 are the *direct*, *indirect, induced*, and *total* effects. Not surprisingly, an increase in demand results in employment growth (both in terms of the size of the distribution value and the deflation amount). For convenience, we provide a summary of the employment effects of the increases predicted by IMPLAN in Table 9.

Table 9: IMPLAN predictions of employment effects at various deflation levels

Predicted Employment Outcomes		5% Increase			10% Increase		
		70% Deflation	*50% Deflation*	*30% Deflation*	*70% Deflation*	*50% Deflation*	*30% Deflation*
Helping Hands	Direct Effect	0.7	0.5	0	1.4	1.4	0.6
	Indirect Effect	0.1	0.1	0	0.2	0.2	0.1
	Induced Effect	0.1	0.1	0.3	0.3	0.3	0.1
	Total Jobs Added	**0.9**	**0.7**	**0.3**	**1.9**	**1.9**	**0.8**
Neighbors in Need	Direct Effect	0.8	0.6	0.3	1.6	1.1	0.7
	Indirect Effect	0.1	0.1	0	0.2	0.2	0.1
	Induced Effect	0.1	0.1	0.1	0.3	0.2	0.1
	Total Jobs Added	**1.0**	**0.7**	**0.4**	**2.1**	**1.5**	**0.9**

These numbers demonstrate that an increase in demand and deflation leads to the creation of many jobs in the local economy. For instance, if 5% of Helping Hands distribution value ($100,594) is disbursed into the community as food distributions in addition to current distributions, and those receiving those food distributions spend 70% of the value of those distributions in the above specified allocations, roughly 0.7 jobs will be created directly (direct impact) in the regional economy. In addition, 0.1 jobs will be created to support those jobs (indirect impacts) and 0.1 jobs will be created as the result of the added income of those 0.7 jobs to the local economy (induced impacts). Thus, the total number of jobs created (total effect) by this increase in distribution will be 0.9.

One might note that for nearly all increases in demand and deflations, the jobs created by Neighbors in Need distribution increases are lower than those created by Helping Hands. This is because the total annual distribution value of Helping Hands is larger than Neighbors in Need, hence the increased distribution values as a percent of the annual distribution value are larger and the effects of those increases are also larger.

The relationship between the size of distribution increases and jobs created is roughly linear. In all except the Neighbors in Need -10% quartile (Table 9), we see a relatively level employment effect between 70% and 50% deflation, but a steep decrease in effect between 50% and 30% deflation.

Diminishing Marginal Returns:

Fundamental to economics is the idea of diminishing marginal returns. In many relationships, we observe that the impacts of certain actions taper off the more those actions are repeated.

EXAMPLE: A factory adds a worker, and production increases by 10 units/hour. Seeing this, the owner becomes excited and hires another worker. Output still increases, but by only 8 units/hour. Frustrated, the owner hires another worker on top of the previous; production expands by only 6 units/hour.

In our model, this means that repeatedly increasing distribution will always lead to more job creation in the community, but at a decreasing rate.

Although this may appear to suggest a non-linear relationship, it should be noted that while the distribution-increase at 50% deflation is worth roughly 71.4% of the increase at 70% deflation, that the increase at 30% is only worth 60% of the increase at 50% deflation; in other words, there is more of a drop off in the amount of spending injected into the economy between 50% and 30% deflation than 70% and 50%, so the extra drop off in the employment multiplier is not unexpected. We also observe that doubling the distribution-increase from 5% of the distribution budget to 10% roughly doubles the employment effects in the case of both food banks, suggesting further linearity. We believe that in the long-run (at successively larger distribution values) the employment effect would eventually begin to taper off due to the principle of diminishing marginal returns. So, while the relationship between distribution-increase amount and jobs created may appear linear in our model, we do not expect this to be the case at extensive increases.

One result that stands out is the negative returns to value added in State and local government passenger transit systems (IMPLAN sector 3430). As it turns out, the sector we chose to inject the transportation expenditure allocation into (IMPLAN sector 3336: Transit and ground passenger transportation services) has a *negative* value-added multiplier with sector 430: -0.000137. This suggests that the two sectors, government and privately provided transportation, are substitutes; as individuals consume more of one, they tend to consume less of the other, as we would expect. We chose to inject into sector 3336 instead of 3430 (the commodity version of government provisioned transit) because it follows from the assumptions we made above, and the multiplier on government transport is 1 (meaning it has no effect) for virtually all industries in our model. In other words, government transportation is very cheap for consumers, and so consumers would probably not spend much of their money on it even if they used it a lot. In any event, while government transportation loses some value added, employment and labor income in that sector still increase at all demand levels.

In these simulations, the induced effects of the increase on employment, labor income, and value added are larger than the indirect effects, although not by much. This suggests that there is relatively little exchange between businesses in the county and that many local businesses receive goods and services from outside Skagit as opposed to within. In an increasingly globalized world, this should not be surprising, given that Skagit County is relatively small and does not have the infrastructure to completely supply its own needs. In larger, more heavily developed locations, both indirect and induced effects would be larger, but especially indirect effects. Of course, this should not discourage donations to food banks (or any non-profit) in rural communities, but is offered merely as an explanation.

If we do assume that job creation has a roughly linear relationship with distribution size, we can use our model to provide an estimate of the total jobs each food bank supports presently based on its total

distribution size. Figure 8 displays a scatter plot of effective distribution increase size (5% and 10% at various deflations) and jobs created from each food bank with corresponding trend line; as the food banks are identical in terms of how they affect local economics, that the trend line for Helping Hands is steeper than that of Neighbors in Need is a quirk of modeling methodology. Figure 9 gives the single trend line we will use in our analysis.

Figure 7: Scatter plot of distribution increase size with individual trend lines for each food bank

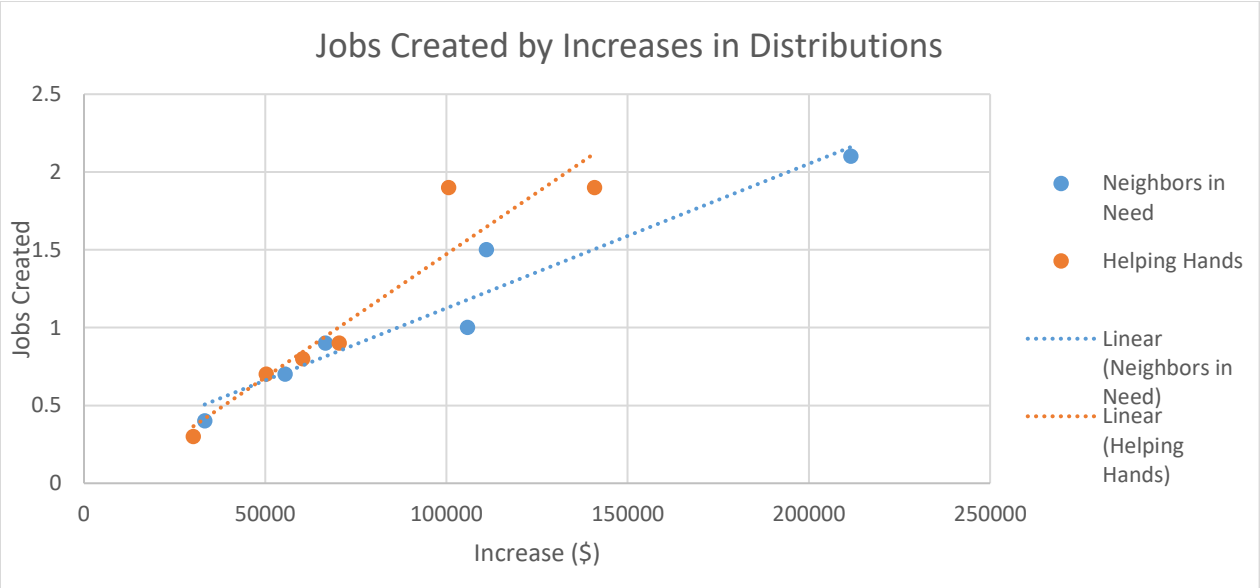
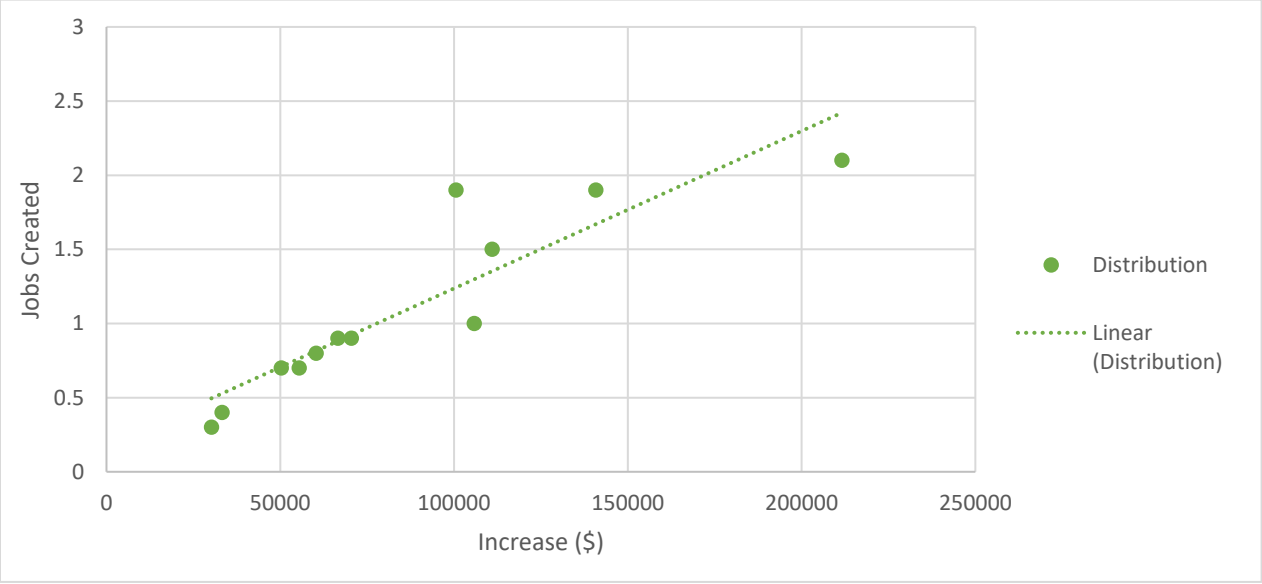


Figure 8: Scatter plot of distribution increase size with single trend line for both food banks



A simple linear regression of this data, expressing jobs created as a function of effective distribution size (total distribution times deflation), returns the following model. Note that we omit the constant term in the regression, assuming that a food bank must distribute food to create any jobs.

Table 10: STATA Output for simple regression of jobs created by distribution size[2]

Linear regression			Number of obs. = 12 F(1, 11) = 115.8 Prob > F = 0 R-squared = 0.9538 Root MSE = 0.27777			
jobs	*Coefficient*	*Std. Err.*	*t*	*P>t*	*[95% Conf. Interval]*	
dist_inc	0.0000121	1.13E-06	10.76	0.000	9.66E-06	1.46E-05

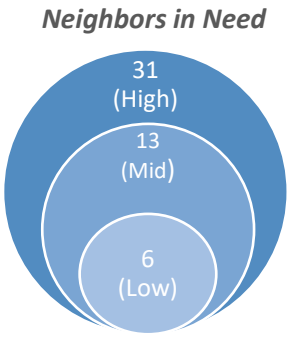
The important piece of information in this model is the coefficient column, as this is our estimate of how many jobs are created per additional dollar of distribution value. Using this inference, Table 11 displays our estimates of the jobs created/supported annually by each of the food banks individually and together. What is more, we can be 95% confident that the true number of jobs created lies within the low to high estimates because of the nature of our regression.

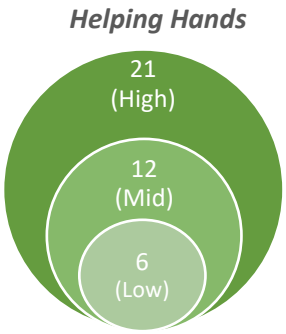
Table 11: Estimated jobs supported annually by the food banks at various deflation levels (Low-High is based on 95% confidence interval of coefficient)

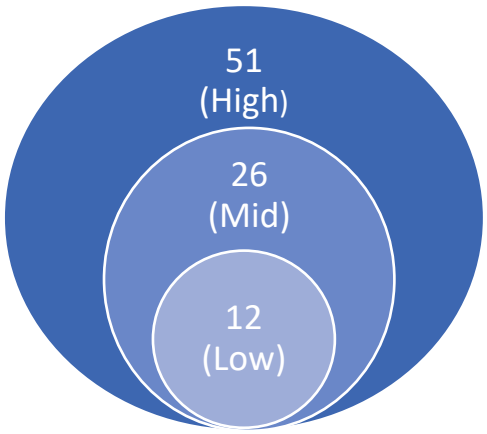
Food Bank	Deflation	Effective Distribution	Low 0.00000966	Mid 0.00001210	High 0.00001460
Helping Hands	100%	$2,011,880	19.43	24.34	29.37
	70%	$1,408,316	13.60	17.04	20.56
	50%	$1,005,940	9.72	12.17	14.69
	30%	$603,564	5.83	7.30	8.81
Neighbors in Need	100%	$2,219,776	21.44	26.86	32.41
	70%	$2,115,828	20.44	25.60	30.89
	50%	$1,109,888	10.72	13.43	16.20
	30%	$665,933	6.43	8.06	9.72
Combined	100%	$4,231,656	40.88	51.20	61.78
	70%	$3,524,144	34.04	42.64	51.45
	50%	$2,115,828	20.44	25.60	30.89
	30%	$1,269,497	12.26	15.36	18.53

There is a wide range of predicted job creation within each food bank and in combination, depending on what is thought to be a realistic deflation level; however, we can safely say that the food banks do make a noteworthy contribution to the local job market. Helping Hands supports somewhere between 6 and 21 jobs, and Neighbors in Need supports between 6 and 31 jobs; together they support at least 12 jobs

[2] STATA is a high-powered data analysis and statistics software made by STATA Corp. and used by the College of Business and Economics at Western Washington University for research and educational purposes. It allows users to input data from sets and create models that can be used for forecasting, estimating causality, and determining relationships between variables.







Jobs sustained by each food bank individually and combined (immediately above).

and as many as 51. Considering the incredibly low price the food banks purchase food at (around 4-10¢/lb.), donating to food banks appears an incredibly effective way to support regional jobs.

We calculate a rough estimate of the rate of return on investment for donating a dollar to a food bank. For instance, we know that Helping Hands distributed around 2.2 million pounds of food to members of Skagit County. 15.4% of that is purchased for 4¢/lb. by Helping Hands, or about 338,800 pounds purchased for $13,552. We can assume purchased food also makes up about 15.4% of the total market value of distributions, or about $309,850. From the above regression, we know that each dollar of distribution value creates at *most*

$$0.146 * 70\%\ deflation = 0.1022$$

jobs, and at *least*

$$0.0966 * 30\%\ deflation = 0.029$$

jobs per $10,000 of food distribution. Therefore, we can estimate that the food purchased by Helping Hands for $13,255 and valued at $309,850 supports between 0.9 jobs and 3.2 jobs, with a mean of 2.05 jobs.

Therefore, the cost per job is simply $\frac{\$13{,}552}{2.05}$ = $6,610 per job (between $15,058 and $4,235 per job for the same interval). A similar calculation using the same methodology for Neighbors in Need returns a cost per job of $3,024 (between $6,936 and $1,933 for the same range). As neither food bank is necessarily more efficient at supporting jobs than the other, the true donation amount per job supported probably lies within that range

The above calculations do not necessarily mean that a donation of $6,610 to Helping Hands will result in a job being created in Skagit County; rather, $6,610 per job merely represents the "efficiency" with which Helping Hands sustains jobs. For comparison: The Outdoor Industry Association estimated that Americans spent about $646 billion dollars on outdoor recreation, supporting 6.1 million jobs in the industry.[3] By the same math, this means that a job in that industry was supported by $105,902. This is comparable to the market value of the

Each food bank exhibits remarkably low "cost per job" numbers via money-donation-based food distribution:

Helping Hands:

$6,610/job

Neighbors in Need:

$3,024/job

This is due to the low price for which food banks purchase food.

[3] Outdoor Industry Association. (2012). *The Outdoor Recreation Economy.* https://outdoorindustry.org/pdf/OIA_OutdoorRecEconomyReport2012.pdf

purchased food distributed per job (around $165,268); but because Helping Hands acquires that food for 4¢/lb., the effect of a donation is massively magnified, and the cost per job shrinks for donated money. We see from Tables 7 and 8 that many of these jobs are likely created in civic and professional organizations (such as city utilities), government sponsored transit, and food retailers.

As detailed in a previous section, the demand on food banks in Skagit County is growing, and their impact on the county will grow with that. In June of 2014, Neighbors in Need served 1,307 families and 12 homeless persons. In June of 2017, they served 2,584 families (a 98% increase) and 179 homeless persons. The expansion of those served far outpaces the growth rate of Skagit County over that time, suggesting that food scarcity is becoming an ever more pressing issue in the region. With this increase in demand comes further opportunity for job creating and community organizing via these food banks.

Additional Questions and Caveats

A good project poses many more questions than it answers. As far as we at CEBR are aware, this is the first major analysis of the economic impacts of a set of food banks anywhere in the United States. Naturally, we had to invent some of the methods of analysis for this report, methods which readers and subsequent studies may find to be flawed; if some of the numbers generated via our methodology seem unexpected, we suggest looking to that methodology for error. There were a number of points we wished to analyze more in depth in this section but were unable to because of the limited size and scope of the study, the available data, and the novelty of the study's subject. These limitations necessitated the creation of several assumptions in order to create this model:

- We assumed that individuals and households receiving distributions from Helping Hands and Neighbors in Need would spend the transfer payment according to the mean spending patterns of the county. A more thorough analysis might include a survey of these community members and **how they allocate income compared to other demographics**, and might supply us with a more accurate picture of the food banks' effects on the community.
- We also assumed that all households receiving food distributions from the food banks would spend the value of the transfer payment in the same way. For instance, we assumed that a household with two adults and two children would allocate this added value in the same way a homeless individual would. It would be interesting to have **information on what happens to that transfer payment depending on who it goes to**. Of course, this is not to advocate distributing food to one demographic over another based on economic impact, but to add further accuracy to our model. That information could even be used to advocate for the economic benefits of offering assistance to certain demographics.
- We assumed a linear relation between job creation and effective distribution increase. Looking at **intertemporal data might allow us to estimate a non-linear relationship**, which may be more accurate.
- One of the most interesting parts of this report is the analysis of the money-donation per job supported math. The numbers we saw were incredibly low, and suggest that food banks may be remarkably efficient at supporting jobs in their communities. However, the calculations performed were approximate and intended as a rough estimate. A **more rigorous method for calculating donations per job supported** is certainly called for to investigate that relationship further.
- We were only able to analyze the jobs supported in the community by food banks; it would be equally interesting to investigate the **job-creating power of food banks**. We know they support 20-50 jobs at around $4,000 of donation/job; how many new jobs could they potentially support and at what cost?
- In our modeling, we made the assumption that families and individuals utilizing food banks were not also using food stamps or other similar food assistance programs. While this assumption most likely did not skew our results significantly, it is worth further investigation. The effects of food stamps on purchasing power has been researched to some extent, but, to our knowledge, no one has yet done a combined or comparative study on purchasing power effects of consumers who use both food banks and food stamps. Would families or individuals who used both spend their increased funds in different areas from those who just use one of the programs?

Each of the above points could easily be their own study, and are all worth further inquiry. The current lack of research on food banks and the findings of this report speak volumes to the sheer number of questions that remain to be answered. For communities such as Skagit County, where food banks are playing increasingly important roles in supplying food to residents, understanding the true impacts of that growth is of the utmost importance.

Appendix

Table 12: Simulated increases in commodity demand by sector, for Indirect and Induced impacts modeling, Neighbors in Need

Allocation	Percent of expenditure	Total Distributions	5% Increase	70% Deflation	50% Deflation	30% Deflation	10% Increase	70% Deflation	50% Deflation	30% Deflation
Total	100	2,219,776	110,989	105,791	55,494	33,297	221,978	211,583	110,989	66,593
Shelter	23.4	519,428	25,971	18,180	12,986	7,791	51,943	36,360	25,971	15,583
Utilities, Fuel, and Public Services	7.5	166,483	8,324	5,827	4,162	2,497	16,648	11,654	8,324	4,994
Housing Operations, Supplies, Furnishing	6.4	142,066	7,103	4,972	3,552	2,131	14,207	9,945	7,103	4,262
Transportation	12.4	275,252	13,763	9,634	6,881	4,129	27,525	19,268	13,763	8,258
Health Care	8	177,582	8,879	6,215	4,440	2,664	17,758	12,431	8,879	5,327
Travel	2.7	59,934	2,997	2,098	1,498	899	5,993	4,195	2,997	1,798
Food at Home	7.6	168,703	8,435	5,905	4,218	2,531	16,870	11,809	8,435	5,061
Food Away from Home	4.7	104,329	5,216	3,652	2,608	1,565	10,433	7,303	5,216	3,130
Entertainment/Recreation	4.4	97,670	4,884	3,418	2,442	1,465	9,767	6,837	4,884	2,930
Education	2.1	46,615	2,331	1,632	1,165	699	4,662	3,263	2,331	1,398
Personal Care Products and Services	1.1	24,418	1,221	855	610	366	2,442	1,709	1,221	733
Apparel and services	3	66,593	3,330	2,331	1,665	999	6,659	4,662	3,330	1,998

Table 13: Simulated increases in commodity demand by sector, for Indirect and Induced impacts modeling, Helping Hands

Allocation	Percent of expenditure	Total Distributions	5% Increase	70% Deflation	50% Deflation	30% Deflation	10% Increase	70% Deflation	50% Deflation	30% Deflation
Total	100	2,011,880	100,594	70,415	50,297	30,178	201,188	140,831	100,594	60,356
Housing	30.9	621,670	31,083	21,758	15,541	9,325	62,167	43,516	31,083	18,650
Shelter	23.4	470,779	23,539	16,477	11,769	7,061	47,077	32,954	23,539	14,123
Utilities, Fuel, and Public Services	7.5	150,891	7,544	5,281	3,772	2,263	15,089	10,562	7,544	4,526
Housing Operations, Supplies, Furnishing	6.4	128,760	6,438	4,506	3,219	1,931	12,876	9,013	6,438	3,862
Transportation	12.4	249,473	12,473	8,731	6,236	3,742	24,947	17,463	12,473	7,484
Health Care	8	160,950	8,047	5,633	4,023	2,414	16,095	11,266	8,047	4,828
Travel	2.7	54,320	2,716	1,901	1,358	814	5,432	3,802	2,716	1,629
Food	12.2	245,449	12,272	8,590	6,136	3,681	24,544	17,181	12,272	7,363
Food at Home	7.6	152,902	7,645	5,351	3,822	2,293	15,290	10,703	7,645	4,587
Food Away from Home	4.7	94,558	4,727	3,309	2,363	1,418	9,455	6,619	4,727	2,836
Entertainment/Recreation	4.4	88,522	4,426	3,098	2,213	1,327	8,852	6,196	4,426	2,655
Education	2.1	42,249	2,112	1,478	1,056	6334	4,224	2,957	2,112	1,267
Personal Care Products and Services	1.1	22,130	1,106	774	553	3396	2,213	1,549	1,106	66
Apparel and Services	3	60,356	3,017	2,112	1,508	905	6,035	4,224	3,017	1,810

ECONOMETRIC ANALYSIS OF THE IMPACTS OF FOOD BANKS
PART II

March 21, 2018

Prepared for:
Helping Hands Food Bank
&
Neighbors in Need Food Bank

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Contents

Econometric Techniques and Methodology

In this section, we will use ordinary least squares (OLS) regression techniques to determine the effects of food bank presence within a community. Regression analysis, such as OLS, attempts to explain the variation in one variable by studying the correlations of those variations with variations in other variables. The "line of best fit" technique is a version of OLS, one that expresses a given dependent (Y) variable as a simple linear function of a single independent (X) variable:

$$y = b + mx$$

In this case, the effect of X on Y is given by *m*, which is simply a constant number representing the slope of a linear equation. If *m* is greater than zero, X has a positive effect on Y; if *m* is less than zero, X has a negative effect on Y. *b* represents the vertical intercept of Y; when X = 0, then Y = b. Since this is a line of best fit, the data points may or may not lie directly on the line. This equation is simply our best prediction of what Y will be if we observe a given X. In other words, OLS allows us to estimate the effects of one variable on another. The goal of a linear regression is to try to find out what number *m* is. To find *m*, we collect data on what values Y takes on and what values X takes on, and try to find on average how much Y changes when X increases by on unit. That average change is *m*; the slope which represents *the effect of X on Y*. That is, if X increases by one, Y increases by $m \times the\ change\ in\ X = m \times 1 = m$.

EXAMPLE: Say we collect data and find that *m* = 2. This means that when X increases by 1, Y increases by $m \times change\ in\ x = 2 \times 1 = 2$ Similarly, say we find that *m* = -1.3. This means that when X increases by 1, Y *decreases* by 1.3 (because *m* = -1.3 is negative)

Out study will express the dependent variable, crime, as a function of many independent variables. The equation will look similar to the following form:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \cdots \beta_n x_n$$

Where β_0 is a more formal way of representing b, the vertical intercept from above, and where $\beta_1\ through\ \beta_n$ is a generalized version of *m*, also known as a *coefficient*. Each x_i is a different variable; for instance, x_1 could be the median income in a given county; x_2 could be the unemployment rate; and so on until x_n. The variable we are most interested in is the number of food banks per county.

When conducting OLS with many variables, we typically write each coefficient (*m)* as β_i where *i* is an index number (1, 2, 3… n). This is because some linear regressions have more than 26 variables, and hence run out of letters to denote coefficients. β_0 is the vertical intercept.

Two pieces of information will be of interest to us when viewing the results. The first being the *sign of the coefficient* value (β_i) and the second being the *statistical significance* of that coefficient value.

It is important to note that in order to have unbiased results an analyst must not expect correlation between variables or choose data to support an intuition. However, it is appropriate to hypothesize the expected sign of the coefficient value β_i for a given variable. That is, whether β_i is greater than or less than zero, has a positive or negative relationship with the dependent

variable. For instance, it is reasonable to assume that unemployment could increases the crime rate in a given locale because loss of income could push individuals to extreme measures in order to find shelter, get food, etc., which could include breaking the law. We would therefore hypothesize that the coefficient on the unemployment variable would be positive if crime were the dependent variable; if unemployment increases, so does crime. If a given β_i has an unexpected sign, it's a good indicator that something else is wrong with the regression, such as the omission of a variable that should be in the regression or endogeneity.

Statistical significance of a coefficient value measure whether the correlation between the independent and dependent variables is really any different from zero, and is measured as the probability of a given coefficient actually being equal to zero. It will be important to look at the statistical significance of our results to determine if given variables do or do not actually affect the dependent variable, crime.

Statistical significance is the probability that a given coefficient is not 0. For instance, a significance of P = 0.1 means that there is a 10% chance that the coefficient in question is 0 (90% chance that it is not 0). In statistics, we typically look for 95% confidence in a result not being 0 (P = 0.05 or less) before we assert causality. This corresponds to the P > t column in the following regression tables.

To conduct our OLS analysis of food banks on local variables of interest, we will use STATA, a high-powered data analysis and statistics software made by STATA Corp. and used by the College of Business and Economics at Western Washington University for research and educational purposes. It allows users to input data from sets and create models that can be used for forecasting, estimating causality, and determining relationships between variables.

How to Read STATA Output:

Linear regression is essentially a set of techniques to identify the effects of some variables (independent) on another variable (dependent) by looking at the correlations between them. However, it is not necessary to understand all the math behind these techniques to be able to interpret the results. In this section, we will display the estimates of the regressions from STATA, reformatted to make them easier to read. Below is an example of STATA's reformatted output, with explanations of each part.

The type of regression. In this section there will be one logistic model and two linear regressions.

The number of standard errors the coefficient is from 0.

Probability that the entire model is invalid. Prob > F = 0.000 means there is a 0% chance that model is invalid.

Mean Sum of Errors, a measure of the accuracy of the model; better models have less error, and lower root MSE's.

Average error of coefficient in predicting an observation. Used to measure how "accurate" the coefficient is

F-statistic, used to determine if all coefficients are 0.

How many observations are in the data set

Linear Regression

Number of Observations = 2000
F (3, 2000) = 438
Prob > F = 0.000
Root MSE = 14

DEP_var	*Coefficient*	*Stand. Err.*	*t-score*	*P > t*	*95% Confidence Interval*	
Var_1	-1.25	.1	-12.50	0.000	-1.446	-0.992
Var_2	3.5	2.5	1.40	0.162	-2.946	9.946
Var_3	.075	.0009	83.33	0.000	0.073	0.077
Var_4	-.0002	.2	0.1	0.920	-0.329	0.392

Row labels for each variable. Dependent is column header.

The most important part of the regression, a positive (negative) coefficient measures how many units the dependent variable will increase (decrease) by if the given independent variable increases by one. Both sign and size are important.

P > t signifies the probability that a given coefficient is 0; is this number is greater than 0.05, then we can't be sure that a given variable actually has an effect on the dependent

A confidence interval is a range of values a given coefficient could likely take on; we can be 95% confident the true coefficient is between these two values.

The most important parts of the regression output to understand are the coefficient and "*P > t*" columns of this table. The coefficient determines the nature and size of the effect of an independent variable on the dependent; the probability of that coefficient not being zero (i.e., the probability of that variable not really affecting the dependent) is given by "*P > t*".

Econometric Model of Crime

In this model, we establish a preliminary idea of the effect of food banks with respect to the surrounding county in Washington State in terms of crime. This study is not exhaustive but instead is intended as a prospective investigation of what could be a much larger study; not only allowing for more independent variables but broadening the scale from Washington State counties to a nationwide analysis. We are only looking for the evidence suggesting the presence of a trend, not the precise measure of the effect of a food bank on crime. Therefore, we expect some omitted variable bias. Upon further analysis, the hope is that the bias can be corrected.

The functional form of the model looks similar to the following:

$$CRIME = \beta_0 + \beta_1 * Median\ Income + \beta_2 * Unemployment + \beta_3 * FB + \beta_4 * Median\ Age + \cdots$$

Crime will be the dependent variable, expressed as crime per 100,000 people. Crime values will be predicted based on the values of the independent variables. Number of Food Banks per county per 100,000 people (FB) will be one of the independent variables. It is important to note that the data is not parameterized by time in years, rather by counties in Washington State. This choice was made because the time periods for when data are published are not similar (i.e. Agricultural data per county is published every five years, with a two year lag. Whereas Cost of Living data is published three times a year, with a one year lag, and only as MSA data.[1]) We predict that a food bank will decrease crime in a community by supplying additional resources to those in need of assistance in that community via food distributions; therefore we expect a negative coefficient on FB.

Below *Table 1* shows the variables included in the model, as well as the units, and expected signs.

Table 1: Variables for Crime model, names, units, expected signs.[2]

Variable	Variable Name	Units	Expected Sign
Crime	crimpop	Total crimes reported per 100,000 people	N/A (Dependent)
Median Income	INC_med	Median Income level in a given county	-
Unemployment Rate	UE5_9	The average unemployment rate per county for 2005-2009	+
Number of Food Banks[3]	FB	Number of food banks per county per 100,000 people	_
Median Age	AGE_med	Median age per county	-

[1] MSA data stands for *Metropolitan Statistical Areas*. As stated by the United States Census Bureau: Metropolitan statistical areas serve to group counties and cities into specific geographic areas for the purposes of a population census and the compilation of related statistical data.

[2] All data are from the following source unless stated otherwise: United States Census Bureau, USA Counties Data Files

[3] The number of food banks per county was collected from *2nd Harvest Food Bank* and *Food Life Line*.

Level of Education	BACH_per	Percent level of education attained to, and beyond, a bachelor's degree per capita	-
Gender	FEM_per	Percentage of female population per county	n/a
Ethnicity Variables: **% Black** **% White** **% Hispanic/Latino** **% Asian** **% Veteran**	 BLACK_per WHITE_per HIS_per ASIAN_per VET_per	% of population identifying in each category	n/a
Access to Capital	banks_per	Number of savings/loans institution per 100,000 people	-
Net Migration	mig_per	Net number of people migrating to a given county per capita	+
Population Level	POP	Population level per county in 2008	+

Median income level was included in place of the poverty rate per county variable because poverty and crime are interdependent variables. It is difficult to determine which variable occurs first and causes the other to occur: poverty causing crime, and crime causing poverty. In econometrics this problem is known as a *simultaneous equation*, or *endogeneity*. Endogeneity tends to bias coefficients, leading to unexpected or inexplicable results. Therefore, in order to avoid this we substituted the poverty variable with median income levels. A common correction for endogeneity is to create an *instrument variable*. The instrumental variable technique, known as *Instrumental Least Squares*, finds a variable that causes change in the endogenous variable in question (poverty) but does not cause change in the overall dependent variable (crime). Then the endogenous variable is expressed as a regression function of the instrumental variable and every other variable in the original regression. This newly created regression function is then substituted into the original regression function in place of the endogenous variable. Further research and investigation of

Endogeneity/Simultaneous Equations:

Endogeneity occurs when two variables (such as crime and poverty) cause each other. Suppose:

$$\boldsymbol{CRIME} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1 POVERTY}$$
$$\boldsymbol{POVERTY} = \gamma_0 + \gamma_1 CRIME$$

where β_1 and γ_1 are positive coefficients. If we increase poverty by one unit, then crime increases by $\beta_1 * 1 = \beta_1$. Then, in the second equation, crime also increases by β_1, causesing poverty to increase by $\gamma_1 * \beta_1$. This causes crime to increase again in the first equation, prompting poverty to increase yet again, and so on in a feedback loop. In the real world, this sort of effect dissipates with each iteration, but because this model is theoretical and linear, it goes on and on like this, causing over estimates of the coefficient we are interest in, β_1. If all we do is estimate the first equation, we observe poverty go up a little bit and see crime skyrocket because of this feedback loop. Thus, overestimating β_1 and concluding with biased results.

this endogeneity issue is possible but not addressed in this analysis.

Another incidence of endogeneity is possible in this model when considering the food bank variable. The question arises, "Do food banks open in a community because crime is high, or does crime increase when food banks begin services?" The thought behind this is that when crime is high the poverty level is also high which means there is a need for resource assistance, e.g. food banks, low income housing, etc. However, it is difficult to refute the argument that food banks act as a locus for crime, by drawing in those already predisposed to committing crimes. Again, further research and investigation of this endogeneity issue is possible but not addressed in this analysis.

Instrumental Least Squares:

A common solution for endogeneity is the process of instrumental least squares. Here we do **two separate regressions**.
First we find some variable, such as disability rates, that predicts the independent variable in question (poverty) without predicting the dependent variable (crime). We then conduct a regression like this:

$$\boldsymbol{POVERTY} = \alpha_0 + \alpha_1 DISABILITY$$

Then we take the disability observations and multiply them by α_1 to obtain estimates of the poverty rate, $\widehat{POVERTY}$ (pronounced "poverty hat"). Since these estimates no longer have crime as an independent variable within them, there is no longer an endogeneity problem. We can now use the $\widehat{POVERTY}$ estimates in place of the actual $\boldsymbol{POVERTY}$ observations in the original model, which should now be unbiased:

$$CRIME = \beta_0 + \beta_1 \widehat{POVERTY}$$

Table 2 gives the STATA output results of the regression model, expressing crime as a function of median income, unemployment rate, number of food banks, demographics, and the other predicting variables mentioned in table 1.

Table 2: STATA Output for Crime Model
(Crime as a function of number of food banks and other variables)

Linear regression				**Number of obs = 39** **F(14, 24) = 3.82** **Prob > F = 0.0019** **R-squared = 0.6905** **Adj R-squared = 0.5099** **Root MSE = 1589.9**		
crimpop	*Coef.*	*Std. Err.*	*t*	*P>t*	*95% Conf. Interval*	
INC_med	-.0107232	.069364	-0.15	0.878	-.153883	.132437
UE5_9	7.221435	1.908264	3.78	0.001	3.282971	11.1599
FB	-105.4292	46.26931	-2.28	0.032	-200.924	-9.93401

AGE_med	-279.9865	131.5653	-2.13	0.044	-551.5238	-8.449139
BACH_per	-36.81969	60.60604	-0.61	0.549	-161.9044	88.26503
FEM_per	671.8733	494.3802	1.36	0.187	-348.4773	1692.224
BLACK_per	111.8874	429.9123	0.26	0.797	-775.408	999.1828
WHITE_per	289.2799	122.4479	2.36	0.027	36.55984	542
HIS_per	54.29864	40.18396	1.35	0.189	-28.63697	137.2343
ASIAN_per	-33.22061	349.7167	-0.09	0.925	-755.0003	688.5592
VET_per	60846.67	30127.52	2.02	0.055	-1333.475	123026.8
banks_per	1.995673	.8766126	2.28	0.032	.186434	3.804913
mig_per	5712.037	6589.941	0.87	0.395	-7888.932	19313.01
POP	.0036722	.0022987	1.60	0.123	-.0010721	.0084166
_cons	-56361.75	25709.14	-2.19	0.038	-109422.8	-3300.69

Analysis of Crime Model

After considering the resulting signs of the coefficients (the second column) we see that the FB variable does in fact carry a negative coefficient as predicted in table 1. The results suggest that there is a negative correlation between the number of food banks and crime per county per 100,000 people in a given county. We cannot yet say that a one unit increase in the number of food banks per 100,000 people leads to a decrease of 105.423 units of crime per 100,000 people because, as mentioned before, this study is not exhaustive but instead is intended as a prospective investigation of what could be a much larger study.

Furthermore, results continue to suggest that there is strong evidence supporting the negative relationship between crime and the number of food banks per county per 100,000 people because of the statistically significant FB variable coefficient (P = 0.032). There is as a 96.8% chance that the number of food banks in a county is statistically significant in predicting crime.

Our intent was to investigate whether the data would suggest a negative or positive relationship between crime and the number of food banks. There are statistical specifications that can be done to improve upon this model, such as updating and collecting more recent data for all of the independent variables, trying other functional forms besides a linear regression, attempting to find an instrument variable for food banks in order to correct for endogeneity, adding or dropping certain independent variables, or expanding the data to nationwide observations.

What is clear from this research is that food banks have a negative relationship with crime and with further investigation there is potential to show that food bank operations result in less crime which can

potentially lower costs for law enforcement activities – from patrol, enforcement, arrests, court, and incarceration costs. Given the significant costs associated with each of these potential impacts the cost savings to a community are likely to be substantial.

Areas for Further Study

Given the findings in this study it is likely that further research related to health care, social services and other types of government assistance based programs are also positively impacted. A community could identify programs they fund to have these types of analyses conducted to understand the potential impacts.