

# **Building Erie by Buying Erie: An Import Substitution Strategy for Erie County**

for the  
**Economic Development Corporation of Erie County**



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“There are essentially only two ways that an economy can grow. Either it can increase its production for the outside world or it can produce for itself what it otherwise would buy from the outside.... The first of these is an expansion of exports. The second is import substitution.”

-Persky et al (1993, p. 18)

## I. INTRODUCTION

How can a region like Erie grow and develop? More jobs and more income would be welcome in a region which has a per capita income level that is 15%-20% below the national average and an unemployment rate that is usually about a four-tenths of a percentage point above the nation's.<sup>1</sup>

A standard approach to economic development has been to try to sell more locally-produced goods and services outside the area, to expand our markets by finding new external customers. That brings money into the area and increases the size of the local economy. This approach views local firms that bring money into the area as the “export base” of the local economy, and naturally focuses on trying to increase local exports as the means to grow the local economy.

But another approach is possible, one that is often overlooked. It starts with the realization that local residents buy many things from sellers outside the area and that if these local customers could be redirected to buy from local firms, they would provide new markets for those local firms just as effectively as new customers elsewhere. We could substitute local production for what was formerly imported—an *import substitution* strategy. Purchases by local residents from firms located outside the area can be considered leakages out of the local economy, money that flows out rather than staying here to generate more jobs and income from responding. An import substitution strategy seeks to plug some of those leaks.

This is a report on a possible import substitution strategy for the Erie area.

An import substitution strategy can take many forms. Some groups around the country simply run advertising campaigns that seek to make area residents aware of the wide variety of goods and services that local firms produce, and encourage them to “buy local” instead of from suppliers outside the area. Local First Chicago or the Think Local Program in Bellingham Washington are examples.<sup>2</sup> Sometimes it

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<sup>1</sup>In 2010, Erie's income per capita was \$33,465 and the U.S.'s was \$39,945; Erie's income was 16% below the national level. (U.S. Bureau of Economic Analysis, Regional Economic Accounts). Between January 1990 and September 2011, Erie's average unemployment rate was 6.34% compared with the U.S. average of 5.95%. (U.S. Bureau of Labor Statistics.)

<sup>2</sup>More information can be found at: [http://www.localfirstchicago.org/pages/about\\_us/10.php](http://www.localfirstchicago.org/pages/about_us/10.php) for Chicago and <http://sustainableconnections.org/thinklocal> for Bellingham. The Business Alliance for Living Local Economies (BALLE) also has a

takes the form of a local currency such as Ithaca Hours in New York or BerkShares in Massachusetts, or time exchanges in which local residents barter their services with each other.<sup>3</sup> And sometimes it is Community Supported Agriculture in which local residents provide support for local farmers<sup>4</sup>, or programs which encourage local supermarkets to develop supply sources from local farmers.

Import substitution does not apply only to physical products. Several researchers have pointed out that it can occur in the area of services, too. Gillis (1987), Cobb and Weinberg (1993), Blackwell, Cobb and Weinberg (2002), and Cobb and Olberding (2007) show that import substitution can apply to such things as a steamboat festival, a boat and travel show, a marathon, and a university. All of these can keep local money local, if they attract resident spending that would otherwise have left the area.

Some import substitution programs focus on the business side rather than the consumer side. A program in Oregon focused on the business supply chain approach by trying to connect local businesses with each other—to help local firms find local suppliers to replace input purchases from outside their local area. It started as the Oregon Marketplace and has grown to become the Northwest Connector, which is:

“an on-line database that contains detailed profiles of Pacific Northwest companies across all industries at every level of the supply chain. The purpose of the tool is to link Oregon businesses to opportunities around the region via a robust, searchable, online “buyer-supplier” database.” (Business Oregon, 2011)<sup>5</sup>

Omaha does something similar in its “Say Yes, Buy O!” campaign and its “Buy the Big O!” annual convention, which attracted approximately 5,000 attendees and over 300 businesses in 2011.<sup>6</sup> And the Greater Des Moines Partnership has a “Buy Into the Circle” campaign which encourages local firms to shift 5% of their purchases to other Des Moines firms.<sup>7</sup> They provide on-line tools for finding local suppliers, and claim that nearly \$90 million of purchases have been brought back to the local area since the inception of the campaign.

These business-to-business programs typically try to help local firms find local suppliers. But it is possible to go further still, recognizing that no local area produces everything, and that there are bound to be local input demands for which there are currently no suppliers. This means that there are opportunities for existing firms to consider expanding their range of operations into new product lines, to meet those local demands for imports which are currently pulling money out of the local economy. If local leaders can identify gaps in the local economy, they can also point out profit opportunities for existing firms. Perhaps this approach can even be married to an incubation strategy which encourages new startups in the local area, such as the Economic Gardening program of Littleton, Colorado.<sup>8</sup>

This report will identify import substitution opportunities for existing or new businesses in the Erie area, to produce for local demand both from consumers and from businesses. We take a different approach from that typically seen in practice thus far, attempting to identify likely import substitution possibilities both from consumer demands and from current Erie businesses, and do this using existing data.

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significant focus on “buying local” although it weds that idea to a broader social agenda. More information on BALLE is at: <http://www.livingeconomies.org/aboutus>.

<sup>3</sup>More information on local currencies can be found at the New Economics Institute, <http://neweconomicsinstitute.org/content/local-currencies>. More on Ithaca Hours is at <http://www.ithacahours.org/> and Berkshares is at: <http://www.berkshares.org/>. It should be mentioned that local currencies and barter approaches have serious weaknesses, along with their strengths.

<sup>4</sup>More information on CSA is available from the U.S. Department of Agriculture at: <http://www.nal.usda.gov/afsic/pubs/csa/csa.shtml>.

<sup>5</sup>More information on Oregon’s program is at: <http://www.oregon4biz.com/Grow-Your-Business/Business-services/Find-Oregon-Suppliers/>.

<sup>6</sup>More information on Omaha’s campaign is at <http://omahachamber.org/chamber/yes.aspx>, and on their annual business-to-business convention is at <http://omahachamber.org/news/NewsDetail.aspx?StoryID=17485>.

<sup>7</sup>More information is available at <http://www.buyintotheircle.com/>.

<sup>8</sup>A description and history of Littleton’s Economic Gardening program by Chris Gibbons, one of its founders, is available at: <http://www.littletongov.org/bia/economicgardening/>.

## II. WHY IS THIS STUDY NECESSARY?

Why should organizations like the Economic Development Corporation consider policies to target selected industries for Erie County? After all, it is logical to expect firms in a market economy to choose their locations based on principles of profit maximization and not need outside intervention in pursuing their own best interests. In a free market economy, if customers are not being served in one area we would expect demand there to be high relative to supply, leading to higher prices and thus higher profits there. The invisible hand of the market will thus signal entrepreneurs that *here* is a good place to start or expand a business, and resources will be willingly reallocated from other areas and other uses.

Similarly, if firms in one area, like Erie, are not being served by local suppliers and instead have to buy inputs from outside the area, incurring higher transportation costs in the process, we might expect entrepreneurs to notice this opportunity for profit. We might expect some entrepreneur to step into this gap and open a company to supply the Erie firms at a lower cost (since there could be transportation savings) and at the same time offer quicker delivery.

But in order for this to happen, entrepreneurs have to be aware of the opportunity. Given that there are a very large number of firms (over 20,000 in Erie County in 2009<sup>9</sup>) buying a very large variety of inputs, it is possible that some profit-making opportunities may go unnoticed. It takes knowledge of the kinds of data that are available, and more than a bit of effort (and cost), to ferret out these opportunities. In a smaller economy, it is entirely possible for some of these opportunities to not come to the attention of those who might do something about it. This is a problem of information--more precisely, a *lack* of information--and this can cause what economists call "market failure," a situation where the free market gives a wrong answer or misses an opportunity. The market process usually does a pretty good job, but it works best when information is freely available. Small investors, and investors in places where there is not a lot of venture capital freely available, may especially benefit from information of this type.

This report seeks to supply information that may have gone unnoticed, in the hopes of pointing out new opportunities for entrepreneurs. If entrepreneurs DO act on this information and open successful new businesses in the local area, there will be a range of benefits to the local area. The entrepreneurs themselves will benefit from the profits that will result, certainly. The local firms that buy from the new businesses should benefit from having suppliers located nearer their operations, which can provide more flexibility and quicker service, and can also result in lower transportation costs.

But the local area will also benefit more broadly through the creation of new jobs for local workers, helping increase employment. As workers at these new jobs spend their earnings they will create demand for the goods and services of other local businesses, helping provide new profits for them and generating new business for their suppliers. We may expect a multiplied effect on the local economy.

But for any firm to be profitable, it must have enough business to pass some minimum threshold. Different industries have different minimum sizes, different scales of operation. In each industry there is a minimum efficient scale (MES) at which the firm realizes the benefits of large scale operations in the form of lower average costs of production. In some industries the MES is very small, and firms can be profitable at a relatively small size; examples would include pizza shops, beauty salons, and car repair garages. In these cases the industry will be made up of a large number of small firms. But in other industries, the MES requires a larger scale of operation before the firm reaches the lowest cost per unit, industries such as automobile assembly, cigarette production, or refrigerator manufacturing. In these cases there are a rather small number of large firms in the industry.

As an industry grows in a region, new opportunities may open up for firms that supply inputs to the growing industry. As industry X grows locally, it may reach the scale at which it buys enough inputs to finally make it profitable for a supplier to open up in the area, catering to the needs of those local firms. The local firms in industry X will already have established supply links with firms outside the area, and a

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<sup>9</sup> According to the Census Bureau, in 2009 there were 6,552 establishments with employees in Erie County, and 13,850 nonemployer establishments which are typically small family-run businesses.

new supplier will have to sell existing firms on the idea of switching to a new and unfamiliar supplier. But if industry X has grown large enough for a local supplier to reach its efficient scale and sell at low average cost, it should be able to compete effectively with suppliers outside the area since it can offer quicker delivery and lower transportation costs. Local firms can buy from the new local suppliers, substituting their products for inputs they were previously importing from more distant suppliers outside the area. This would be one form of import substitution

New local supply firms can save on transportation costs over firms located at some distance, and this is a true economy for the firms involved and for the economy overall. This means greater efficiency generally, with society getting more output from the same quantity of inputs. But the profitability of these firms depends on the amount of transportation costs. It is clear that inputs that cost the most to transport are the ones that would be likely candidates for this import substitution strategy.

So HAS enough growth occurred in the area to warrant the opening of new suppliers, perhaps unnoticed by entrepreneurs? Might there be opportunities for profitable new firms to open locally, to supply inputs to other local firms which had previously been brought in from outside the area? If such opportunities exist unnoticed, it would be possible to help grow the local economy through this import substitution strategy.

Answering these questions is the goal of this study.

### III. IDENTIFYING IMPORT SUBSTITUTION POSSIBILITIES

Import substitution is not a new idea. It has been a standard strategy on the international economic development stage for many years,<sup>10</sup> although it has been less widely used at the local or regional level. In his seminal work on urban economics, Thompson (1968, 16) mentions that a region will replace imports with local production as it grows. Jane Jacobs called it “adding new work to old” (1969, 59). But more than two decades later, Persky et al noted that “The theoretical case for emphasizing import substitution is strong. Unfortunately, there has been little discussion of how best to move from theory to actual programs of import substitution at the local level.” (1993, p. 18)

So how DO we identify good candidates for import substitution in the local economy? One approach would be to find industries that are under-represented in the local area. If it is typical for industry X to represent 8% of most local economies, but it only represents 5% of this specific local economy, then it is logical to think that the local area may be importing some of that good. This approach makes the basic assumption that local consumption patterns for the good are also typical; low production locally could simply result from local consumers wanting less of the good, after all. In other words, we might expect less than average representation of snow-clearing firms in Orlando, and less than average pool cleaning services in Minneapolis.<sup>11</sup>

This approach typically relies on comparison of each industry's share of local activity (based on measures such as production, employment, sales, or income) with that industry's share nationally. The ratio of these two is called a *location quotient* (LQ).

$$\text{Location Quotient in industry } i = \frac{\text{local percent of total activity in industry } i}{\text{national percent of total activity in industry } i}$$

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<sup>10</sup> Bruton (1998) and Kwon (2010) provide an overview of the history of import substitution at the international level and its battle with an export-based approach.

<sup>11</sup> The use of location quotients to identify exports actually involves four assumptions: 1) consumption patterns are identical between the local area and the nation; 2) labor productivity is also constant across regions, otherwise increased purchases locally might simply signify that local firms are less productive and take more inputs than other areas to make the same amount of output; 3) local demands are met first by local production, so there is no cross-hauling from other areas; and 4) the good involved is homogeneous/identical across regions so there is no need to import what can be produced locally. (Persky et al (1993) 22.)

A location quotient greater than 1.0 implies that the local area is producing more of this good or service than is required for local consumption, and is probably exporting the good outside the region. And an LQ less than one implies that the area isn't producing enough for local consumption and is importing some of the good to satisfy local demands. (The terms "import" and "export" will be used in this report to refer to purchases or sales outside the region, not necessarily international transactions—although those are included, too.)

Persky et al (1993) took this approach to import substitution in the Chicago area. They reasoned that industries that are good candidates for an import substitution strategy should have LQs less than 0.9, and have had growth both in employment and LQ in the preceding period. They thought that this should help rule out industries that are fundamentally unsuited to the area. For example, if the area is importing oil, it makes no sense to target the petroleum industry for import substitution if the area has no naturally-occurring petroleum resources. And they interpreted an increasing LQ as an indicator that there is already some import substitution occurring. They also required the industries to be large enough to make a difference. In their case, the industry had to have at least 1,000 employees in 1986.

The location quotient approach is a good first step at identifying import substitution possibilities, and we will apply that to the Erie data in this report. But first, we need to discuss the data involved.

## IV. DATA

A study of import substitution requires a data base with consistent industry detail for the local area, in our case, Erie County. This seems like a simple issue until you realize that there are over 3,000 counties in the U.S. and over 1,000 industry categories (at the six-digit NAICS level). Not many data bases have that kind of detail.

One widely used source is the U.S. Census Bureau's *County Business Patterns* database, (hereafter known as CBP) which has been described as providing "...the most industrially detailed employment data publicly available for all states and counties of the United States." (Isserman and Westervelt, 2006, p. 313) In fact, the Census Bureau says that its CBP "provides the only source of annual, complete, and consistent county-level data for U.S. employer business establishments, with industry detail." (U.S. Census Bureau, 2011A.)

The CBP program includes data on employment and payroll for the first quarter of the year,<sup>12</sup> annual payroll, and number of establishments by size category of employment. It includes all full- and part-time employees, but excludes proprietors and partners of unincorporated businesses. (U.S. Census Bureau, 2011A.)

The CBP data are gathered primarily from administrative records rather than surveys. The CBP program "draws on administrative records of the Internal Revenue Service, the Social Security Administration, and the Bureau of Labor Statistics, giving them a higher degree of reliability than voluntary, unchecked responses to census questions." (Isserman and Westervelt, 2006, p. 313) It is also available on an annual basis with a lag of "only" about 18 months, which is relatively quick given the amount of data involved—over 2 million records (industries) in over 3,000 counties annually. (Isserman and Westervelt, 2006, p. 313)

While CBP has good coverage of economic activity down to the 6-digit NAICS<sup>13</sup> level, it does not include all industrial sectors. "County Business Patterns covers all NAICS industries **except** crop and animal production (NAICS 111,112), rail transportation (NAICS 482), Postal Service (NAICS 491), pension, health, welfare, and vacation funds (NAICS 525110, 525120, 525190), trusts, estates, and agency

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<sup>12</sup>Technically, for the week including March 12. (U.S. Census Bureau, 2011A.)

<sup>13</sup>NAICS (pronounced "nakes") stands for North American Industry Classification System, the government's accepted way of classifying industries. The larger the number of digits in the industry code, the greater the level of industrial detail or disaggregation. More info can be found at U.S. Census Bureau (2011D): <http://www.census.gov/eos/www/naics/> and in Appendix A.

accounts (NAICS 525920), private households (NAICS 814), and public administration (NAICS 92).” (U.S. Census Bureau, 2011A.) While we would prefer to have data on all sectors, we recognize that the world of data is imperfect and that we have limited choices. As choices go, this one is not too bad since most of the omitted sectors are not likely to be of great interest for the purposes of this study anyway. One exception here might be agriculture. We know that Erie County farmers produce for export, but the CBP data omit them.

A key drawback of the CBP is that it does not provide detailed data for all industries. By law, the Census Bureau must guarantee confidentiality to business firms. To do so, in some cases the Census Bureau introduces “noise” into the estimates. Cells that include noise may have up to 5% perturbation, but many have less than 2%. So the detailed numbers may be a little off, by design.

In cases where the confidentiality problem is more severe, the Census Bureau simply suppresses the data values. This is especially a problem for smaller counties where there are fewer establishments, and it becomes an increasingly common problem the greater the level of industrial detail. Isserman and Westervelt estimate that in 2002 about 2/3 of all data records in CBP were NOT disclosed. That’s quite a hole in the data! But the good news is that most of those problems are at the finer levels of industry detail and for the smaller counties. At the higher levels of industrial aggregation (NAICS 2-digit “supersectors” and 3-digit industry subsectors) most of the data are available for Erie County. Table 1 shows the extent of the non-disclosure problem for employment data for Erie County for 2009, the most recent year for which data are available. Each “cell” is one industry at the level of NAICS detail specified in the column at the left. It is clear that the suppression problem, both in absolute number of cells and in percentage terms, becomes more severe with a greater level of industrial detail.

Table 1  
Suppressed Data for Erie County Employment, 2009

NAICS level	Number of Suppressed Cells	Total Number of Cells	% of Cells Suppressed	% of Cells Reported
2 digit	2	20	10.0	90.0
3 digit	23	81	28.4	71.6
4 digit	93	239	38.9	61.1
5 digit	250	473	52.9	47.1
6 digit	375	616	60.9	39.1
Total	663	1,429	46.4	53.6

The good news is that it is often possible to estimate data for the missing cells, given information that the Census Bureau does not suppress. Since they report the number of establishments in each employment size category, it is possible to determine a range within which the missing data value must fall for a particular industry. They also report a Data Suppression Flag for each suppressed cell which gives a separate range for the missing number, providing another clue. And the suppressed data are included in totals at the next higher level of industrial disaggregation; an employment value that is suppressed for a 3-digit industry is included in the total for that industry’s 2-digit parent. These clues make it possible to estimate missing values with a reasonable degree of accuracy. But it is well to remember that these numbers are only estimates. Still, estimates will allow us to identify the industries that are unusually large or small locally, and that is one goal of this project.

It was possible to make estimates of the values for the suppressed data cells at the 2- and 3-digit levels. Table 2 reports the amounts of employment and payroll that were involved in those estimated cells. We note that the percentage of the total value of each variable (employment, first quarter payroll, and annual payroll) that was involved in the estimations was smaller than the percentage of cells involved, implying that the suppressed cells tended to be smaller than average.

Table 2  
Relative Importance of Estimated Data for Erie County, 2009

NAICS level	# of Suppressed Cells Estimated	% of Cells Suppressed Estimated	Employment Involved	% of Total Employment Involved	1st Quarter Payroll Involved	% of 1st Qtr Payroll Involved	Annual Payroll Involved	% of Annual Payroll Involved
2 digit	2	10.0	6,847	6.0%	\$70.1 mil	7.8%	\$262.5 mil	7.1%
3 digit	23	28.4	14,646	12.8	217.0 mil	24.0	800.4 mil	21.6

County Business Patterns provides data on four measures of business activity in the county: number of establishments, first quarter employment, first quarter payroll, and annual payroll. Which of these is most relevant for the purposes of this study?

For this study we need a good measure of the amount of activity in each industry. Ideally this would be a measure of output, such as sales or amount of product sold. CBP's employment and payroll variables are actually measures of inputs, rather than output, but it makes sense to expect these input measures to be correlated with output across industries. If an industry produces more output, it will need more inputs. But this need not always be proportional, as economies or diseconomies of scale may occur.

How closely related are input and output measures? CBP does not provide output measures, but the Census Bureau's Economic Census does. It gives data on sales, a measure of output, as well as first-quarter employment and annual payroll, which are input measures. The Economic Census doesn't cover as many industries as CBP, and it is conducted only every five years, so its most recent data are for 2007. For those reasons we prefer to use CBP data for the purposes of this study. But the Economic Census data can give us some insight into the relationship between input and output measures.

For 2007, data from the Economic Census tells us that the correlation between sales and annual payroll was 0.62 for the 18 two-digit industries for which there were data at the national level, and 0.89 for the 12 two-digit industries for which there were data for Erie. At the three-digit level, the correlation was 0.55 for 82 three-digit industries nationally, and 0.72 for the 47 industries for which there were data for Erie. Recall that the correlation coefficient varies from -1.0 (perfect inverse correlation) to +1.0 (perfect positive or direct correlation.)

The correlation between annual sales and first-quarter employment was 0.49 for 18 two-digit industries for the U.S., and 0.82 for 12 two-digit Erie industries. The correlation was 0.41 for 82 three-digit industries nationally, and 0.60 for 47 three-digit Erie industries.

These data tell us that the input and output measures are positively correlated, as we had expected. When output rises, so does input—although not in lockstep. The annual payroll measures are more strongly correlated than the first-quarter employment measures, and the relationships are stronger in Erie than for the nation as a whole. Our conclusion is that CBP's input measures can act as a reasonable proxy for output in the local area, although they will not be perfect. We have our database for analysis.

## V. ERIE'S EXPORTING AND IMPORTING INDUSTRIES

Table 3 shows location quotients (LQs) for Erie's 2- and 3-digit NAICS industries for 2009, based on first quarter employment, first quarter payroll, and annual payroll. Cells in green denote location quotients greater than one, indicating that Erie has more than the national share of activity in those industries. This implies that Erie exports the output of those industries. Brighter green indicates LQs greater than 1.5, where Erie's activities are at least 50% higher than what would be expected from national averages. These are Erie's specialties, our signature industries.

In Table 3, we notice clusters of green, especially in the manufacturing sector (NAICS 31-33), the Health Care and Social Assistance sector (62), Educational Services (61), and the Retail sector (44-45).



Table 3  
Location Quotients for Erie's 2- and 3-Digit Industries, 2009

NAICS	Industry	Employment	Payroll	
			1st Qtr	Annual
<b>11----</b>	<b>Agriculture, forestry, fishing and hunting</b>	<b>0.046</b>	<b>0.019</b>	<b>0.015</b>
113	Forestry and logging	0.044	0.015	0.014
114	Fishing, hunting and trapping	0.000	0.000	0.000
115	Support activities for agriculture and forestry	0.050	0.021	0.018
<b>21----</b>	<b>Mining, quarrying, and oil and gas extraction</b>	<b>0.134</b>	<b>0.078</b>	<b>0.102</b>
211	Oil and gas extraction	0.324	0.163	0.175
212	Mining (except oil and gas)	0.087	0.057	0.102
213	Support activities for mining	0.098	0.000	0.059
<b>22----</b>	<b>Utilities</b>	<b>0.818</b>	<b>0.829</b>	<b>0.827</b>
221	Utilities	0.818	0.829	0.827
<b>23----</b>	<b>Construction</b>	<b>0.608</b>	<b>0.577</b>	<b>0.670</b>
236	Construction of buildings	0.782	0.606	0.710
237	Heavy and civil engineering construction	0.358	0.372	0.542
238	Specialty trade contractors	0.608	0.627	0.695
<b>31----</b>	<b>Manufacturing</b>	<b>2.010</b>	<b>2.771</b>	<b>2.694</b>
311	Food manufacturing	0.780	1.103	1.040
312	Beverage and tobacco product manufacturing	2.680	5.416	5.122
313	Textile mills	0.021	0.062	0.058
314	Textile product mills	0.480	0.451	0.420
315	Apparel manufacturing	0.019	0.080	0.074
316	Leather and allied product manufacturing	0.000	0.000	0.000
321	Wood product manufacturing	0.814	0.996	1.006
322	Paper manufacturing	0.150	0.123	0.099
323	Printing and related support activities	0.730	0.839	0.735
324	Petroleum and coal products manufacturing	1.760	1.988	2.027
325	Chemical manufacturing	0.126	0.101	0.111
326	Plastics and rubber products manufacturing	4.780	5.740	5.707
327	Nonmetallic mineral product manufacturing	0.427	0.271	0.407
331	Primary metal manufacturing	2.097	2.375	2.311
332	Fabricated metal product manufacturing	3.546	4.341	3.968
333	Machinery manufacturing	2.285	2.430	2.487
334	Computer and electronic product manufacturing	1.053	1.019	0.907
335	Electrical equipment, appliance, and component manufacturing	1.408	1.546	1.520
336	Transportation equipment manufacturing	5.282	8.276	8.955
337	Furniture and related product manufacturing	0.506	0.610	0.763
339	Miscellaneous manufacturing	1.238	1.254	1.116
<b>42----</b>	<b>Wholesale trade</b>	<b>0.588</b>	<b>0.528</b>	<b>0.528</b>
423	Merchant wholesalers, durable goods	0.636	0.569	0.549
424	Merchant wholesalers, nondurable goods	0.516	0.482	0.511
425	Wholesale electronic markets and agents and brokers	0.568	0.307	0.369
<b>44----</b>	<b>Retail trade</b>	<b>1.054</b>	<b>1.173</b>	<b>1.158</b>
441	Motor vehicle and parts dealers	1.190	1.406	1.431
442	Furniture and home furnishings stores	0.825	1.018	1.051
443	Electronics and appliance stores	0.815	0.786	0.758
444	Building material and garden equipment and supplies dealers	0.877	1.053	1.071
445	Food and beverage stores	0.990	1.166	1.135
446	Health and personal care stores	0.900	1.084	1.017
447	Gasoline stations	1.869	1.879	1.839
448	Clothing and clothing accessories stores	0.816	0.843	0.812
451	Sporting goods, hobby, book, and music stores	1.016	1.136	1.139
452	General merchandise stores	1.238	1.455	1.348
453	Miscellaneous store retailers	1.001	1.019	1.004
454	Nonstore retailers	0.556	0.530	0.535
<b>48----</b>	<b>Transportation and warehousing</b>	<b>0.544</b>	<b>0.568</b>	<b>0.533</b>
481	Air transportation	0.071	0.047	0.045
483	Water transportation	0.000	0.000	0.000
484	Truck transportation	0.831	1.102	1.040
485	Transit and ground passenger transportation	1.067	0.897	0.779
486	Pipeline transportation	0.154	0.049	0.056
487	Scenic and sightseeing transportation	0.211	0.320	0.235
488	Support activities for transportation	0.253	0.200	0.185
492	Couriers and messengers	0.461	0.656	0.615
493	Warehousing and storage	0.363	0.390	0.326
<b>51----</b>	<b>Information</b>	<b>0.690</b>	<b>0.512</b>	<b>0.486</b>
511	Publishing industries (except Internet)	0.560	0.628	0.533
512	Motion picture and sound recording industries	0.392	0.365	0.343
515	Broadcasting (except Internet)	1.232	0.769	0.738
517	Telecommunications	1.020	0.605	0.643
518	Data processing, hosting and related services	0.029	0.015	0.018
519	Other information services	0.273	0.041	0.049
<b>52----</b>	<b>Finance and insurance</b>	<b>0.745</b>	<b>0.667</b>	<b>0.747</b>
521	Monetary authorities- central bank	0.000	0.000	0.000
522	Credit intermediation and related activities	0.493	0.409	0.425
523	Securities, commodity contracts, fin investments & related activities	0.268	0.116	0.154
524	Insurance carriers and related activities	1.246	1.496	1.641
525	Funds, trusts, and other financial vehicles	0.398	0.170	0.228
<b>53----</b>	<b>Real estate and rental and leasing</b>	<b>0.496</b>	<b>0.395</b>	<b>0.407</b>
531	Real estate	0.423	0.347	0.358
532	Rental and leasing services	0.715	0.592	0.602
533	Lessors of nonfinancial intangible assets (except copyrighted works)	0.000	0.000	0.000
<b>54----</b>	<b>Professional, scientific, and technical services</b>	<b>0.466</b>	<b>0.269</b>	<b>0.277</b>
541	Professional, scientific, and technical services	0.466	0.269	0.277
<b>55----</b>	<b>Management of companies and enterprises</b>	<b>0.354</b>	<b>0.332</b>	<b>0.308</b>
551	Management of companies and enterprises	0.354	0.332	0.308
<b>56----</b>	<b>Administrative, support, waste management &amp; remediation svcs</b>	<b>0.693</b>	<b>0.572</b>	<b>0.537</b>
561	Administrative and support services	0.679	0.522	0.493
562	Waste management and remediation services	1.039	1.366	1.282
<b>61----</b>	<b>Educational services</b>	<b>1.511</b>	<b>1.288</b>	<b>1.245</b>
611	Educational services	1.511	1.288	1.245
<b>62----</b>	<b>Health care and social assistance</b>	<b>1.320</b>	<b>1.597</b>	<b>1.517</b>
621	Ambulatory health care services	1.348	1.720	1.656
622	Hospitals	1.100	1.288	1.192
623	Nursing and residential care facilities	1.647	2.314	2.159
624	Social assistance	1.335	1.532	1.493
<b>71----</b>	<b>Arts, entertainment, and recreation</b>	<b>1.301</b>	<b>0.979</b>	<b>0.994</b>
711	Performing arts, spectator sports, and related industries	1.982	1.026	0.819
712	Museums, historical sites, and similar institutions	0.702	0.593	0.701
713	Amusement, gambling, and recreation industries	1.150	1.121	1.227
<b>72----</b>	<b>Accommodation and food services</b>	<b>0.963</b>	<b>0.849</b>	<b>0.852</b>
721	Accommodation	0.491	0.315	0.350
722	Food services and drinking places	1.053	1.032	1.019
<b>81----</b>	<b>Other services (except public administration)</b>	<b>0.977</b>	<b>0.988</b>	<b>0.948</b>
811	Repair and maintenance	0.801	0.953	0.936
812	Personal and laundry services	0.953	1.281	1.210
813	Religious, grantmaking, civic, professional, and similar organizations	1.064	0.900	0.856
<b>99----</b>	<b>Industries not classified</b>	<b>0.729</b>	<b>1.204</b>	<b>0.454</b>
999	Industries not classified	0.729	1.204	0.454

At the other end of the spectrum are the cells in white and those highlighted in pink. The white cells have LQs less than 1.0, and the pink cells have LQs less than 0.5. In all of these industries, Erie has less than the level of activity we might expect from national averages. In the pink cells, Erie has less than half the amount we would expect. That implies either that we are consuming less than the usual share of these activities, or that we are importing them from outside the region. It is among these activities that we might expect to find potential candidates for import substitution. As with the exporting industries, there are clusters of pink cells in Table 3, and we'll point out several of these below.

To help with the analysis, Table 4 shows the 3-digit industries ranked from highest to lowest LQ (using annual payroll data). At the top of this table we see the industries we would expect from Erie's blue-collar heritage: transportation equipment manufacturing (which would include GE's locomotive operations), plastics, primary and fabricated metals, and machinery manufacturing. We also see some service industries in the export category: insurance carriers, nursing homes, and the offices of medical practitioners ("ambulatory health care services"). Erie has more than its share of these activities and pulls in cash from customers outside the county. There are also some surprises: Erie has significantly more than its share of gasoline service stations, apparently.

From Table 3 we notice that there are many pink cells in the Information sector (NAICS 51.) We are apparently letting others do information-related work for us. Yet the table also shows that we have high LQs in the education sector (NAICS 61), and our colleges clearly train people to handle information. Similarly, we have a high LQ in the insurance carriers industry (NAICS 524), which also needs information processing. Sector 54, Professional, Scientific and Technical Services also would seem to fit in with our focus on higher education, as well as the high LQs in manufacturing and health care industries.

Table 3 also shows low LQs in sector 48, Transportation and Warehousing. Yet the entries at the top of Table 4 include many industries that make "stuff", stuff that needs to be transported and stored.

In Table 3 we sometimes see a pink row nestled between two green rows. While an industry does not necessarily interact heavily with those adjacent to it in the NAICS listings, sometimes they do. And that is often the case with the chemical industry (NAICS 325) and its neighbors petroleum and coal products manufacturing (NAICS 324) and plastics and rubber products manufacturing (NAICS 326). While Erie has a very low LQ for chemicals, it has LQs significantly greater than 1.0 for the other two industries—and greater than 5 in the case of plastics. Might those exporting industries purchase inputs from the chemical industry, but from outside the area? Might this represent an opportunity for an Erie entrepreneur? The answer to that question clearly depends on which parts of each exporting industry Erie actually has, and the inputs they need. And we'll turn to the question of inputs in the next section.

But before turning to that issue we should point out that not all industries in the pink section at the bottom of Table 4 represent opportunities for Erie import substitution. For example, we're unlikely to attract firms in sector 212 (mining except oil and gas) unless we suddenly discover previously-unknown natural resources buried locally. Another of the industries near the bottom of the list is NAICS 521—monetary authorities-central bank. Clearly, Erie is unlikely to attract a branch of the Federal Reserve Bank in the near future. And sector 512, motion picture and sound recording, has some presence locally, but it is improbable that we would be able to attract a major presence in this industry since it is heavily concentrated in a few cluster locations, like Los Angeles and New York. We know that for some industries it is important to locate in a cluster of similar firms, requiring the presence of a broad range of related activities to make the location profitable. The movie industry seems to require just these kinds of agglomeration economies. These examples make the case that some of the industries at the bottom of Table 4 have low location quotients because Erie does not possess the factors that are necessary for profitable location of the activity here.

We see from Table 3 that not all parts of a broader industry category follow the same pattern with respect to exporting or importing. The manufacturing supersector (NAICS 31-33) shows up as an exporting sector for Erie, but there are several three-digit industries in which Erie imports products. The more industrially detailed the data, the clearer the picture we see. However, there is a tradeoff here—the more industrially detailed the data, the more problem we have with suppression of data, too.

**Table 4**  
**Erie's 3-digit Industries, Ranked by Annual Payroll LQ, 2009**

NAICS	Industry	Employment	Payroll	
			1st Qtr	Annual
336	Transportation equipment manufacturing	5,282	9,276	8,955
326	Plastics and rubber products manufacturing	4,780	5,740	5,707
312	Beverage and tobacco product manufacturing	2,680	5,416	5,122
332	Fabricated metal product manufacturing	3,546	4,341	3,968
333	Machinery manufacturing	2,265	2,420	2,487
331	Primary metal manufacturing	2,097	2,375	2,311
623	Nursing and residential care facilities	1,647	2,314	2,159
324	Petroleum and coal products manufacturing	1,760	1,988	2,027
447	Gasoline stations	1,869	1,879	1,930
621	Ambulatory health care services	1,348	1,720	1,656
524	Insurance carriers and related activities	1,246	1,496	1,641
335	Electrical equipment, appliance, and component manufacturing	1,408	1,546	1,520
624	Social assistance	1,335	1,532	1,493
441	Motor vehicle and parts dealers	1,190	1,406	1,431
452	General merchandise stores	1,238	1,455	1,348
562	Waste management and remediation services	1,039	1,366	1,282
611	Educational services	1,511	1,288	1,245
713	Amusement, gambling, and recreation industries	1,150	1,121	1,227
812	Personal and laundry services	0,953	1,281	1,210
622	Hospitals	1,100	1,288	1,192
451	Sporting goods, hobby, book, and music stores	1,016	1,136	1,139
445	Food and beverage stores	0,990	1,166	1,135
339	Miscellaneous manufacturing	1,238	1,254	1,116
444	Building material and garden equipment and supplies dealers	0,877	1,053	1,071
442	Furniture and home furnishings stores	0,825	1,018	1,051
311	Food manufacturing	0,780	1,103	1,040
484	Truck transportation	0,831	1,102	1,040
722	Food services and drinking places	1,053	1,032	1,019
446	Health and personal care stores	0,900	1,084	1,017
321	Wood product manufacturing	0,814	0,996	1,006
453	Miscellaneous store retailers	1,001	1,019	1,004
811	Repair and maintenance	0,801	0,953	0,936
334	Computer and electronic product manufacturing	1,053	1,019	0,907
813	Religious, grantmaking, civic, professional, and similar organizations	1,064	0,900	0,856
221	Utilities	0,818	0,829	0,827
711	Performing arts, spectator sports, and related industries	1,992	1,026	0,819
448	Clothing and clothing accessories stores	0,816	0,843	0,812
485	Transit and ground passenger transportation	1,067	0,897	0,779
337	Furniture and related product manufacturing	0,506	0,610	0,763
443	Electronics and appliance stores	0,815	0,786	0,758
515	Broadcasting (except Internet)	1,232	0,769	0,738
323	Printing and related support activities	0,730	0,839	0,735
236	Construction of buildings	0,782	0,606	0,710
712	Museums, historical sites, and similar institutions	0,702	0,593	0,701
238	Specialty trade contractors	0,608	0,627	0,695
517	Telecommunications	1,020	0,605	0,643
492	Couriers and messengers	0,461	0,656	0,615
532	Rental and leasing services	0,715	0,592	0,602
423	Merchant wholesalers, durable goods	0,636	0,569	0,549
237	Heavy and civil engineering construction	0,358	0,372	0,542
454	Nonstore retailers	0,556	0,530	0,535
511	Publishing industries (except Internet)	0,560	0,628	0,533
424	Merchant wholesalers, nondurable goods	0,516	0,482	0,511
561	Administrative and support services	0,679	0,522	0,493
999	Industries not classified	0,729	1,204	0,454
522	Credit intermediation and related activities	0,493	0,409	0,425
314	Textile product mills	0,480	0,451	0,420
327	Nonmetallic mineral product manufacturing	0,427	0,271	0,407
425	Wholesale electronic markets and agents and brokers	0,568	0,307	0,369
531	Real estate	0,423	0,347	0,358
721	Accommodation	0,491	0,315	0,350
512	Motion picture and sound recording industries	0,392	0,365	0,343
493	Warehousing and storage	0,363	0,390	0,326
551	Management of companies and enterprises	0,354	0,332	0,308
541	Professional, scientific, and technical services	0,466	0,269	0,277
487	Scenic and sightseeing transportation	0,211	0,320	0,235
525	Funds, trusts, and other financial vehicles	0,398	0,170	0,228
488	Support activities for transportation	0,253	0,200	0,185
211	Oil and gas extraction	0,324	0,163	0,175
523	Securities, commodity contracts, fin investments & related activities	0,268	0,116	0,154
325	Chemical manufacturing	0,126	0,101	0,111
212	Mining (except oil and gas)	0,087	0,057	0,102
322	Paper manufacturing	0,150	0,123	0,099
315	Apparel manufacturing	0,019	0,080	0,074
213	Support activities for mining	0,098	0,000	0,059
313	Textile mills	0,021	0,062	0,058
486	Pipeline transportation	0,154	0,049	0,056
519	Other information services	0,273	0,041	0,049
481	Air transportation	0,071	0,047	0,045
115	Support activities for agriculture and forestry	0,050	0,021	0,018
518	Data processing, hosting and related services	0,029	0,015	0,018
113	Forestry and logging	0,044	0,015	0,014
114	Fishing, hunting and trapping	0,000	0,000	0,000
316	Leather and allied product manufacturing	0,000	0,000	0,000
483	Water transportation	0,000	0,000	0,000
521	Monetary authorities- central bank	0,000	0,000	0,000
533	Lessors of nonfinancial intangible assets (except copyrighted works)	0,000	0,000	0,000

Tables 5 and 6 provide similar information on location quotients for four-digit industry groups for Erie. Although there are 290 of these industries at the national level, there are data only for 166 of them for Erie. Unfortunately, the data are suppressed for some of Erie's larger industries in cases where there are few firms in the industry—such as NAICS 3365: railroad rolling stock manufacturing, and 6113: colleges and universities. But with data on 166 industry categories, the glass is still more than half full; although the picture is not complete, it gives us quite a bit of detail.<sup>14</sup>

As might be expected, this added industry detail helps identify specific industries that are strong exporters and others that are most probably import industries. The pink cells at the bottom of Table 6 are logical candidates to explore for possible import substitution targets. Of course, they would also need to be compatible with Erie location factors. But that is another study.

## VI: AN ALTERNATIVE APPROACH: INPUT-OUTPUT ANALYSIS

There is another, more direct way to identify demands in the Erie economy. We know that Erie specializes in some industries, those identified above by location quotients as export industries. Those industries need to buy inputs in order to produce their goods and services, so they have demands for a range of products which they could conceivably buy from local firms. But are there local providers of these inputs, and do they have the capacity to provide the amounts needed by other local producers?

If we knew what inputs local firms—in fact, all firms, not just the exporters--need, and how much, we could conceivably calculate the demand for various inputs from local firms. We could then compare those demands with the capacity of local firms to produce (i.e., supply), and identify products for which there is excess demand currently. These cases of excess demand would be prime opportunities for import substitution.

One way to determine what inputs local firms need would be to survey them, and ask them to share information on what inputs they buy and in what quantities. This would be a rather expensive and time-consuming project, and would probably get significantly less than 100% participation given that managers are usually pretty busy just running their businesses. Moreover, some firms may consider the requested information to be confidential.

An alternate approach is to estimate the amounts of demand for each input using national industry averages. The U.S. Bureau of Economic Analysis publishes national input-output tables which tell us about the interactions of industries.<sup>15</sup> The BEA gathers data on how much firms in each industry buy from firms in other industries. From this they are able to calculate the amount of each input that a firm in any given industry needs to purchase in order to produce its output—in other words, the recipe for making each industry's output. These values are called “direct requirement coefficients”, and they are in percentage terms so they sum to 1.00 for each industry. We can think of them as telling us how many cents of each input are necessary for one dollar's worth of that industry's output.

For example, in order for a firm in the plastics and rubber products industry to produce one dollar of output, it needs to buy 30.1 cents of inputs from the chemical products industry (its biggest single supplier), 6.7 cents of inputs from other plastics and rubber products firms, 2.7 cents from utility companies, 2.3 cents from fabricated metal products firms, 3.5 cents of wholesale trade services, 0.9 cents of truck transportation, 20.8 cents of labor, etc. There is also 10.5 cents of gross operating surplus left for the owners of the firm who risked their capital.

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<sup>14</sup>There were Erie industries for which the CBP reported data for one or two of the variables (first quarter employment, first quarter payroll, or annual payroll) but not all three. In the tables below, where one of the variables shows an LQ and another shows a zero value, that indicates that the data for that variable were suppressed for that industry. Annual payroll was the variable with the most complete data.

<sup>15</sup>Information about BEA's Input-Output programs can be found at <http://www.bea.gov/industry/index.htm>.

Table 5  
Location Quotients for Erie's 4-Digit Industries, 2009

		Payroll		
		Employment	1st Qtr	Annual
<b>21----</b>	<b>Mining, quarrying, and oil and gas extraction</b>	<b>0.13</b>	<b>0.08</b>	<b>0.10</b>
2111	Oil and gas extraction	0.00	0.16	0.18
2123	Nonmetallic mineral mining and quarrying	0.00	0.18	0.29
2131	Support activities for mining	0.00	0.00	0.06
2361	Residential building construction	0.78	0.64	0.76
2362	Nonresidential building construction	0.78	0.58	0.67
2371	Utility system construction	0.00	0.00	0.45
2372	Land subdivision	0.00	0.38	0.55
2373	Highway, street, and bridge construction	0.00	0.42	0.78
2381	Foundation, structure, and building exterior contractors	0.63	0.54	0.78
2382	Building equipment contractors	0.67	0.76	0.77
2383	Building finishing contractors	0.63	0.56	0.63
2389	Other specialty trade contractors	0.29	0.26	0.35
<b>31----</b>	<b>Manufacturing</b>	<b>2.01</b>	<b>2.77</b>	<b>2.69</b>
3113	Sugar and confectionery product manufacturing	0.93	0.45	0.39
3118	Bakeries and tortilla manufacturing	0.78	0.99	1.07
3149	Other textile product mills	0.00	0.92	0.83
3211	Sawmills and wood preservation	0.75	0.98	0.82
3219	Other wood product manufacturing	0.99	1.23	1.31
3222	Converted paper product manufacturing	0.22	0.20	0.16
3231	Printing and related support activities	0.73	0.84	0.74
3261	Plastics product manufacturing	5.05	5.71	5.78
3262	Rubber product manufacturing	3.57	5.87	5.39
3273	Cement and concrete product manufacturing	0.89	0.59	0.87
3315	Foundries	4.34	5.17	5.61
3321	Forging and stamping	4.70	5.81	4.78
3323	Architectural and structural metals manufacturing	3.14	3.86	3.65
3327	Machine shops; turned product; and screw, nut, and bolt manufacturing	3.99	4.78	4.10
3328	Coating, engraving, heat treating, and allied activities	4.77	4.51	4.69
3329	Other fabricated metal product manufacturing	3.63	4.79	4.61
3332	Industrial machinery manufacturing	0.00	0.26	0.24
3335	Metalworking machinery manufacturing	7.82	8.58	8.70
3339	Other general purpose machinery manufacturing	2.70	2.91	2.95
3344	Semiconductor and other electronic component manufacturing	2.45	2.14	2.08
3353	Electrical equipment manufacturing	2.41	2.62	2.67
3359	Other electrical equipment and component manufacturing	1.01	1.05	0.97
3362	Motor vehicle body and trailer manufacturing	0.67	0.78	0.78
3371	Household and institutional furniture and kitchen cabinet manufacturing	0.17	0.20	0.16
3372	Office furniture (including fixtures) manufacturing	1.35	1.43	1.93
3391	Medical equipment and supplies manufacturing	1.04	1.14	0.95
3399	Other miscellaneous manufacturing	1.44	1.43	1.35
<b>42----</b>	<b>Wholesale trade</b>	<b>0.59</b>	<b>0.53</b>	<b>0.53</b>
4231	Motor vehicle and motor vehicle parts and supplies merchant wholesalers	0.69	0.43	0.45
4233	Lumber and other construction materials merchant wholesalers	0.62	0.85	0.93
4234	Professional and commercial equipment and supplies merchant wholesalers	0.27	0.21	0.20
4236	Electrical and electronic goods merchant wholesalers	0.24	0.17	0.16
4237	Hardware, plumbing and heating equipment and supplies merchant wholesalers	0.00	0.74	0.72
4238	Machinery, equipment, and supplies merchant wholesalers	1.21	1.42	1.36
4239	Miscellaneous durable goods merchant wholesalers	0.61	0.74	0.64
4241	Paper and paper product merchant wholesalers	1.33	1.07	1.16
4243	Apparel, piece goods, and notions merchant wholesalers	0.04	0.00	0.04
4244	Grocery and related product merchant wholesalers	0.65	0.74	0.77
4246	Chemical and allied products merchant wholesalers	0.76	0.60	0.57
4248	Beer, wine, and distilled alcoholic beverage merchant wholesalers	0.88	0.89	1.17
4249	Miscellaneous nondurable goods merchant wholesalers	0.28	0.23	0.23
4251	Wholesale electronic markets and agents and brokers	0.00	0.31	0.37
<b>44----</b>	<b>Retail trade</b>	<b>1.05</b>	<b>1.17</b>	<b>1.16</b>
4411	Automobile dealers	1.18	1.45	1.47
4412	Other motor vehicle dealers	0.97	1.00	1.14
4413	Automotive parts, accessories, and tire stores	1.29	1.38	1.40
4421	Furniture stores	0.89	1.10	1.11
4422	Home furnishings stores	0.76	0.92	0.98
4431	Electronics and appliance stores	0.82	0.79	0.76
4441	Building material and supplies dealers	0.86	1.04	1.06
4442	Lawn and garden equipment and supplies stores	1.01	1.20	1.19
4451	Grocery stores	0.97	1.10	1.07
4452	Specialty food stores	0.92	1.37	1.30
4453	Beer, wine, and liquor stores	1.48	2.20	2.12
4461	Health and personal care stores	0.90	1.08	1.02
4471	Gasoline stations	1.87	1.88	1.93
4481	Clothing stores	0.86	0.87	0.83
4482	Shoe stores	0.50	0.53	0.52
4483	Jewelry, luggage, and leather goods stores	0.87	0.98	0.96
4511	Sporting goods, hobby, and musical instrument stores	1.08	1.13	1.13
4512	Book, periodical, and music stores	0.87	1.16	1.15
4521	Department stores	1.33	1.59	1.54
4531	Florists	1.52	1.98	1.84
4532	Office supplies, stationery, and gift stores	0.85	0.84	0.77
4533	Used merchandise stores	0.53	0.58	0.59
4539	Other miscellaneous store retailers	1.28	1.15	1.20
4541	Electronic shopping and mail-order houses	0.18	0.10	0.10
4542	Vending machine operators	1.65	2.24	2.01
4543	Direct selling establishments	0.95	1.14	1.16

		Payroll		
		Employment	1st Qtr	Annual
<b>48----</b>	<b>Transportation and warehousing</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
4841	General freight trucking	0.88	1.18	1.02
4842	Specialized freight trucking	0.73	0.93	1.08
4853	Taxi and limousine service	0.71	0.51	0.52
4854	School and employee bus transportation	1.94	1.94	1.72
4884	Support activities for road transportation	1.16	0.83	0.75
4885	Freight transportation arrangement	0.18	0.25	0.23
4921	Couriers and express delivery services	0.48	0.67	0.62
4922	Local messengers and local delivery	0.13	0.20	0.38
4931	Warehousing and storage	0.36	0.39	0.33
<b>51----</b>	<b>Information</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
5111	Newspaper, periodical, book, and directory publishers	0.91	1.45	1.30
5151	Radio and television broadcasting	1.44	1.03	0.95
5182	Data processing, hosting, and related services	0.00	0.02	0.02
5191	Other information services	0.27	0.04	0.05
<b>52----</b>	<b>Finance and insurance</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
5221	Depository credit intermediation	0.00	0.53	0.56
5222	Nondepository credit intermediation	0.18	0.11	0.12
5231	Securities and commodity contracts intermediation and brokerage	0.27	0.13	0.18
5239	Other financial investment activities	0.26	0.10	0.13
5242	Agencies, brokerages, and other insurance related activities	0.69	0.74	0.70
5259	Other investment pools and funds	0.40	0.00	0.23
<b>53----</b>	<b>Real estate and rental and leasing</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
5311	Lessors of real estate	0.42	0.37	0.41
5312	Offices of real estate agents and brokers	0.00	0.20	0.19
5313	Activities related to real estate	0.49	0.40	0.40
5321	Automotive equipment rental and leasing	0.00	0.23	0.25
5322	Consumer goods rental	1.19	1.22	1.18
5324	Commercial and industrial machinery and equipment rental and leasing	0.33	0.38	0.39
<b>54----</b>	<b>Professional, scientific, and technical services</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
5411	Legal services	0.53	0.42	0.46
5412	Accounting, tax preparation, bookkeeping, and payroll services	0.51	0.45	0.40
5413	Architectural, engineering, and related services	0.33	0.31	0.31
5414	Specialized design services	0.00	0.00	0.05
5415	Computer systems design and related services	0.11	0.07	0.07
5416	Management, scientific, and technical consulting services	0.42	0.33	0.31
5417	Scientific research and development services	0.04	0.00	0.02
5418	Advertising, public relations, and related services	2.25	0.39	0.42
5419	Other professional, scientific, and technical services	0.65	0.60	0.57
<b>55----</b>	<b>Management of companies and enterprises</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
5511	Management of companies and enterprises	0.35	0.33	0.31
<b>56----</b>	<b>Administrative and support and waste management and remediation services</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
5611	Office administrative services	0.59	0.43	0.42
5612	Facilities support services	0.00	0.08	0.07
5613	Employment services	0.45	0.32	0.28
5614	Business support services	2.41	1.69	1.48
5615	Travel arrangement and reservation services	0.43	0.25	0.22
5616	Investigation and security services	0.37	0.42	0.41
5617	Services to buildings and dwellings	0.71	0.54	0.68
5619	Other support services	0.70	1.48	1.38
5629	Remediation and other waste management services	0.25	0.25	0.23
<b>61----</b>	<b>Educational services</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
6111	Elementary and secondary schools	1.37	1.38	1.36
6112	Junior colleges	1.60	1.75	1.72
6116	Other schools and instruction	0.50	0.36	0.34
6117	Educational support services	0.28	0.28	0.21
<b>62----</b>	<b>Health care and social assistance</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
6211	Offices of physicians	1.26	1.81	1.73
6212	Offices of dentists	0.93	1.03	1.01
6213	Offices of other health practitioners	1.41	1.66	1.62
6214	Outpatient care centers	2.15	1.89	1.82
6215	Medical and diagnostic laboratories	0.00	2.61	2.53
6216	Home health care services	0.89	1.21	1.19
6219	Other ambulatory health care services	1.98	2.51	2.41
6221	General medical and surgical hospitals	1.10	1.29	1.19
6223	Specialty (except psychiatric and substance abuse) hospitals	2.10	2.21	2.16
6231	Nursing care facilities	1.19	1.73	1.60
6232	Residential mental retardation, mental health and substance abuse facilities	2.62	3.81	3.51
6233	Community care facilities for the elderly	1.85	2.70	2.58
6241	Individual and family services	1.92	2.05	2.02
6242	Community food and housing, and emergency and other relief services	1.86	1.82	1.71
6243	Vocational rehabilitation services	0.55	0.55	0.50
6244	Child day care services	0.66	0.83	0.81
<b>71----</b>	<b>Arts, entertainment, and recreation</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
7111	Performing arts companies	1.51	0.59	0.50
7121	Museums, historical sites, and similar institutions	0.00	0.59	0.70
7131	Amusement parks and arcades	0.00	2.36	2.57
7139	Other amusement and recreation industries	1.16	1.27	1.35
<b>72----</b>	<b>Accommodation and food services</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
7211	Traveler accommodation	0.49	0.30	0.32
7212	RV (recreational vehicle) parks and recreational camps	0.00	0.00	1.41
7221	Full-service restaurants	1.08	1.03	0.99
7222	Limited-service eating places	0.90	0.92	0.96
7223	Special food services	1.27	1.13	1.03
7224	Drinking places (alcoholic beverages)	2.09	2.05	2.09
<b>81----</b>	<b>Other services (except public administration)</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
8111	Automotive repair and maintenance	0.82	1.02	0.98
8112	Electronic and precision equipment repair and maintenance	0.10	0.06	0.05
8113	Commercial, industrial mach & eqpt (exc auto and electronic) repair & maintenance	1.20	1.44	1.45
8114	Personal and household goods repair and maintenance	0.62	0.47	0.57
8121	Personal care services	1.20	1.28	1.34
8122	Death care services	1.57	2.67	1.96
8123	Drycleaning and laundry services	0.75	1.20	1.22
8129	Other personal services	0.26	0.18	0.20
8131	Religious organizations	0.88	1.05	0.96
8132	Grantmaking and giving services	0.39	0.43	0.44
8133	Social advocacy organizations	1.09	0.68	0.61
8134	Civic and social organizations	3.76	3.73	3.56
8139	Business, professional, labor, political, and similar organizations	0.57	0.37	0.38

**Table 6  
Erie's 4-digit Industries, Ranked by Annual Payroll LQ, 2009**

		Payroll		
		Employment	1st Qtr	Annual
3335	Metalworking machinery manufacturing	7.82	8.58	8.70
3261	Plastics product manufacturing	5.05	5.71	5.78
3315	Foundries	4.34	5.17	5.61
3262	Rubber product manufacturing	3.57	5.87	5.39
3321	Forging and stamping	4.70	5.81	4.78
3328	Coating, engraving, heat treating, and allied activities	4.77	4.51	4.69
3329	Other fabricated metal product manufacturing	3.63	4.79	4.61
3327	Machine shops; turned product; and screw, nut, and bolt manufacturing	3.99	4.78	4.10
3323	Architectural and structural metals manufacturing	3.14	3.86	3.65
8134	Civic and social organizations	3.76	3.73	3.56
6232	Residential mental retardation, mental health and substance abuse facilities	2.62	3.81	3.51
3339	Other general purpose machinery manufacturing	2.70	2.91	2.95
3353	Electrical equipment manufacturing	2.41	2.62	2.67
6233	Community care facilities for the elderly	1.85	2.70	2.58
7131	Amusement parks and arcades		2.36	2.57
6215	Medical and diagnostic laboratories		2.61	2.53
6219	Other ambulatory health care services	1.98	2.51	2.41
6223	Specialty (except psychiatric and substance abuse) hospitals	2.10	2.21	2.16
4453	Beer, wine, and liquor stores	1.48	2.20	2.12
7224	Drinking places (alcoholic beverages)	2.09	2.05	2.09
3344	Semiconductor and other electronic component manufacturing	2.45	2.14	2.08
6241	Individual and family services	1.92	2.05	2.02
4542	Vending machine operators	1.65	2.24	2.01
8122	Death care services	1.57	2.67	1.96
3372	Office furniture (including fixtures) manufacturing	1.35	1.43	1.93
4471	Gasoline stations	1.87	1.88	1.93
4531	Florists	1.52	1.98	1.84
6214	Outpatient care centers	2.15	1.89	1.82
6211	Offices of physicians	1.26	1.81	1.73
4854	School and employee bus transportation	1.94	1.94	1.72
6112	Junior colleges	1.60	1.75	1.72
6242	Community food and housing, and emergency and other relief services	1.86	1.82	1.71
6213	Offices of other health practitioners	1.41	1.66	1.62
6231	Nursing care facilities	1.19	1.73	1.60
4521	Department stores	1.33	1.59	1.54
5614	Business support services	2.41	1.69	1.48
4411	Automobile dealers	1.18	1.45	1.47
8113	Commercial, industrial mach & eqpt (exc auto and electronic) repair & maintenance	1.20	1.44	1.45
7212	RV (recreational vehicle) parks and recreational camps			1.41
4413	Automotive parts, accessories, and tire stores	1.29	1.38	1.40
5619	Other support services	0.70	1.48	1.38
6111	Elementary and secondary schools	1.37	1.38	1.36
4238	Machinery, equipment, and supplies merchant wholesalers	1.21	1.42	1.36
3399	Other miscellaneous manufacturing	1.44	1.43	1.35
7139	Other amusement and recreation industries	1.16	1.27	1.35
8121	Personal care services	1.20	1.28	1.34
3219	Other wood product manufacturing	0.99	1.23	1.31
5111	Newspaper, periodical, book, and directory publishers	0.91	1.45	1.30
4452	Specialty food stores	0.92	1.37	1.30
8123	Drycleaning and laundry services	0.75	1.20	1.22
4539	Other miscellaneous store retailers	1.28	1.15	1.20
6216	Home health care services	0.89	1.21	1.19
4442	Lawn and garden equipment and supplies stores	1.01	1.20	1.19
6221	General medical and surgical hospitals	1.10	1.29	1.19
5322	Consumer goods rental	1.19	1.22	1.18
4248	Beer, wine, and distilled alcoholic beverage merchant wholesalers	0.88	0.89	1.17
4543	Direct selling establishments	0.95	1.14	1.16
4241	Paper and paper product merchant wholesalers	1.33	1.07	1.16
4512	Book, periodical, and music stores	0.87	1.16	1.15
4412	Other motor vehicle dealers	0.97	1.00	1.14
4511	Sporting goods, hobby, and musical instrument stores	1.08	1.13	1.13
4421	Furniture stores	0.89	1.10	1.11
4842	Specialized freight trucking	0.73	0.93	1.08
4451	Grocery stores	0.97	1.10	1.07
3118	Bakeries and tortilla manufacturing	0.78	0.99	1.07
4441	Building material and supplies dealers	0.86	1.04	1.06
7223	Special food services	1.27	1.13	1.03
4841	General freight trucking	0.88	1.18	1.02
4461	Health and personal care stores	0.90	1.08	1.02
6212	Offices of dentists	0.93	1.03	1.01
7221	Full-service restaurants	1.08	1.03	0.99
8111	Automotive repair and maintenance	0.82	1.02	0.98
4422	Home furnishings stores	0.76	0.92	0.98
3359	Other electrical equipment and component manufacturing	1.01	1.05	0.97
4483	Jewelry, luggage, and leather goods stores	0.87	0.98	0.96
8131	Religious organizations	0.88	1.05	0.96
7222	Limited-service eating places	0.90	0.92	0.96
5151	Radio and television broadcasting	1.44	1.03	0.95
3391	Medical equipment and supplies manufacturing	1.04	1.14	0.95
4233	Lumber and other construction materials merchant wholesalers	0.62	0.85	0.93
3273	Cement and concrete product manufacturing	0.89	0.59	0.87



		Payroll		
		Employment	1st Qtr	Annual
4481	Clothing stores	0.86	0.87	0.83
3149	Other textile product mills		0.92	0.83
3211	Sawmills and wood preservation	0.75	0.98	0.82
6244	Child day care services	0.66	0.83	0.81
2373	Highway, street, and bridge construction		0.42	0.78
2381	Foundation, structure, and building exterior contractors	0.63	0.54	0.78
3362	Motor vehicle body and trailer manufacturing	0.67	0.78	0.78
4532	Office supplies, stationery, and gift stores	0.85	0.84	0.77
4244	Grocery and related product merchant wholesalers	0.65	0.74	0.77
2382	Building equipment contractors	0.67	0.76	0.77
2361	Residential building construction	0.78	0.64	0.76
4431	Electronics and appliance stores	0.82	0.79	0.76
4884	Support activities for road transportation	1.16	0.83	0.75
3231	Printing and related support activities	0.73	0.84	0.74
4237	Hardware, plumbing and heating equipment and supplies merchant wholesalers		0.74	0.72
5242	Agencies, brokerages, and other insurance related activities	0.69	0.74	0.70
7121	Museums, historical sites, and similar institutions		0.59	0.70
5617	Services to buildings and dwellings	0.71	0.54	0.68
2362	Nonresidential building construction	0.78	0.58	0.67
4239	Miscellaneous durable goods merchant wholesalers	0.61	0.74	0.64
2383	Building finishing contractors	0.63	0.56	0.63
4921	Couriers and express delivery services	0.48	0.67	0.62
8133	Social advocacy organizations	1.09	0.68	0.61
4533	Used merchandise stores	0.53	0.58	0.59
5419	Other professional, scientific, and technical services	0.65	0.60	0.57
8114	Personal and household goods repair and maintenance	0.62	0.47	0.57
4246	Chemical and allied products merchant wholesalers	0.76	0.60	0.57
5221	Depository credit intermediation		0.53	0.56
2372	Land subdivision		0.38	0.55
4853	Taxi and limousine service	0.71	0.51	0.52
4482	Shoe stores	0.50	0.53	0.52
6243	Vocational rehabilitation services	0.55	0.55	0.50
7111	Performing arts companies	1.51	0.59	0.50
5411	Legal services	0.53	0.42	0.46
2371	Utility system construction			0.45
4231	Motor vehicle and motor vehicle parts and supplies merchant wholesalers	0.69	0.43	0.45
8132	Grantmaking and giving services	0.39	0.43	0.44
5611	Office administrative services	0.59	0.43	0.42
5418	Advertising, public relations, and related services	2.25	0.39	0.42
5616	Investigation and security services	0.37	0.42	0.41
5311	Lessors of real estate	0.42	0.37	0.41
5412	Accounting, tax preparation, bookkeeping, and payroll services	0.51	0.45	0.40
5313	Activities related to real estate	0.49	0.40	0.40
3113	Sugar and confectionery product manufacturing	0.93	0.45	0.39
5324	Commercial and industrial machinery and equipment rental and leasing	0.33	0.38	0.39
8139	Business, professional, labor, political, and similar organizations	0.57	0.37	0.38
4922	Local messengers and local delivery	0.13	0.20	0.38
4251	Wholesale electronic markets and agents and brokers		0.31	0.37
2389	Other specialty trade contractors	0.29	0.26	0.35
6116	Other schools and instruction	0.50	0.36	0.34
4931	Warehousing and storage	0.36	0.39	0.33
7211	Traveler accommodation	0.49	0.30	0.32
5413	Architectural, engineering, and related services	0.33	0.31	0.31
5416	Management, scientific, and technical consulting services	0.42	0.33	0.31
5511	Management of companies and enterprises	0.35	0.33	0.31
2123	Nonmetallic mineral mining and quarrying		0.18	0.29
5613	Employment services	0.45	0.32	0.28
5321	Automotive equipment rental and leasing		0.23	0.25
3332	Industrial machinery manufacturing		0.26	0.24
5629	Remediation and other waste management services	0.25	0.25	0.23
5259	Other investment pools and funds	0.40		0.23
4885	Freight transportation arrangement	0.18	0.25	0.23
4249	Miscellaneous nondurable goods merchant wholesalers	0.28	0.23	0.23
5615	Travel arrangement and reservation services	0.43	0.25	0.22
6117	Educational support services	0.28	0.28	0.21
4234	Professional and commercial equipment and supplies merchant wholesalers	0.27	0.21	0.20
8129	Other personal services	0.26	0.18	0.20
5312	Offices of real estate agents and brokers		0.20	0.19
5231	Securities and commodity contracts intermediation and brokerage	0.27	0.13	0.18
2111	Oil and gas extraction		0.16	0.18
3222	Converted paper product manufacturing	0.22	0.20	0.16
3371	Household and institutional furniture and kitchen cabinet manufacturing	0.17	0.20	0.16
4236	Electrical and electronic goods merchant wholesalers	0.24	0.17	0.16
5239	Other financial investment activities	0.26	0.10	0.13
5222	Nondepository credit intermediation	0.18	0.11	0.12
4541	Electronic shopping and mail-order houses	0.18	0.10	0.10
5612	Facilities support services		0.08	0.07
5415	Computer systems design and related services	0.11	0.07	0.07
2131	Support activities for mining			0.06
8112	Electronic and precision equipment repair and maintenance	0.10	0.06	0.05
5414	Specialized design services			0.05
5191	Other information services	0.27	0.04	0.05
4243	Apparel, piece goods, and notions merchant wholesalers	0.04		0.04
5417	Scientific research and development services	0.04		0.02
5182	Data processing, hosting, and related services		0.02	0.02



On the other hand, for every dollar of its output, the motor vehicle industry needs to buy 8.9 cents of inputs from the fabricated metals industry, 6.9 cents from the primary metals industry, 3.4 cents from the plastics and rubber industry, 2.6 cents from the computer and electronics industry, 5.0 cents of wholesale trade services, 1.1 cents from the truck transportation industry, 1.0 cent from utility industries, 14.7 cents of labor, etc., leaving 6.7 cents of gross operating surplus for the owners.

Given data on the amount of activity of each industry in Erie, we could use these input-output direct requirements coefficients to estimate the amount of various inputs that Erie firms need to buy--their demands, and we could compare that with supply capabilities locally to identify import substitution possibilities.

A search of the literature uncovered no previous efforts that use this approach of comparing potential demand with actual supply, so it is necessary to create the methodology. And the devil can be in the details on this kind of analysis.

First, the data. Ideally we would have data on output for all Erie industries. Unfortunately, we do not. As mentioned above, there are some data on sales by industry in the Economic Census, but there are many holes in those data for Erie. And the most recent Economic Census is for 2007. In contrast, the County Business Patterns data that we have been using above have more complete coverage, and are more timely since there are currently data for 2009. Unfortunately the CBP data do not provide any output measures, like sales. Instead they only provide data for employment and payroll, which are input measures. But, as explained above, output data are positively correlated with inputs, especially the annual payroll data, so we can use the payroll data as a proxy here. So long as we use the same variable, annual payroll, for both the estimated demands calculated by this method and the actual supplies currently, the technique will indicate where there is excess demand, and thus an opportunity for import substitution.

Since payroll and output do not move together perfectly, the results we get should be considered estimates that give a general indication of the true measures, rather than precise values. Given the data available, it's the best we can do. But these results should still be quite useful in indicating good candidate industries to investigate for import substitution possibilities.

In operationalizing this concept, we also have to deal with data on the input-output (I/O) relationships. As mentioned above, the U.S. Bureau of Economic Analysis publishes input-output tables for the nation. Their Regional Economics unit also generates input-output information for regions that estimate purchasing patterns for local areas.<sup>16</sup> But for this study we chose to use the national relationships, since the regional I/O tables would reflect purchasing patterns (local vs. importing) that are in place locally *now*, when our approach is to consider how we can change those relationships. Our approach requires estimation of the amount of inputs that a local firm might buy from each other industry, and then compare those potential demands to current supply. Use of current local purchasing patterns, as the regional I/O tables do, will automatically lump the very input demands that we seek to identify into the import category.

At the national level, the BEA offers detailed benchmark I/O tables, but given the huge amounts of data that must be processed, these take five years or more to produce. The most recent benchmark table currently available is for 2002, and a lot has happened since then in terms of technology and production functions. As the BEA itself warns: "The farther the event year is from the reference year, the less reliable the results." (Streitwieser (2011), p. 13.) The 2007 table is not expected to be released until 2014.

That leaves us with the annual I/O tables. The most recent set of tables is for 2009, which fits nicely with our 2009 CBP database. The BEA's industry breakdown is also based on the NAICS industry classification system, although they may aggregate the industries a little differently, sometimes aggregating up to the supersector level and at other times breaking out more finely detailed industries that they consider to be of special interest. The BEA offers annual I/O tables at two basic levels of industry detail: the Sector level which has 15 industry categories, roughly at the two-digit NAICS level,

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<sup>16</sup>Information on BEA's Regional Input-Output Modeling System (RIMS II) is at <http://www.bea.gov/regional/rims/>.

and the Summary level, which has 60+ industries, mostly at the 3- and 4-digit NAICS level. We have already seen in the location quotient analysis that the two-digit level is too aggregated to give the kind of information we need, so it makes sense to use the Sector level for this analysis. Appendix B gives the direct requirements coefficients table for these industries for 2009.

The process for identifying import substitution candidates for Erie first involves aligning the industries from the CBP data and the I/O data. For our purposes, there were 61 industry categories in the I/O table, although Erie had no data for three of them. It was also necessary to disaggregate NAICS 541 (Professional, scientific and technical services) into three 4-digit industry groups in the CBP data for Erie to get complete coverage. Most of the I/O industries were at the 3-digit level, although some were at the 2-digit and some at the 4-digit level. The full list is given in Appendix Table A-2. These covered all Erie industries from the CBP data except “Industries not classified”, the residual category that included only \$126,000 of annual payroll out of an Erie total of \$3.7 billion or about three one-thousandths of one percent.

The annual payroll value for 2009 for each Erie industry was multiplied by the direct requirements coefficients for each of the 61 I/O industries, yielding the amount that this Erie industry would be expected to buy from each of those 61 industries to produce its output. This was done for all Erie industries, then summed across those Erie industries to get estimated total demand that these Erie firms would have for the inputs produced by the 61 I/O industry categories, in order to produce the amounts the Erie firms actually produced in 2009. These estimated demand amounts can then be compared with the actual amounts the Erie firms produced in 2009 to identify excess demand—our import substitution candidates.

For example, in 2009 the Plastics and rubber products manufacturing industry (NAICS 326) had an annual payroll of nearly \$121 million. Plastics firms need 30.1 cents of inputs from the Chemical products industry (NAICS 325) to produce a dollar of Plastics products, so we multiply the Erie Plastics’s industry’s \$121 million by .301 to get an estimate of the amount that they would buy from the Chemicals industry, about \$36.3 million. These amounts are in terms of payroll, so that \$36.3 million tells us that local Chemicals firms would need to have hired that much labor in order to generate the products that the Plastics industry would buy from them. We do this for all other Erie industries and that gives a total potential demand for the local Chemicals industry from all local Erie firms.

We can then compare that amount to the actual payroll amount of the Chemicals industry in 2009 to get an idea of whether our Chemicals firms were producing enough output just for local Erie firms. In this specific case, there was a total potential demand of approximately \$78.1 million (in terms of payroll) for the local Chemicals industry from Erie firms in 2009. The local Chemicals industry actually had payroll of only \$4.2 million in 2009, implying that local firms were buying about \$74 million of inputs from firms outside Erie county. (Technically, it is the amount of Chemicals products that \$74 million of annual payroll could have produced.) This implies that there is a potential for a significant increase in chemicals production in Erie—for import substitution.

Table 7 reports the estimated demand, actual supply (annual payroll), and excess demand for all industries for which we have data. Remember that these calculations were all done with annual payroll amounts, rather than output data. Since the annual payroll data are correlated to a reasonable degree with the output values, they can serve as useful proxies—estimates--of the actual values. But this means that the actual excess demand values are in terms of payroll in the respective industries. Still, if there is a positive excess demand, it means that there is potential room for a firm to supply that demand locally. A negative value for excess demand means that Erie is exporting goods and services in that industry.

Table 8 reports the same data, but sorted by amount of excess demand. The industries at the bottom of this list with negative excess demand (excess supply, actually) represent Erie’s exporting industries: other transportation equipment (which includes locomotives), hospital and other medical services, retailing, insurance, and educational services, to name a few.

But we’re more interested in those at the top of the list—those that are potential targets for an import substitution strategy. The top candidates in the manufacturing category include chemicals, primary

Table 7  
 Estimated Demand, Actual Supply, and Excess Demand  
 (All values are in terms of thousands of dollars of annual payroll.)

		Total		
Industry Category		Estimated Demand	Actual Supply	Excess Demand
111CA	Farms	16,020	20	16,000
113FF	Forestry, fishing, and related activities	3,723	40	3,683
211	Oil and gas extraction	13,357	1,495	11,862
212	Mining, except oil and gas	6,424	947	5,477
213	Support activities for mining	62	827	-765
22	Utilities	37,317	34,209	3,108
23	Construction	12,206	143,610	-131,404
311FT	Food and beverage and tobacco products	35,043	70,408	-35,365
313TT	Textile mills and textile product mills	4,584	1,316	3,268
315AL	Apparel and leather and allied products	1,475	183	1,292
321	Wood products	9,453	9,505	-52
322	Paper products	15,368	1,463	13,905
323	Printing and related support activities	7,803	11,928	-4,125
324	Petroleum and coal products	23,475	12,811	10,663
325	Chemical products	78,078	4,213	73,865
326	Plastics and rubber products	33,362	120,544	-87,182
327	Nonmetallic mineral products	12,023	5,054	6,969
331	Primary metals	75,794	32,636	43,158
332	Fabricated metal products	82,582	180,556	-97,974
333	Machinery	22,581	95,804	-73,223
334	Computer and electronic products	67,665	45,021	22,644
335	Electrical equipment, appliances, and components	15,577	19,354	-3,777
3361MV	Motor vehicles, bodies and trailers, and parts	14,486	0	14,486
3364OT	Other transportation equipment	83,578	487,452	-403,874
337	Furniture and related products	2,595	7,549	-4,954
339	Miscellaneous manufacturing	18,441	23,789	-5,348
42	Wholesale trade	69,189	134,475	-65,286
44RT	Retail trade	10,152	313,973	-303,821
481	Air transportation	6,365	794	5,571
482	Rail transportation	5,245	0	5,245
483	Water transportation	408	0	408
484	Truck transportation	22,405	40,245	-17,840
485	Transit and ground passenger transportation	1,587	6,010	-4,423
486	Pipeline transportation	1,032	163	868
487OS	Other transportation and support activities	12,819	13,516	-697
493	Warehousing and storage	11,771	6,189	5,582
511	Publishing industries (includes software)	6,950	30,430	-23,480
512	Motion picture and sound recording industries	5,971	4,184	1,786
513	Broadcasting and telecommunications	27,078	47,957	-20,879
514	Information and data processing services	10,922	813	10,109
521CI	Fed Reserve banks, credit intermediation, & related	44,740	51,908	-7,168
523	Securities, commodity contracts, and investments	32,442	16,789	15,653
524	Insurance carriers and related activities	85,152	193,592	-108,440
525	Funds, trusts, and other financial vehicles	2,070	192	1,878
531	Real estate	124,198	16,016	108,182
532RL	Rental and leasing svcs & lessors of intangible assets	39,907	9,178	30,729
5411	Legal services	26,477	31,552	-5,075
5412OP	Misc professional, scientific, and technical services	152,439	73,873	78,566
5415	Computer systems design and related services	18,157	5,855	12,302
55	Management of companies and enterprises	72,423	62,155	10,268
561	Administrative and support services	87,686	103,051	-15,365
562	Waste management and remediation services	7,388	15,648	-8,260
61	Educational services	2,768	99,910	-97,142
621	Ambulatory health care services	17,422	395,212	-377,790
622HO	Hospitals and nursing and residential care facilities	151	394,813	-394,662
624	Social assistance	0	61,060	-61,060
711AS	Performing arts, spectator sports, museums, & related	7,725	20,818	-13,093
713	Amusements, gambling, and recreation industries	1,074	25,581	-24,507
721	Accommodation	6,125	11,972	-5,847
722	Food services and drinking places	15,865	104,723	-88,858
81	Other services, except government	27,289	100,770	-73,481

Table 8  
 Estimated Demand, Actual Supply, and Excess Demand, Sorted by Excess Demand  
 (All values are in terms of thousands of dollars of annual payroll.)

		Total		
Industry Category		Estimated Demand	Actual Supply	Excess Demand
531	Real estate	124,198	16,016	108,182
5412OP	Misc professional, scientific, and technical services	152,439	73,873	78,566
325	Chemical products	78,078	4,213	73,865
331	Primary metals	75,794	32,636	43,158
532RL	Rental and leasing svcs & lessors of intangible assets	39,907	9,178	30,729
334	Computer and electronic products	67,665	45,021	22,644
111CA	Farms	16,020	20	16,000
523	Securities, commodity contracts, and investments	32,442	16,789	15,653
3361MV	Motor vehicles, bodies and trailers, and parts	14,486	0	14,486
322	Paper products	15,368	1,463	13,905
5415	Computer systems design and related services	18,157	5,855	12,302
211	Oil and gas extraction	13,357	1,495	11,862
324	Petroleum and coal products	23,475	12,811	10,663
55	Management of companies and enterprises	72,423	62,155	10,268
514	Information and data processing services	10,922	813	10,109
327	Nonmetallic mineral products	12,023	5,054	6,969
493	Warehousing and storage	11,771	6,189	5,582
481	Air transportation	6,365	794	5,571
212	Mining, except oil and gas	6,424	947	5,477
482	Rail transportation	5,245	0	5,245
113FF	Forestry, fishing, and related activities	3,723	40	3,683
313TT	Textile mills and textile product mills	4,584	1,316	3,268
22	Utilities	37,317	34,209	3,108
525	Funds, trusts, and other financial vehicles	2,070	192	1,878
512	Motion picture and sound recording industries	5,971	4,184	1,786
315AL	Apparel and leather and allied products	1,475	183	1,292
486	Pipeline transportation	1,032	163	868
483	Water transportation	408	0	408
321	Wood products	9,453	9,505	-52
487OS	Other transportation and support activities	12,819	13,516	-697
213	Support activities for mining	62	827	-765
335	Electrical equipment, appliances, and components	15,577	19,354	-3,777
323	Printing and related support activities	7,803	11,928	-4,125
485	Transit and ground passenger transportation	1,587	6,010	-4,423
337	Furniture and related products	2,595	7,549	-4,954
5411	Legal services	26,477	31,552	-5,075
339	Miscellaneous manufacturing	18,441	23,789	-5,348
721	Accommodation	6,125	11,972	-5,847
521CI	Fed Reserve banks, credit intermediation, & related	44,740	51,908	-7,168
562	Waste management and remediation services	7,388	15,648	-8,260
711AS	Performing arts, spectator sports, museums, & related	7,725	20,818	-13,093
561	Administrative and support services	87,686	103,051	-15,365
484	Truck transportation	22,405	40,245	-17,840
513	Broadcasting and telecommunications	27,078	47,957	-20,879
511	Publishing industries (includes software)	6,950	30,430	-23,480
713	Amusements, gambling, and recreation industries	1,074	25,581	-24,507
311FT	Food and beverage and tobacco products	35,043	70,408	-35,365
624	Social assistance	0	61,060	-61,060
42	Wholesale trade	69,189	134,475	-65,286
333	Machinery	22,581	95,804	-73,223
81	Other services, except government	27,289	100,770	-73,481
326	Plastics and rubber products	33,362	120,544	-87,182
722	Food services and drinking places	15,865	104,723	-88,858
61	Educational services	2,768	99,910	-97,142
332	Fabricated metal products	82,582	180,556	-97,974
524	Insurance carriers and related activities	85,152	193,592	-108,440
23	Construction	12,206	143,610	-131,404
44RT	Retail trade	10,152	313,973	-303,821
621	Ambulatory health care services	17,422	395,212	-377,790
622HO	Hospitals and nursing and residential care facilities	151	394,813	-394,662
3364OT	Other transportation equipment	83,578	487,452	-403,874

metals, computer and electronic products, motor vehicles and, ironically to those of us that know Erie's history, paper products. The non-manufacturing category includes real estate, selected professional, scientific and technical services, rental and leasing services, securities and investments, and computer systems design to name a few.

It is useful to remember when using input-output analysis that this technique assumes simple proportional relationships between the inputs and the outputs. In other words, it assumes that a doubling of output will mean a doubling of all inputs in the production process. This assumption of constant returns to scale is clearly not accurate for some industries, especially if there are large changes in the amount of output. If there are economies of scale—benefits to larger scale production—then the amount of inputs needed will be less than proportional to the change in inputs. In other words, a doubling of the output will require less than a doubling of the inputs because there are benefits to large scale production. This will happen if the industry is at less than its minimum efficient scale, as discussed earlier. This may mean that the actual benefits from import substitution in terms of jobs and payroll may be smaller than estimated from the simple proportional calculations. But that would also mean that costs of production are falling and local firms that purchase these inputs will be reaping benefits in the form of lower input costs, and that will inject greater profits into the local economy to help offset the other effect.

## **VII. PUTTING THE PIECES TOGETHER: IDENTIFYING IMPORT SUBSTITUTION CANDIDATES FOR ERIE**

We have identified import substitution candidates using two different methods: location quotients and input-output analysis. The first compares Erie's proportion of each industry with the national averages to identify industries where Erie has less than "its share". The second uses a more sophisticated analysis, comparing Erie's current supply by each industry with the demands we might expect from existing Erie firms, to identify excess demand industries. The top candidates from each technique are listed in Tables 9 and 10.

But just because an industry makes one of these two lists does not necessarily mean it is a good target for import substitution for Erie. As has been noted above, an industry may be under-represented in Erie because the area is simply not suited to that activity. This may be due, perhaps, to a lack of crucial natural resources as is the case with coal mining. Or it may be an industry in which firms need to locate in a cluster of related suppliers and customers, and Erie simply may not have that particular cluster. Examples would be movie-making, automobile manufacturing, and investment banking.

But it makes sense to examine the list of likely candidates in Tables 9 and 10 looking for industries that *could* flourish in Erie's economic environment. In this regard it is logical to focus especially on industries that are similar to those that are currently doing well here, candidates that are similar to industries with high location quotients. This suggests that we pay special attention to low LQ and high excess demand industries in the manufacturing sector, and to industries connected with health care and education, sectors where Erie has high location quotients.

In the manufacturing category, Chemical products (NAICS 325) makes both the low LQ and high excess demand lists. As mentioned above, this industry would appear to tie into other local manufacturing industries, especially Plastics (NAICS 326). Paper manufacturing (NAICS 322) also makes both lists, and the region presumably has some reserves of expertise in this field. Of special interest on the excess demand list are also Primary Metals (NAICS 331) and Computer and electronics manufacturing (NAICS 334).

Tied to these industries are the Transportation and Warehousing industries. Air Transportation (NAICS 481) makes both lists, as does Warehousing and Storage (NAICS 493). Rail Transportation (NAICS 482) shows excess demand, and is not in the LQ table because that industry is excluded from the CBP database. And Water Transportation (NAICS 483) is also on the low LQ list. These sectors would

Table 9  
Candidate Industries with Annual Payroll Location Quotients Less than 0.50

NAICS	Industry	Employment	Payroll	
			1st Qtr	Annual
533	Lessors of nonfin intangible assets (exc copyrighted works)	0.000	0.000	0.000
521	Monetary authorities- central bank	0.000	0.000	0.000
483	Water transportation	0.000	0.000	0.000
316	Leather and allied product manufacturing	0.000	0.000	0.000
114	Fishing, hunting and trapping	0.000	0.000	0.000
113	Forestry and logging	0.044	0.015	0.014
518	Data processing, hosting and related services	0.029	0.015	0.018
115	Support activities for agriculture and forestry	0.050	0.021	0.018
481	Air transportation	0.071	0.047	0.045
519	Other information services	0.273	0.041	0.049
486	Pipeline transportation	0.154	0.049	0.056
313	Textile mills	0.021	0.062	0.058
213	Support activities for mining	0.098	0.000	0.059
315	Apparel manufacturing	0.019	0.080	0.074
322	Paper manufacturing	0.150	0.123	0.099
212	Mining (except oil and gas)	0.087	0.057	0.102
325	Chemical manufacturing	0.126	0.101	0.111
523	Securities, commodity contracts, fin investments & related	0.268	0.116	0.154
211	Oil and gas extraction	0.324	0.163	0.175
488	Support activities for transportation	0.253	0.200	0.185
525	Funds, trusts, and other financial vehicles	0.398	0.170	0.228
487	Scenic and sightseeing transportation	0.211	0.320	0.235
541	Professional, scientific, and technical services	0.466	0.269	0.277
551	Management of companies and enterprises	0.354	0.332	0.308
493	Warehousing and storage	0.363	0.390	0.326
512	Motion picture and sound recording industries	0.392	0.365	0.343
721	Accommodation	0.491	0.315	0.350
531	Real estate	0.423	0.347	0.358
425	Wholesale electronic markets and agents and brokers	0.568	0.307	0.369
327	Nonmetallic mineral product manufacturing	0.427	0.271	0.407
314	Textile product mills	0.480	0.451	0.420
522	Credit intermediation and related activities	0.493	0.409	0.425
999	Industries not classified	0.729	1.204	0.454
561	Administrative and support services	0.679	0.522	0.493

Table 10  
Candidate Industries with More than \$5 million of (Annual Payroll) Excess Demand

Industry Category	Total			
	Estimated Demand	Actual Supply	Excess Demand	
531	Real estate	124,198	16,016	108,182
5412OP	Misc professional, scientific, and technical services	152,439	73,873	78,566
325	Chemical products	78,078	4,213	73,865
331	Primary metals	75,794	32,636	43,158
532RL	Rental and leasing svcs & lessors of intangible assets	39,907	9,178	30,729
334	Computer and electronic products	67,665	45,021	22,644
111CA	Farms	16,020	20	16,000
523	Securities, commodity contracts, and investments	32,442	16,789	15,653
3361MV	Motor vehicles, bodies and trailers, and parts	14,486	0	14,486
322	Paper products	15,368	1,463	13,905
5415	Computer systems design and related services	18,157	5,855	12,302
211	Oil and gas extraction	13,357	1,495	11,862
324	Petroleum and coal products	23,475	12,811	10,663
55	Management of companies and enterprises	72,423	62,155	10,268
514	Information and data processing services	10,922	813	10,109
327	Nonmetallic mineral products	12,023	5,054	6,969
493	Warehousing and storage	11,771	6,189	5,582
481	Air transportation	6,365	794	5,571
212	Mining, except oil and gas	6,424	947	5,477
482	Rail transportation	5,245	0	5,245

appear to complement Truck Transportation (NAICS 484) where Erie has an LQ slightly higher than one and a serious excess supply—indicating that Erie exports trucking services to other areas.

Table 11 shows the 20 industries with the highest direct requirements coefficients for each of selected transportation and warehousing industries. In other words, these are the industries to whom trucking and warehousing is most important. It would make sense to consult these lists as import substitution targets are chosen, since cleverly chosen targets may also lead to import substitution in the Transportation and Warehousing sector.

In the services areas, Professional, scientific and technical services (NAICS 541) has an annual payroll LQ of only 0.28. For the I/O analysis this industry was disaggregated and two of its components, Miscellaneous professional, scientific and technical services (NAICS 5412OP—all professional services except legal and computer) and Computer systems design (NAICS 5415) show significant excess demand, as does Information and data processing (NAICS 514). Given the region's specialization in higher education--which trains people for these fields--these sectors might be logical targets for incubation of new businesses. This would also have the beneficial effect of retaining local college graduates and reducing brain drain.

Real estate (NAICS 531) heads the list of excess demand industries in Erie, and it is also on the low LQ list. This industry includes those who lease, rent, or manage real property, real estate agents, and appraisers. Erie's virtually non-existent population growth since the Bicentennial and lower than average income levels may have something to do with low demands in this sector.

We note that the apparel industries (313 Textile mills, 314 Textile mill products, 315 Apparel manufacturing, and 316 Leather product manufacturing) are all on the low LQ list, and show some excess demand although they do not rise to the \$5 million level. The history of these industries, moving out of the northeast U.S. first to the South and then offshore, suggests that this would not be a likely cluster for the Erie area.

We also note that "Farms" are also high on the excess demand list. But this is an artifact of the data available. The I/O industries include crop and animal farming, but the CBP database does not have data for those industries. As a result, the measure of current supply is inaccurately low, causing a high excess demand number. With the data we have from the CBP, we simply cannot tell if agriculture is a likely candidate for import substitution or not.

Table 11  
Direct Requirements Coefficients for Selected Transportation and Warehousing Industries

**481: Air transportation**

GFE	Federal government enterprises	0.0107
514	Information and data processing services	0.0070
562	Waste management and remediation services	0.0060
521CI	Federal Reserve banks, credit intermed, and relateds	0.0057
323	Printing and related support activities	0.0054
GFG	Federal general government	0.0053
511	Publishing industries (includes softw are)	0.0050
5415	Computer systems design and related services	0.0046
484	Truck transportation	0.0044
561	Administrative and support services	0.0043
5412OP	Misc professional, scientific, and technical services	0.0035
512	Motion picture and sound recording industries	0.0031
337	Furniture and related products	0.0027
523	Securities, commodity contracts, and investments	0.0025
321	Wood products	0.0024
532RL	Rental and leasing services and lessors of intangible assets	0.0023
487OS	Other transportation and support activities	0.0023
332	Fabricated metal products	0.0023
713	Amusements, gambling, and recreation industries	0.0021
326	Plastics and rubber products	0.0021

**482: Rail transportation**

212	Mining, except oil and gas	0.0368
331	Primary metals	0.0272
22	Utilities	0.0245
327	Nonmetallic mineral products	0.0140
484	Truck transportation	0.0123
322	Paper products	0.0110
325	Chemical products	0.0067
311FT	Food and beverage and tobacco products	0.0058
GFE	Federal government enterprises	0.0054
482	Rail transportation	0.0048
213	Support activities for mining	0.0046
321	Wood products	0.0045
326	Plastics and rubber products	0.0044
111CA	Farms	0.0040
332	Fabricated metal products	0.0026
337	Furniture and related products	0.0019
335	Electrical equipment, appliances, and components	0.0018
3361MV	Motor vehicles, bodies and trailers, and parts	0.0017
323	Printing and related support activities	0.0014
333	Machinery	0.0012

**483: Water transportation**

5412OP	Misc professional, scientific, and technical services	0.0018
111CA	Farms	0.0013
GFG	Federal general government	0.0012
GFE	Federal government enterprises	0.0012
311FT	Food and beverage and tobacco products	0.0011
331	Primary metals	0.0006
483	Water transportation	0.0006
481	Air transportation	0.0005
212	Mining, except oil and gas	0.0004
327	Nonmetallic mineral products	0.0004
484	Truck transportation	0.0003
486	Pipeline transportation	0.0003
482	Rail transportation	0.0003
487OS	Other transportation and support activities	0.0003
325	Chemical products	0.0002
213	Support activities for mining	0.0002
22	Utilities	0.0002
55	Management of companies and enterprises	0.0002
23	Construction	0.0002
GSLG	State and local general government	0.0002

**484: Truck transportation**

484	Truck transportation	0.0609
327	Nonmetallic mineral products	0.0422
321	Wood products	0.0258
311FT	Food and beverage and tobacco products	0.0212
322	Paper products	0.0173
337	Furniture and related products	0.0168
331	Primary metals	0.0166
212	Mining, except oil and gas	0.0162
111CA	Farms	0.0153
313TT	Textile mills and textile product mills	0.0153
213	Support activities for mining	0.0114
23	Construction	0.0112
3361MV	Motor vehicles, bodies and trailers, and parts	0.0110
339	Miscellaneous manufacturing	0.0104
323	Printing and related support activities	0.0099
315AL	Apparel and leather and allied products	0.0096
332	Fabricated metal products	0.0095
325	Chemical products	0.0094
333	Machinery	0.0091
326	Plastics and rubber products	0.0089

**493: Warehousing and storage**

493	Warehousing and storage	0.0459
44RT	Retail trade	0.0137
484	Truck transportation	0.0109
42	Wholesale trade	0.0083
323	Printing and related support activities	0.0064
487OS	Other transportation and support activities	0.0058
511	Publishing industries (includes softw are)	0.0046
483	Water transportation	0.0045
514	Information and data processing services	0.0044
321	Wood products	0.0040
3364OT	Other transportation equipment	0.0038
337	Furniture and related products	0.0037
111CA	Farms	0.0037
332	Fabricated metal products	0.0036
339	Miscellaneous manufacturing	0.0035
327	Nonmetallic mineral products	0.0034
333	Machinery	0.0029
326	Plastics and rubber products	0.0027
GSLG	State and local general government	0.0026
331	Primary metals	0.0025



Given all this information, the industries in Table 12 are industries that deserve further consideration for import substitution initiatives.

Table 12  
Import Substitution Candidates

NAICS	Industry
322	Paper manufacturing
325	Chemical manufacturing
331	Primary metal manufacturing
334	Computer and electronic product manufacturing
481	Air transportation
482	Rail transportation
493	Warehousing and storage
514	Information and data processing services
531	Real estate
541	Professional, scientific, and technical services
5412OP	All prof, sci & tech services except legal and computer
5415	Computer systems design and related services

## VIII. CHOOSING AMONG THE CANDIDATES

In choosing potential industry targets, the crucial criterion is whether or not this is an appropriate area for each candidate industry from the perspective of an investor that is motivated by the bottom line. Can the firm make a profit if it locates here, and how does that profit compare with locations elsewhere? Does the area have the other location factors—besides the excess demand—that are necessary for a profitable operation? That is not a simple question since each industry has its own set of location factors. But the analysis in this report provides information on the crucial demand side of the profit equation, which it is often hard for a firm from outside the region to evaluate.

Local leaders with limited resources who are concerned with economic development will also logically consider the impact each candidate industry is likely to have on the local area. One question to ask is about the relative income level of the candidate industries. Table 13 shows the average annual payroll per job for each industry for 2009.<sup>17</sup> This varies significantly for the candidate industries, from a low of \$24,774 in Real estate to a high of \$49,860 in Computer and electronics manufacturing.

Another issue to consider is the future prospects of each industry. Is the candidate industry projected to grow rapidly in the future, or to decline? The U.S. Bureau of Labor Statistics prepares 10-year projections of growth rates by industry for the country.<sup>18</sup> These forecasts are reported in Appendix C for all industries. Table 13 also reports the projected national growth rates for 2008-18 for the import substitution candidates reported above. It is interesting to note that for the eight industries for which there are data on both payroll per job and projected growth rates that there is a negative correlation (-0.41) between the two variables, meaning that selecting an industry with a higher pay rate also tends to mean selecting an industry with slower expected growth in the future. The notable exception is NAICS 5415, computer systems design.

<sup>17</sup> Average annual payroll per job was calculated from the County Business Patterns data by dividing the first quarter payroll amount by the first quarter employment, and multiplying by four to annualize it. Note that the CBP employment numbers include both part-time and full-time workers and the payroll per job values are not adjusted to “full time equivalents”. This can make a significant difference if some industries have larger numbers of part-time workers than others.

<sup>18</sup> Details of the projections are available at: <http://www.bls.gov/emp/#data>.

Table 13  
Summary Information for Import Substitution Candidates

NAICS	Industry	2009 Location Quotient	Estimated Excess Demand (thou of \$)	2009 Erie Annual Payroll (thou of \$)	2009 Erie Annual Payroll Per Job	2008-18 Expected Annual U.S. Growth Rate	National Multiplier
322	Paper manufacturing	0.099	13,905	\$1,463	\$30,737	-2.7%	2.3147
325	Chemical manufacturing	0.111	73,865	4,213	40,926	-0.7	2.3456
331	Primary metal manufacturing	2.311	43,158	32,636	43,464	-1.0	2.6352
334	Computer and electronic product manufacturing	0.907	22,644	45,021	49,860	-2.1	1.7696
481	Air transportation	0.045	5,571	794	na	0.7	1.9873
482	Rail transportation	0.000	5,245	na	na	0.5	1.9562
493	Warehousing and storage	0.326	5,582	6,189	29,115	1.2	1.5567
514	Information and data processing services	na	10,109	813	na	na	1.8268
531	Real estate	0.358	108,182	16,016	24,774	1.3	1.4691
541	Professional, scientific, and technical services	0.277		111,280	28,021	3.0	na
5412OP	All prof. sci & tech services except legal and computer	0.197	78,566	73,873	na	2.9	1.5464
5415	Computer systems design and related services	0.071	12,302	5,855	39,347	3.8	1.4712

Another consideration is the likely impact of the industry on other industries and the economy overall—the so-called multiplier. The logic goes like this: in order for Industry X to produce one dollar of its output, it will need to buy inputs from other industries. Those industries in turn will need to buy their own inputs, some of which may include products produced by Industry X. It is possible to estimate the total amount of inputs/production that must take place for one dollar of Industry X's output to be produced. In input-output parlance, this amount is called the Total Requirement. It is different from the Direct Requirements Coefficients discussed earlier since it takes into account feedbacks from the purchases of other industries.

Using an example discussed above, in order to produce \$1 of its output the Plastics industry (NAICS 326) must buy 30.1 cents of inputs from the Chemicals industry (NAICS 325), along with many other inputs. But in order to produce that 30.1 cents of chemicals, the Chemicals industry must buy inputs of its own, and those inputs include about 1.5 cents of plastics products. The same is true for all the others of the Plastics' industry's inputs, although they all will need different amounts of plastics products. So to produce that initial \$1 of plastics products, the BEA estimates that the Plastics industry will need to produce a total of \$1.07996 of output. Other industries will also need to produce their own products: the Chemicals industry will need to produce a total of 44.3 cents of chemicals, there will need to be an additional 4.2 cents of utilities production, 7.5 cents of professional services, etc. The total of all new production from this initial \$1 of demand for the Plastics industry is nearly \$2.43.

This means that the Total Requirements value can also be considered a multiplier, since that one dollar of initial demand will generate a total of \$2.43 of production across the economy—the original \$1.00 of plastics output plus another \$1.43 of products in a broad range of industries. The BEA estimates the Total Requirements for all the industries in its input-output tables. These are reported in Table 14 below, and for the candidate industries in Table 13 above. For the candidate industries, the multipliers tend to be positively correlated with average pay ( $r = 0.36$ ,  $n=7$ ) and negatively correlated with expected growth rate ( $r = -0.71$ ,  $n = 10$ ).

Table 14  
2009 National Total Requirements Multipliers

I/O Code	Industry	Multiplier	I/O Code	Industry	Multiplier
111CA	Farms	2.3330	486	Pipeline transportation	1.6730
113FF	Forestry, fishing, and related activities	1.5573	487OS	Other transportation and support activities	1.5518
211	Oil and gas extraction	1.4057	493	Warehousing and storage	1.5567
212	Mining, except oil and gas	1.6504	511	Publishing industries (includes software)	1.9512
213	Support activities for mining	1.8341	512	Motion picture and sound recording industries	1.7211
22	Utilities	1.5176	513	Broadcasting and telecommunications	1.7627
23	Construction	1.9738	514	Information and data processing services	1.8268
321	Wood products	2.4188	521CI	Federal Reserve banks, credit intermediation, and related	1.8992
327	Nonmetallic mineral products	2.1162	523	Securities, commodity contracts, and investments	2.0670
331	Primary metals	2.6352	524	Insurance carriers and related activities	1.6139
332	Fabricated metal products	2.2940	525	Funds, trusts, and other financial vehicles	2.0293
333	Machinery	2.2110	531	Real estate	1.4691
334	Computer and electronic products	1.7696	532RL	Rental & leasing services & lessors of intangible assets	1.6433
335	Electrical equipment, appliances, and components	2.0669	5411	Legal services	1.3675
3361MV	Motor vehicles, bodies and trailers, and parts	2.8175	5415	Computer systems design and related services	1.4712
3364OT	Other transportation equipment	2.2942	5412OP	Misc professional, scientific, and technical services	1.5464
337	Furniture and related products	2.2533	55	Management of companies and enterprises	1.5968
339	Miscellaneous manufacturing	1.9432	561	Administrative and support services	1.6426
311FT	Food and beverage and tobacco products	2.5920	562	Waste management and remediation services	1.8940
313TT	Textile mills and textile product mills	2.3024	61	Educational services	1.5964
315AL	Apparel and leather and allied products	1.7659	621	Ambulatory health care services	1.6197
322	Paper products	2.3147	622HO	Hospitals and nursing and residential care facilities	1.7142
323	Printing and related support activities	2.2182	624	Social assistance	1.6405
324	Petroleum and coal products	2.1161	711AS	Performing arts, spectator sports, museums, and related	1.7441
325	Chemical products	2.3456	713	Amusements, gambling, and recreation industries	1.6848
326	Plastics and rubber products	2.4263	721	Accommodation	1.7804
42	Wholesale trade	1.3594	722	Food services and drinking places	1.8703
44RT	Retail trade	1.4796	81	Other services, except government	1.7436
481	Air transportation	1.9873	GFG	Federal general government	1.8023
482	Rail transportation	1.9562	GFE	Federal government enterprises	1.6384
483	Water transportation	2.1152	GSLG	State and local general government	1.6183
484	Truck transportation	1.9650	GSLG	State and local government enterprises	2.0685
485	Transit and ground passenger transportation	1.5566			

I/O industry codes are explained in Appendix A, Table A-2.

## IX. CONCLUSIONS

The goal of this study is to explore the possibility of identifying likely candidate industries for import substitution in the Erie area. We considered two different approaches to this issue, first using location quotients to identify industries that are likely importers and exporters in the Erie area. Then we applied a new approach and identified industries where there is excess demand that is not being served in the local area. Each approach provides a list of potential import substitution candidates.

Combining the two approaches left us with the dozen or so likely import substitution candidates listed in Table 12. While this analysis can suggest some likely candidates for import substitution, it cannot make the ultimate decision. That can only be done by exploring the appropriateness of each candidate for profitable location in the local area, as well as its likely impact on the local economy. Table 13 helps with regard to the latter issue.

What this analysis CAN do is help fill in one piece of the puzzle; it can indicate to potential Erie suppliers where there is local demand for products that is currently not being supplied. That amounts to a profit opportunity for entrepreneurs to explore. If they act on this information, it may ultimately result in benefits to those who choose to take up that challenge as well as benefits to the broader local community.

## **Appendix A Industry Definitions**

As mentioned above, this study makes use of the North American Industry Classification System (NAICS). Details of the system can be found at: <http://www.census.gov/eos/www/naics/>, including detailed descriptions of the individual industry categories at <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2007> and [http://www.census.gov/eos/www/naics/2007NAICS/2007\\_Definition\\_File.pdf](http://www.census.gov/eos/www/naics/2007NAICS/2007_Definition_File.pdf)

Many of the NAICS category names are descriptive, but sometimes it is not completely clear just what an industry includes. In those cases, it is useful to see the subindustries that make up a broader category. That's the purpose of this Appendix.

While both the County Business Patterns and the BEA's Input-Output System use NAICS industry classifications, the I/O system sometimes aggregates individual categories to make new ones. Because of that, this Appendix includes two lists. Table A-1 gives the broader NAICS classifications, and Table A-2 is the list of the I/O industry categories with their components. The full list of NAICS codes down to the 6-digit level is too long to include in its entirety here, but Table A-1 includes the 2- and 3-digit categories, with selected 4-digit industries to help clarify things. Caution: there are industries listed here that are not covered in the County Business Patterns database, as explained in the text.

**Table A-1: All NAICS Codes**

<b>11</b>	<b>Agriculture, forestry, fishing and hunting</b>	<b>51</b>	<b>Information</b>
111	Crop Production	511	Publishing industries (except Internet)
112	Animal Production	512	Motion picture and sound recording industries
113	Forestry and logging	515	Broadcasting (except Internet)
114	Fishing, hunting and trapping	517	Telecommunications
115	Support activities for agriculture and forestry	518	Data processing, hosting and related services
<b>21</b>	<b>Mining, quarrying, and oil and gas extraction</b>	519	Other information services
211	Oil and gas extraction	<b>52</b>	<b>Finance and insurance</b>
212	Mining (except oil and gas)	521	Monetary authorities- central bank
213	Support activities for mining	522	Credit intermediation and related activities
213111	Drilling oil and gas wells	523	Securities, commodity contracts, other fin instrmts & related activities
<b>22</b>	<b>Utilities</b>	524	Insurance carriers and related activities
221	Utilities	525	Funds, trusts, and other financial vehicles
2211	Electric power generation, transmission and distribution	<b>53</b>	<b>Real estate and rental and leasing</b>
2212	Natural gas distribution	531	Real estate
2213	Water, sewage and other systems	532	Rental and leasing services
<b>23</b>	<b>Construction</b>	533	Lessors of nonfinancial intangible assets (except copyrighted works)
236	Construction of buildings	<b>54</b>	<b>Professional, scientific, and technical services</b>
237	Heavy and civil engineering construction	541	Professional, scientific, and technical services
238	Specialty trade contractors	5411	Legal services
<b>31-33</b>	<b>Manufacturing</b>	5412	Accounting, tax preparation, bookkeeping, and payroll services
311	Food manufacturing	5413	Architectural, engineering, and related services
312	Beverage and tobacco product manufacturing	5414	Specialized design services
313	Textile mills	5415	Computer systems design and related services
314	Textile product mills	5416	Management, scientific, and technical consulting services
315	Apparel manufacturing	5417	Scientific research and development services
316	Leather and allied product manufacturing	5418	Advertising, public relations, and related services
321	Wood product manufacturing	5419	Other professional, scientific, and technical services
322	Paper manufacturing	<b>55</b>	<b>Management of companies and enterprises</b>
323	Printing and related support activities	551	Management of companies and enterprises
324	Petroleum and coal products manufacturing	<b>56</b>	<b>Administrative, support, waste management &amp; remediation svcs</b>
325	Chemical manufacturing	561	Administrative and support services
3251	Basic chemical manufacturing	562	Waste management and remediation services
3252	Resin, synthetic rubber, artificial synthetic fibers & filaments mfg	<b>61</b>	<b>Educational services</b>
3253	Pesticide, fertilizer, and other agricultural chemical manufacturing	611	Educational services
3254	Pharmaceutical and medicine manufacturing	6111	Elementary and secondary schools
3255	Paint, coating, and adhesive manufacturing	6112	Junior colleges
3256	Soap, cleaning compound, and toilet preparation manufacturing	6113	Colleges, universities, and professional schools
3259	Other chemical product and preparation manufacturing	6114	Business schools and computer and management training
326	Plastics and rubber products manufacturing	6115	Technical and trade schools
327	Nonmetallic mineral product manufacturing	6116	Other schools and instruction
331	Primary metal manufacturing	6117	Educational support services
332	Fabricated metal product manufacturing	<b>62</b>	<b>Health care and social assistance</b>
333	Machinery manufacturing	621	Ambulatory health care services
334	Computer and electronic product manufacturing	6211	Offices of physicians
3341	Computer and peripheral equipment manufacturing	6212	Offices of dentists
3342	Communications equipment manufacturing	6213	Offices of other health practitioners
3343	Audio and video equipment manufacturing	6214	Outpatient care centers
3344	Semiconductor and other electronic component manufacturing	6215	Medical and diagnostic laboratories
3345	Navigational, measuring, electromedical, & control instruments mfg	6216	Home health care services
3346	Manufacturing and reproducing magnetic and optical media	6219	Other ambulatory health care services
335	Electrical equipment, appliance, and component manufacturing	622	Hospitals
336	Transportation equipment manufacturing	623	Nursing and residential care facilities
3361	Motor vehicle manufacturing	624	Social assistance
3362	Motor vehicle body and trailer manufacturing	6241	Individual and family services
3363	Motor vehicle parts manufacturing	6242	Community food and housing, emergency and other relief svcs
3364	Aerospace product and parts manufacturing	6243	Vocational rehabilitation services
3365	Railroad rolling stock manufacturing	6244	Child day care services
3366	Ship and boat building	<b>71</b>	<b>Arts, entertainment, and recreation</b>
3369	Other transportation equipment manufacturing	711	Performing arts, spectator sports, and related industries
337	Furniture and related product manufacturing	712	Museums, historical sites, and similar institutions
339	Miscellaneous manufacturing	713	Amusement, gambling, and recreation industries
<b>42</b>	<b>Wholesale trade</b>	<b>72</b>	<b>Accommodation and food services</b>
423	Merchant wholesalers, durable goods	721	Accommodation
424	Merchant wholesalers, nondurable goods	722	Food services and drinking places
425	Wholesale electronic markets and agents and brokers	<b>81</b>	<b>Other services (except public administration)</b>
<b>44-45</b>	<b>Retail trade</b>	811	Repair and maintenance
441	Motor vehicle and parts dealers	8111	Automotive repair and maintenance
442	Furniture and home furnishings stores	8112	Electronic and precision equipment repair and maintenance
443	Electronics and appliance stores	8113	Commercial and industrial mach and eqpt repair and maintenance
444	Building material and garden equipment and supplies dealers	8114	Personal and household goods repair and maintenance
445	Food and beverage stores	812	Personal and laundry services
446	Health and personal care stores	8121	Personal care services
447	Gasoline stations	8122	Death care services
448	Clothing and clothing accessories stores	8123	Drycleaning and laundry services
451	Sporting goods, hobby, book, and music stores	8129	Other personal services
452	General merchandise stores	813	Religious, grantmaking, civic, professional, and similar organizations
453	Miscellaneous store retailers	<b>91</b>	<b>Public administration</b>
454	Nonstore retailers	921	Executive, Legislative, and Other General Government Support
<b>48-49</b>	<b>Transportation and warehousing</b>	922	Justice, Public Order, and Safety Activities
481	Air transportation	923	Administration of Human Resource Programs
482	Rail Transportation	924	Administration of Environmental Quality Programs
483	Water transportation	925	Administration of Housing Programs, Urban Planning, and Community Development
484	Truck transportation	926	Administration of Economic Programs
485	Transit and ground passenger transportation	927	Space Research and Technology
486	Pipeline transportation	928	National Security and International Affairs
487	Scenic and sightseeing transportation	<b>99</b>	<b>Industries not classified</b>
488	Support activities for transportation		
491	Postal Service		
492	Couriers and messengers		
493	Warehousing and storage		

**Table A-2: Input-Output Industries**

Sector Code	Sector Description	Summary Code	Summary Description	Detail Code	Detail Description				
11	Agriculture, forestry, fishing, and	111CA	Farms	1111A0	Oilseed farming				
				1111B0	Grain farming				
				111200	Vegetable and melon farming				
				111335	Tree nut farming				
				1113A0	Fruit farming				
				111400	Greenhouse, nursery, and floriculture production				
				111910	Tobacco farming				
				111920	Cotton farming				
				1119A0	Sugarcane and sugar beet farming				
				1119B0	All other crop farming				
		112120	Dairy cattle and milk production						
		1121A0	Cattle ranching and farming						
		112300	Poultry and egg production						
		112800	Animal production, except cattle & poultry & eggs						
		113FF	Forestry, fishing, and related activities	113300	Logging				
				113A00	Forest nurseries, forest products, and timber tracts				
				114100	Fishing				
				114200	Hunting and trapping				
				115000	Support activities for agriculture and forestry				
				21	Mining	211	Oil and gas extraction	211000	Oil and gas extraction
212	Mining, except oil and gas	212100	Coal mining						
		212210	Iron ore mining						
		212230	Copper, nickel, lead, and zinc mining						
		2122A0	Gold, silver, and other metal ore mining						
		212310	Stone mining and quarrying						
		212320	Sand, gravel, clay, and ceramic and refractory minerals mining and quarrying						
		212390	Other nonmetallic mineral mining and quarrying						
		213	Support activities for mining	213111		Drilling oil and gas wells			
				21311A		Support activities for other mining			
				21311B		Support activities for oil and gas operations			
22	Utilities	22	Utilities	221100		Electric power generation, transmission, & distribtn			
221200		Natural gas distribution							
221300		Water, sewage and other systems							
23	Construction	23	Construction	230101	Nonresidential commercial & health care structures				
				230102	Nonresidential manufacturing structures				
				230103	Other nonresidential structures				
				230201	Residntl permanent site single- & multi-family strctrs				
				230202	Other residential structures				
				230301	Nonresidential maintenance and repair				
				230302	Residential maintenance and repair				
				31G	Manufacturing	311FT	Food and beverage and tobacco products	311111	Dog and cat food manufacturing
								311119	Other animal food manufacturing
								311210	Flour milling and malt manufacturing
								311221	Wet corn milling
								311225	Fats and oils refining and blending
								31122A	Soybean and other oilseed processing
311230	Breakfast cereal manufacturing								
311313	Beet sugar manufacturing								
31131A	Sugar cane mills and refining								
311320	Chocolate and confectionery mfg from cacao beans								
311330	Confectionery mfg from purchased chocolate								
311340	Nonchocolate confectionery manufacturing								
311410	Frozen food manufacturing								
311420	Fruit and vegetable canning, pickling, and drying								
311513	Cheese manufacturing								
311514	Dry, condensed, and evaporated dairy product mfg								
31151A	Fluid milk and butter manufacturing								
311520	Ice cream and frozen dessert manufacturing								
311615	Poultry processing								
31161A	Animal (exc poultry) slaughtering, rendering, & processing								
311700	Seafood product preparation and packaging								
311810	Bread and bakery product manufacturing								
311820	Cookie, cracker, and pasta manufacturing								
311830	Tortilla manufacturing								
311910	Snack food manufacturing								
311920	Coffee and tea manufacturing								
311930	Flavoring syrup and concentrate manufacturing								
311940	Seasoning and dressing manufacturing								
311990	All other food manufacturing								
312110	Soft drink and ice manufacturing								
312120	Breweries								
312130	Wineries								
312140	Distilleries								
3122A0	Tobacco product manufacturing								
313TT	Textile mills and textile product mills	313100	Fiber, yarn, and thread mills						
		313210	Broadwoven fabric mills						
		313220	Narrow fabric mills and schiffli machine embroidery						
		313230	Nonwoven fabric mills						
		313240	Knit fabric mills						
		313310	Textile and fabric finishing mills						
		313320	Fabric coating mills						
		314110	Carpet and rug mills						
		314120	Curtain and linen mills						
		314910	Textile bag and canvas mills						
315AL	Apparel and leather and allied products	314990	All other textile product mills						
		315100	Apparel knitting mills						
		315210	Cut and sew apparel contractors						
		315220	Men's and boys' cut and sew apparel manufacturing						
		315230	Women's and girls' cut and sew apparel mfg						
		315290	Other cut and sew apparel manufacturing						
		315900	Apparel accessories and other apparel mfg						
		316100	Leather and hide tanning and finishing						
		316200	Footwear manufacturing						
		316900	Other leather and allied product manufacturing						

31G cont.	Manufacturing cont.	321	Wood products	321100	Sawmills and wood preservation		
				321219	Reconstituted wood product manufacturing		
				32121A	Veneer and plywood manufacturing		
				32121B	Engineered wood member and truss manufacturing		
				321910	Wood windows and doors and millwork		
				321920	Wood container and pallet manufacturing		
				321991	Manufactured home (mobile home) manufacturing		
				321992	Prefabricated wood building manufacturing		
				321999	All other miscellaneous wood product manufacturing		
				322	Paper products	322110	Pulp mills
		322120	Paper mills				
		322130	Paperboard Mills				
		322210	Paperboard container manufacturing				
		32222A	Coated and laminated paper, packaging paper and plastics film manufacturing				
		32222B	All other paper bag and coated & treated paper mfg				
		322230	Stationery product manufacturing				
		322291	Sanitary paper product manufacturing				
		322299	All other converted paper product manufacturing				
		323	Printing and related support activities	32311A		Printing	
		323120		Support activities for printing			
		324	Petroleum and coal products	324110	Petroleum refineries		
				324121	Asphalt paving mixture and block manufacturing		
				324122	Asphalt shingle and coating materials manufacturing		
				324191	Petroleum lubricating oil and grease manufacturing		
				324199	All other petroleum and coal products manufacturing		
		325	Chemical products	325110	Petrochemical manufacturing		
				325120	Industrial gas manufacturing		
				325130	Synthetic dye and pigment manufacturing		
				325181	Alkalies and chlorine manufacturing		
				325182	Carbon black manufacturing		
				325188	All other basic inorganic chemical manufacturing		
				325190	Other basic organic chemical manufacturing		
				325211	Plastics material and resin manufacturing		
				325212	Synthetic rubber manufacturing		
				325220	Artificial and synthetic fibers and filaments mfg		
				325310	Fertilizer manufacturing		
				325320	Pesticide and other agricultural chemical mfg		
				325411	Medicinal and botanical manufacturing		
				325412	Pharmaceutical preparation manufacturing		
				325413	In-vitro diagnostic substance manufacturing		
				325414	Biological product (except diagnostic) manufacturing		
				325510	Paint and coating manufacturing		
				325520	Adhesive manufacturing		
				325610	Soap and cleaning compound manufacturing		
				325620	Toilet preparation manufacturing		
				325910	Printing ink manufacturing		
				3259A0	All other chemical product and preparation mfg		
				326	Plastics and rubber products	326110	Plastics packaging materials and unlaminated film and sheet manufacturing
						326121	Unlaminated plastics profile shape manufacturing
						326122	Plastics pipe and pipe fitting manufacturing
						326130	Laminated plastics plate, sheet (except packaging), and shape manufacturing
						326140	Polystyrene foam product manufacturing
						326150	Urethane and other foam product (except polystyrene) manufacturing
		326160	Plastics bottle manufacturing				
		32619A	Other plastics product manufacturing				
		326210	Tire manufacturing				
		326220	Rubber and plastics hoses and belting manufacturing				
		326290	Other rubber product manufacturing				
		327	Nonmetallic mineral products			32711A	Pottery, ceramics, and plumbing fixture manufacturing
						32712A	Brick, tile, and other structural clay product mfg
						32712B	Clay and nonclay refractory manufacturing
						327211	Flat glass manufacturing
				327212	Other pressed and blown glass and glassware mfg		
				327213	Glass container manufacturing		
				327215	Glass product mfg made of purchased glass		
				327310	Cement manufacturing		
				327320	Ready-mix concrete manufacturing		
				327330	Concrete pipe, brick, and block manufacturing		
				327390	Other concrete product manufacturing		
				3274A0	Lime and gypsum product manufacturing		
				327910	Abrasive product manufacturing		
				327991	Cut stone and stone product manufacturing		
				327992	Ground or treated mineral and earth manufacturing		
				327993	Mineral wool manufacturing		
				327999	Miscellaneous nonmetallic mineral products		
				331	Primary metals	331110	Iron and steel mills and ferroalloy manufacturing
		331200	Steel product manufacturing from purchased steel				
		331314	Secondary smelting and alloying of aluminum				
		33131A	Alumina refining and primary aluminum production				
		33131B	Aluminum product mfg from purchased aluminum				
		331411	Primary smelting and refining of copper				
		331419	Primary smelting and refining of nonferrous metal (except copper and aluminum)				
		331420	Copper rolling, drawing, extruding and alloying				
		331490	Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloying				
		331510	Ferrous metal foundries				
		331520	Nonferrous metal foundries				
		332	Fabricated metal products	332114	Custom roll forming		
				33211A	All other forging, stamping, and sintering		
				33211B	Crown and closure mfg and metal stamping		
				33221A	Cutlery, utensil, pot, and pan manufacturing		
				33221B	Handtool manufacturing		
				332310	Plate work and fabricated structural product mfg		
				332320	Ornamental and architectural metal products mfg		
				332410	Power boiler and heat exchanger manufacturing		
				332420	Metal tank (heavy gauge) manufacturing		
				332430	Metal can, box, & other metal container (light gauge) mfg		
				332500	Hardware manufacturing		
				332600	Spring and wire product manufacturing		
				332710	Machine shops		
				332720	Turned product and screw, nut, and bolt mfg		
332800	Coating, engraving, heat treating and allied activities						
332913	Plumbing fixture fitting and trim manufacturing						
33291A	Valve and fittings other than plumbing						
332991	Ball and roller bearing manufacturing						
332996	Fabricated pipe and pipe fitting manufacturing						
33299A	Ammunition manufacturing						
33299B	Arms, ordnance, and accessories manufacturing						
33299C	Other fabricated metal manufacturing						

31G cont.	Manufacturing cont.	333	Machinery	333111	Farm machinery and eqpt manufacturing				
				333112	Lawn and garden eqpt manufacturing				
				333120	Construction machinery manufacturing				
				333130	Mining and oil and gas field machinery manufacturing				
				333220	Plastics and rubber industry machinery manufacturing				
				333295	Semiconductor machinery manufacturing				
				33329A	Other industrial machinery manufacturing				
				333314	Optical instrument and lens manufacturing				
				333315	Photographic and photocopying eqpt manufacturing				
				333319	Other commercial and service industry machinery mfg				
				33331A	Vending, commercial, industrial, and office machinery mfg				
				333414	Heating eqpt (except warm air furnaces) mfg				
				333415	Air conditioning, refrigeration, & warm air heating eqpt mfg				
				33341A	Air purification and ventilation eqpt mfg				
				333511	Industrial mold manufacturing				
				333514	Special tool, die, jig, and fixture manufacturing				
				333515	Cutting tool and machine tool accessory mfg				
				33351A	Metal cutting and forming machine tool mfg				
				33351B	Rolling mill and other metalworking machinery mfg				
				333611	Turbine and turbine generator set units mfg				
				333612	Speed changer, industrial high-speed drive, and gear mfg				
				333613	Mechanical power transmission eqpt mfg				
				333618	Other engine eqpt mfg				
				333912	Air and gas compressor mfg				
				33391A	Pump and pumping eqpt mfg				
				333920	Material handling eqpt mfg				
				333991	Power-driven handtool mfg				
				333993	Packaging machinery mfg				
				333994	Industrial process furnace and oven mfg				
				33399A	Other general purpose machinery mfg				
				33399B	Fluid power process machinery				
				334	Computer and electronic products	334111	Electronic computer mfg		
						334112	Computer storage device mfg		
		33411A	Computer terminals & other computer peripheral eqpt mfg						
		334210	Telephone apparatus mfg						
		334220	Broadcast and wireless communications eqpt						
		334290	Other communications eqpt mfg						
		334300	Audio and video eqpt mfg						
		334411	Electron tube mfg						
		334412	Bare printed circuit board mfg						
		334413	Semiconductor and related device mfg						
		334417	Electronic connector mfg						
		334418	Printed circuit assembly (electronic assembly) mfg						
		334419	Other electronic component mfg						
		33441A	Electronic capacitor, resistor, coil, transformer, and other inductor mfg						
		334510	Electromedical and electrotherapeutic apparatus mfg						
		334511	Search, detection, and navigation instruments mfg						
		334512	Automatic environmental control mfg						
		334513	Industrial process variable instruments mfg						
		334514	Totalizing fluid meters and counting devices mfg						
		334515	Electricity and signal testing instruments mfg						
		334516	Analytical laboratory instrument mfg						
		334517	Irradiation apparatus mfg						
		33451A	Watch, clock, & other measuring & controlling device mfg						
		334613	Magnetic and optical recording media mfg						
		33461A	Software, audio, and video media reproducing						
		335	Electrical equipment, appliances, and			335110	Electric lamp bulb and part mfg		
						335120	Lighting fixture mfg		
						335210	Small electrical appliance mfg		
						335221	Household cooking appliance mfg		
						335222	Household refrigerator and home freezer mfg		
						335224	Household laundry eqpt mfg		
						335228	Other major household appliance mfg		
						335311	Power, distribution, and specialty transformer mfg		
				335312	Motor and generator mfg				
				335313	Switchgear and switchboard apparatus mfg				
				335314	Relay and industrial control mfg				
				335911	Storage battery mfg				
				335912	Primary battery mfg				
				335920	Communication and energy wire and cable mfg				
				335930	Wiring device mfg				
				335991	Carbon and graphite product mfg				
				335999	All other miscellaneous electrical eqpt and component mfg				
				336MV	Motor vehicles, bodies and trailers, and	336111	Automobile mfg		
						336112	Light truck and utility vehicle mfg		
						336120	Heavy duty truck mfg		
						336211	Motor vehicle body mfg		
						336212	Truck trailer mfg		
						336213	Motor home mfg		
						336214	Travel trailer and camper mfg		
						336300	Motor vehicle parts mfg		
						3364OT	Other transportation equipment	336411	Aircraft mfg
								336412	Aircraft engine and engine parts mfg
				336413	Other aircraft parts and auxiliary eqpt mfg				
				336414	Guided missile and space vehicle mfg				
				33641A	Propulsion units & parts for space vehcls & guided missiles				
				336500	Railroad rolling stock mfg				
				336611	Ship building and repairing				
				336612	Boat building				
		336991	Motorcycle, bicycle, and parts mfg						
		336992	Military armored vehicle, tank, and tank component mfg						
		336999	All other transportation eqpt mfg						
		337	Furniture and related products	337110	Wood kitchen cabinet and countertop mfg				
				337121	Upholstered household furniture mfg				
				337122	Nonupholstered wood household furniture mfg				
				337127	Institutional furniture mfg				
				33712A	Metal and other household furniture (except wood) mfg				
				337215	Showcase, partition, shelving, and locker mfg				
				33721A	Wood television, radio, and sewing machine cabinet mfg				
				33721B	Office furniture and custom architectural woodwork and millwork mfg				
337218	Office furniture and custom architectural woodwork and millwork mfg								
337910	Mattress mfg								
337920	Blind and shade mfg								
339	Miscellaneous manufacturing	339111	Laboratory apparatus and furniture mfg						
		339112	Surgical and medical instrument mfg						
		339113	Surgical appliance and supplies mfg						
		339114	Dental eqpt and supplies mfg						
		339115	Ophthalmic goods mfg						
		339116	Dental laboratories						
		339910	Jewelry and silverware mfg						
		339920	Sporting and athletic goods mfg						
		339930	Doll, toy, and game mfg						
		339940	Office supplies (except paper) mfg						
339950	Sign mfg								
339991	Gasket, packing, and sealing device mfg								
339992	Musical instrument mfg								
339994	Broom, brush, and mop mfg								
33999A	All other miscellaneous mfg								



42	Wholesale trade	42	Wholesale trade	42000A	Wholesale trade
44RT	Retail trade	44RT	Retail trade	440000	Retail trade
48TW	Transportation and warehousing	481	Air transportation	481000	Air transportation
		482	Rail transportation	482000	Rail transportation
		483	Water transportation	483000	Water transportation
		484	Truck transportation	484000	Truck transportation
		485	Transit & ground passenger transpnt	485000	Transit and ground passenger transportation
		486	Pipeline transportation	486000	Pipeline transportation
		487OS	Other transportation and support activities	484000	Scenic and sightseeing transportation and support activities
				492000	Couriers and messengers
		493	Warehousing and storage	493000	Warehousing and storage
51	Information	511	Publishing industries (includes software)	511110	Newspaper publishers
				511120	Periodical publishers
				511130	Book publishers
				5111A0	Directory, mailing list, and other publishers
				511200	Software publishers
				516110	Internet Publishing and Broadcasting
		512	Motion picture and sound recording	512100	Motion picture and video industries
				512200	Sound recording industries
				515100	Radio and television broadcasting
		513	Broadcasting and telecommunications	515200	Cable and other subscription programming
				517000	Telecommunications
		514	Information and data processing services	518100	Internet service providers and web search portals
				518200	Data processing, hosting, and related services
				519100	Other information services
6	Educational services, health care, and	61	Educational services	611100	Elementary and secondary schools
				611A00	Junior colleges, colleges, universities, & professional schools
				611800	Other educational services
		621	Ambulatory health care services	621600	Home health care services
				621A00	Offices of physicians, dentists, & other health practitioners
				621800	Medical and diagnostic labs and outpatient and other ambulatory care services
		622HO	Hospitals and nursing and residential care	622000	Hospitals
				623000	Nursing and residential care facilities
		624	Social assistance	624000	Community food, housing, and other relief services, including rehabilitation services
				624200	Child day care services
				624400	Child day care services
				624A00	Individual and family services
7	Arts, entertainment, recreation,	711AS	Performing arts, spectator sports, museums,	711100	Performing arts companies
				711200	Spectator sports
				711500	Independent artists, writers, and performers
				711A00	Promoters of performing arts and sports and agents for public figures
				712000	Museums, historical sites, zoos, and parks
		713	Amusements, gambling, and recreation	713940	Fitness and recreational sports centers
				713950	Bowling centers
				713A00	Amusement parks, arcades, and gambling industries
				713B00	Other amusement and recreation industries
		721	Accommodation	7211A0	Hotels and motels, including casino hotels
				721A00	Other accommodations
		722	Food services and drinking places	722000	Food services and drinking places
81	Other services, except government	81	Other services, except government	811192	Car washes
				8111A0	Automotive repair and maintenance, except car washes
				811200	Electronic and precision equipment repair and maintenance
				811300	Commercial and industrial machinery and equipment repair and maintenance
				811400	Personal and household goods repair and maintenance
				812100	Personal care services
				812200	Death care services
				812300	Dry-cleaning and laundry services
				812900	Other personal services
				813100	Religious organizations
				813A00	Grantmaking, giving, and social advocacy organizations
				813B00	Civic, social, professional, and similar organizations
				814000	Private households
FIRE	Finance, insurance, real estate, rental,	521CI	Federal Reserve banks, credit intermediation,	522A00	Nondepository credit intermediation and related activities
				52A000	Monetary authorities and depository credit intermediation
		523	Securities, commodity contracts, and investments	523000	Securities, commodity contracts, investments, and related activities
		524	Insurance carriers and related activities	5241A0	Insurance carriers
				524200	Insurance agencies, brokerages, and related activities
		525	Funds, trusts, and other financial vehicles	525A00	Funds, trusts, and other financial vehicles
		531	Real estate	531000	Real estate
				500800	Owner-occupied dwellings
		532RL	Rental and leasing services and lessors of	532100	Automotive equipment rental and leasing
				532230	Video tape and disc rental
				532400	Commercial and industrial mach & eqpt rental and leasing
				532A00	General and consumer gds rental exc video tapes & discs
				533000	Lessors of nonfinancial intangible assets
G	Government	GFE	Federal government enterprises	491000	Postal service
				500101	Federal electric utilities
				500102	Other Federal Government enterprises
		GFG	Federal general government	500500	General Federal defense government services
				500600	General Federal nondefense government services
		GSLE	State and local government enterprises	500201	State and local government passenger transit
				500202	State and local government electric utilities
		GSLG	State and local general government	500203	Other state and local government enterprises
				500700	General state and local government services
PROF	Professional and business services	5411	Legal services	541100	Legal services
		5412OP	Miscellaneous professional, scientific, and	541200	Accounting, tax preparation, bookkeeping, & payroll svcs
				541300	Architectural, engineering, and related services
				541400	Specialized design services
				541610	Management, scientific, and technical consulting services
				5416A0	Environmental and other technical consulting services
				541700	Scientific research and development services
				5418A0	Advertising and related services
				541920	Photographic services
				541940	Veterinary services
				5419A0	All other misc professional, scientific, and technical svcs
		5415	Computer systems design and related	541511	Custom computer programming services
				541512	Computer systems design services
				54151A	Other computer related services, including facilities mgmt
		55	Management of companies & enterprises	550000	Management of companies and enterprises
		561	Administrative and support services	561100	Office administrative services
				561200	Facilities support services
				561300	Employment services
				561400	Business support services
				561500	Travel arrangement and reservation services
				561600	Investigation and security services
				561700	Services to buildings and dwellings
				561900	Other support services
F010	Personal consumption expenditures	562	Waste management & remediation svcs	562000	Waste management and remediation services
F020	Private fixed investment	F010	Personal consumption expenditures	F01000	Personal consumption expenditures
F030	Change in private inventories	F020	Private fixed investment	F02000	Private fixed investment
F040	Exports of goods and services	F030	Change in private inventories	F03000	Change in private inventories
F050	Imports of goods and services	F040	Exports of goods and services	F04000	Exports of goods and services
F100	Government consumption expenditures	F050	Imports of goods and services	F05000	Imports of goods and services
		F06C	National defense: Consumption exp	F06C00	Federal Government defense: Consumption expenditures
		F06I	National defense: Gross investment	F06I00	Federal Government defense: Gross investment
		F07C	Nondefense: Consumption exp	F07C00	Federal Government nondefense: Consumption exp
		F07I	Nondefense: Gross investment	F07I00	Federal Government nondefense: Gross investment
		F08C	State and local government consumption expenditures, education	F08C00	State and local government education: Consumption expenditures
		F08I	State and local government gross investment, education	F08I00	State and local government education: Gross investment
		F09C	State and local government consumption expenditures, other	F09C00	State and local government other: Consumption expenditures
		F09I	State and local government gross investment, other	F09I00	State and local government other: Gross investment
Other		Other		500300	
Used		Used		500900	
				500401	
				500402	







## Appendix C

### Actual and Projected National Employment Growth Rates by Industry

NAICS	Industry	Average annual rate of change	
		Actual 1998-2008	Projected 2008-18
	<b>Total employment</b>	0.7	1.0
11	Agriculture, forestry, fishing, and hunting	-1.8	-0.4
111	Crop production	-1.3	-0.8
112	Animal production	-2.6	-0.4
114	Fishing, hunting and trapping	-2.0	0.0
115	Support activities for agriculture and forestry	1.2	0.6
	<b>Nonagriculture wage and salary</b>	0.9	1.0
21	Mining	2.4	-1.6
211	Oil and gas extraction	1.4	-1.7
212	Mining, except oil and gas	-0.7	-0.1
213	Support activities for mining	6.1	-2.6
22	Utilities	-0.9	-1.1
23	Construction	1.6	1.7
31-33	Manufacturing	-2.6	-0.9
311	Food manufacturing	-0.5	0.0
312	Beverage and tobacco product	-0.5	-0.9
313	Textile mills	-9.8	-6.3
314	Textile product mills	-4.5	-4.7
315	Apparel manufacturing	-10.8	-7.8
316	Leather and allied product	-8.6	-3.7
321	Wood product manufacturing	-2.8	-0.8
322	Paper manufacturing	-3.3	-2.7
323	Printing and related support activities	-3.3	-1.7
324	Petroleum and coal products manufacturing	-1.4	-2.5
325	Chemical manufacturing	-1.5	-0.7
326	Plastics and rubber products manufacturing	-2.5	-0.8
327	Nonmetallic mineral product manufacturing	-1.3	0.3
331	Primary metal manufacturing	-3.6	-1.0
332	Fabricated metal product manufacturing	-1.3	-0.9
333	Machinery manufacturing	-2.4	-0.8
334	Computer and electronic product manufacturing	-3.8	-2.1
335	Electrical equipment, appliance, and component mfg	-3.3	-1.4
336	Transportation equipment manufacturing	-2.5	-1.1
337	Furniture and related product manufacturing	-2.9	0.6
339	Miscellaneous manufacturing	-1.4	1.9
42	Wholesale trade	0.3	0.4
44, 45	Retail trade	0.5	0.4
48, 492, 493	Transportation and warehousing	0.8	0.9
481	Air transportation	-1.3	0.7
482	Rail transportation	0.2	0.5
483	Water transportation	2.6	0.3
484	Truck transportation	0.3	1.0
485	Transit and ground passenger transportation	1.4	1.2
486	Pipeline transportation	-1.3	-0.9
491	Postal Service	-1.6	-1.4
492	Couriers and messengers	0.1	0.2
493	Warehousing and storage	3.6	1.2

NAICS	Industry	Average annual rate of change	
		Actual 1998-2008	Projected 2008-18
51	Information	-0.7	0.4
511	Publishing industries	-1.1	-0.5
512	Motion picture, video, and sound recording industries	0.3	1.1
515	Broadcasting (except internet)	-0.2	0.7
517	Telecommunications	-1.3	-0.9
518, 519	Data processing, hosting, related services, and other information services	0.4	3.8
52	Finance and insurance	0.8	0.5
523	Securities, commodity contracts, and other financial investments and related activities	2.2	1.1
524	Insurance carriers and related activities	0.4	0.3
525	Funds, trusts, and other financial vehicles	2.1	1.6
53	Real estate, rental, and leasing	1.0	1.1
531	Real estate	1.5	1.3
532,533	Rental and leasing svcs & lessors of intangible assets	-0.1	0.6
533	Lessors of nonfinancial intangible assets (except copyrighted works)	1.1	3.0
54	Professional, scientific, and technical services	2.7	3.0
5411	Legal services	1.3	2.0
5412	Accounting, tax preparation, bookkeeping, and payroll services	1.7	1.9
5413	Architectural, engineering, and related services	2.6	2.0
5414	Specialized design services	1.8	3.8
5415	Computer systems design and related services	4.1	3.8
5416	Management, scientific, and technical consulting services	5.5	6.2
5417	Scientific research and development services	2.5	2.3
5418	Advertising and related services	0.2	0.8
5419	Other professional, scientific, and technical services	3.1	2.0
55	Management of companies and enterprises	0.8	0.5
56	Administrative and support and waste management and remediation services	0.9	1.6
561	Administrative and support services	0.8	1.6
562	Waste management and remediation services	1.9	2.3
61	Education services	3.1	2.4
6112, 6113	Junior colleges, colleges, universities, & prof schools	2.6	1.5
6114-7	Other educational services	5.2	4.5
62	Health care and social assistance	2.6	2.3
621	Ambulatory health care services	3.1	3.1
622	Hospitals, private	1.8	1.1
623	Nursing and residential care facilities	1.9	1.9
624	Social assistance	4.1	2.8
71	Arts, entertainment, and recreation	1.8	1.4
711	Performing arts, spectator sports, & related industries	1.5	1.4
712	Museums, historical sites, and similar institutions	3.1	2.0
713	Amusement, gambling, and recreation industries	1.8	1.4
72	Accommodation and food services	1.8	0.7
721	Accommodation	0.5	0.5
722	Food services and drinking places	2.1	0.7
81	Other services	1.0	1.2
811	Repair and maintenance	0.3	0.5
812	Personal and laundry services	1.0	1.8
814	Private households	0.4	1.2
	Federal government	0.0	0.3
	State and local government	1.4	0.8

Source: U.S. Bureau of Labor Statistics, "Employment Projections." <http://www.bls.gov/emp/#data>

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