4

Section

First Draft

ECONOMIC DEVELOPMENT PLAN FOR THE MANUFACTURING SECTOR

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Summary

Manufacturing has been a key driver of job creation in our economy for many decades, and in the past, it was a dynamic economic sector that had shown steady exports' growth. Even though the service sector has increased its importance in the island's economy in the recent decades, manufacturing continues to play a principal role, accounting for 66% (46%) of Puerto Rico's National Gross Product (GDP) in 2012.

Some basic facts about this sector are the following:

- 98.72% of Puerto Rico's exports come from the manufacturing sector.
- In 1993, around 155 thousand persons were working in manufacturing, and by 2013, half of them had lost their job.
- This economic sector employed 77.5 thousand people in 2013, which represents 12% of total non-farm private employment of the island.
- Manufacturing wages represented 14% of Puerto Rico's total wages in 2012, but only 9.8% of the manufacturing national net income.
- The number of establishments diminished from 2,180 in 2003 to 1,829 in 2011, a 16% decline.
- In 2011 55% of manufacturing's firms employed less than 10 workers. In 2006 this percentage was 51.
- 72% of manufacturing companies employed less than 20 employees in 2011.
- 95% if imports in 2012 were manufacturing products (74% of adjusted imports are raw materials and 20% consumer goods)
- There is a gap between the U.S. and Puerto Rico's labor compensation in this economic sector. This gap increased from $4.90 in 2001 to $6.43 in 2012. The manufacturing wages in the island are around 33% lower than in United States.
- The clothing industry wage gap increases from $2.36 in 2001 to $4.37 in 2012. In the more recent years, Puerto Rico's wages for this industry were 34% less than the U.S.A.'s.
- In the case of the food sub-sector, the difference between the two countries' wages decreased from $3.36 in 2001 to $3.03, in 2012. The gap in 2012 implies that the island was 24% lower than the U.S.
- In the chemical industries, the wages' difference diminished from 3.36 to 3.03, resulting that in 2012 the island's wages were 14% lower than those of the United States.
- The pharmaceutical industry in Puerto Rico has a greater share of the total manufacturing employment than USA. In 2012, this pharmaceutical employment was nearly 9 times more concentrated in the island than in USA. It has a location quotient (LQ) of almost 9 (8.7). Another high-technology distinguishing industry is the medical devices' industry with a LQ of 5.28 in 2012.
- The LQ for the clothing industry doubled from 2001 to 2012. This coefficient increased from 4.13 to 8.70 in that period.
- Finally the LQ for the food sector diminished from 1.28 in 2001 to 1.17 in 2012. This sector has a high growth potential to satisfy the internal demand for this type of commodity.

To determine the relative importance of several variables in explaining the growth rates of the manufacturing industry's employment, several Artificial Neural Networks models were constructed. This class of model is a type of artificial intelligence that imitates human brain structure. Some of the findings of the applications of these models are the following:

- The flows of the United States' foreign direct investment to Latin America and other countries in the region have the two higher weights in the model. The flow of FDI from US to Asia also has a high relative importance for the dependent variable in the ANN model. These can be taken as proxies for the United States' trade agreements, as NAFTA and CAFTA, and other changes in global competitiveness.

- The U.S. producer's price index growth rate and the inflation in the island are in the top five most relevant predictors of manufacturing employment. Also it was found that the state of the aggregate's economic activity in United States as well as in Puerto Rico has had a relative high impact on Puerto Rico's manufacturing sector's performance. These variables may be taken as indicators of the aggregate demand in both of the economies. On the other hand, the cost of labor in the island relative to the United States does not seem to be very important in this model. It ranks 8th in importance on the list of the 23 explanatory variables.
- The dynamics of employment in the chemical sub-sector is very similar to that of the total manufacturing employment. Some differences are: the U.S.'s manufacturing employment seems to be related to this sector's employment, Puerto Rico's real wages occupied the 10th position in importance out of 23 and the slope of yield curve the 14th position.
- The food sector, as it is known, produces for the local markets. Thus, the principal independent variables in the ANN model for this sector employment are indicators of the state of Puerto Rico's economy. The island's total retail sales indicator is the most important input variable for this sector's employment.
- The employment in the apparel industry of the island has as principal predictors: the US's manufacturing employment, and Puerto Rico's total retail sale estimate. The third and fourth places in importance belong to U.S. FDI outflows to Asia and Latin America, respectively.

The principal findings of the diagnostic of the manufacturing sector can be summarized as:

- External shocks that have caused the loss of the island's competitiveness at the regional and global levels seem to be the principal reasons for the meltdown of the growth trend of this economic sector.
- These impulses affect directly, and with a high intensity, high-tech industries that are predominantly non-locals firms.
- The impacts of these external shocks on local firms have been, principally, through the aggregate demand channel.
- Local industries, such as food, fabricated metals and non-metallic minerals were less affected by the external perturbations than non-local firms

Principal recommendations

The results of the statistical analyses discussed above are the basis that are being used to design the general and specific strategies to return the manufacturing sector to the growth path. But that also depends on the review of Puerto Rico's and other countries' development plans and other relevant literature. Finally, it took into account the views of several of Puerto Rico's economists that are very knowledgeable about this economic sector.

The long-term strategic vision for the manufacturing sector in the island is built on a number of fundamental elements, as listed below:

- Increase local firm participation in manufacturing production: it was found that these firms are more resistant to adverse external shocks.
- To raise the intra-sectoral linkage of manufacturing industries: This will increase the multiplier effect of firms' expansion and its effects on the employment level.
- To promote business clusters.
- To reduce energy cost: level and volatility
- The recommendations are based on current incentives and programs and do not imply significant additional government spending: the fiscal and economic conditions of the island do not allow for additional expenditure.
- The recommendation for long-run is based on socially desirable alternatives

Increase labor productivity

- To build up relationships among post-secondary education institutions and the manufacturing sector.
- To coordinate with the manufacturing associations and universities to ensure that the supply and demand for occupations and professions converge toward an equilibrium level.
- To coordinate with higher education institutions the design of continuing education courses for this sector's employees.
- To develop work experience for youth in this sector
- To include small and medium manufacturing firms (PYMES) as possible places to do government sponsored student summer internships and work programs.

Increase efficiency of small and medium firms (PYMES)

- To improve management practices of small and medium size manufacturing firms using the advice of business and industrial engineering departments of some of Puerto Rico's higher education institutions
- To coordinate student internships with some universities for graduate and undergraduate students in PYMES, under the supervision of professors, to develop projects, varying with each firm's necessity, to increase the PYMES efficiency.

Increases customer satisfaction with PYMES' products and services

- To promote the use of statistical quality control methods (SQCM) in these companies' production processes.
- To use statistical professors and students of Puerto Rico's universities to advise PYMES firms in the establishment of SQCM practices in the production process, as well as in the interactions with consumers in the case of firms that sell products directly to consumers.
- Encourage after sales evaluations to guarantee consumer satisfaction with the products
- Promote links between engineering and natural science faculties of the island's universities, and small and medium manufacturing firms to stimulate the development of new products and/or improve the efficiency of the production line.
- To increase the survival's probabilities of manufacturing firms
- To offer PYMES's assistance in production efficiency and market strategies to increase the probability of survival in a globalized world

Industries policies

- To promote firms from certain sub-sectors or industries
- To direct the job creation policies to specific target industries as manufacturing PYMES

Improve manufacturing firms' forward and backward linkages

- To require from the firms that receive incentives from PRIDCO to buy certain percent of raw materials and services to local producers. For example 15%.
- Promote local services and intermediate products.
- Develop information systems to establish interactions among firms in the manufacturing and the other economics sectors
- Link the existing incentives given to others sectors to their acquisition of some percentage of the raw materials and intermediate products from local manufacturing target industries, such as food, non-metallic minerals, and finished metals products

To further develop the industry clusters in Puerto Rico's manufacturing sector

- Incorporation of universities to R&D clusters programs
- To coordinate with the industry associations and some of the universities on the island the development of research programs focused on the pharmaceutical, computers and medical devices' industries' R&D's agenda.
- To coordinate with some universities the consideration of the R&D program of the industry clusters as one of the criteria to decide the research area of future employees' recruitment.
- To promote the participation of the island's universities in some special projects, as outsourcing services for some of the manufacturing firms.
- To develop new programs when existing curriculums cannot be modified to satisfy the labor's requirement of manufacturers
- Stimulate the incorporation of new companies to existing clusters
- To incentive the establishment in the island of firms that produce intermediate -goods that are used as input by the final products firms: locals and non-locals
- To coordinate with universities to produce patent applications that can be produced in the island.
- To promote with high level education institutions the development of associate and others technical degree programs in high-tech manufacturing areas

Reduce the level and volatility of energy cost

- To establish alternative energy generation options for some regions or industrial parks
- Promote energy-efficient technologies in this sector starting with firms that receive incentives from PRIDCO.

Increase local firms' production to allow imports substitution and Exports

- Promotion of local firms products in domestic and U.S.A. markets
- To use the government's radio and television stations and the internet to do the advertising.
- To determine the imported manufacturing products that can be produced locally.
- To use economics' and business's university students' research projects to examine this issue.
- To coordinate with the manufacturing sector's associations the implementation of an imports' substitution program.
- To promote exports of Puerto Rico's manufacturing goods to Latin-American communities in the U.S.A. (including P.R.'s Diaspora)

Section 1

Analysis of Manufacturing Sector in Puerto Rico

I. Introduction

Manufacturing has been a key driver of job creation of our economy for many decades, and in the past was a dynamic economic sector, which have shown steady exports growth. Even though the service sector have increased its importance in the island's economy in recent decades, manufacturing continues to play a principal role, accounting for 66% (46%) of Puerto Rico National Gross Product (GDP) in 2012. Manufacturing is especially significant because traditionally it has been the principal exporter sector of the world's economies. The positive effect of this economics sector extends beyond manufacturing itself. Reports from the Puerto Rico Planning Board indicate that each dollar's worth of manufactured goods creates another $1.545 of activity in other sectors, (service income multiplier is 2.1). Also more than 97% percent of Puerto Rico's exports comes from the manufacturing sector.

This section presents an evaluation of the dynamics of the manufacturing sector in Puerto Rico in the last two decades. To achieve this objectives, in addition to analyzing the island manufacturing data, several journal papers and other relevant literature were reviewed. The academic literature was principally related to some of the theoretical and methodological issues relevant to the construction of the models used in this research to analyze the data and is quoted in the following sections of this section. The principal studies of Puerto Rico's development, from the Echenique and Tobin Reports (1975 and 1976) to the New Model of Puerto Rico (2013) (Department of Economic Development and Commerce of Puerto Rico) and the Federal Reserve Bank of New York Study (2012), were examined. Tables A.1, and A.2 in Appendix A, reports a summary of the principal recommendations of these documents. Development Plans from others jurisdictions were also analyzed, a sample of these studies are listed in Table A.3. The results of these studies were helpful in the evaluation of this economic sector as well as in the design of the development strategies presented in section 4.

The rest of this section is organized as follows. Section II contains a diagnostic analysis of Puerto Rico‘s Manufacturing sector. This analysis includes: descriptive statistics of some of the manufacturing sector indicators, identification of the structural changes dates for some industries' employment trends in this economic sector, and an artificial intelligence model (ANN) that is used to identify the determinants of manufacturing employment dynamics in the island. In Section III a regional analysis, using the location quotient (LQ) to compare the manufacturing sector of Puerto Rico with the same sector in U.SA., is presented. A brief final section (IV) offers some concluding comments.

II. Puerto Rico's Manufacturing sector Diagnosis

This section reports the results of various exploratory-descriptive statistical analysis of the Puerto Rico manufacturing sector data. Monthly as well as annual data from 1990 to 2013 was examined. The principal sources of the data were the Bureau of Labor Statistics (BLS) of U.S., the Puerto Rico Planning Board and the Puerto Rico Industrial Development Company (PRIDCO).

A. General descriptive analysis

Some basic facts about this sector are the following:

- Manufacturing gross product accounted for 66% (46%) of Puerto Rico's National Gross Product (GDP) in 2012, and 76% of the island net national income. These percentages has been relative stable since 2003.
- 98.72% of Puerto Rico exports come from the manufacturing sector.

- From 1993 to 2003 the value of exports increased in 112%, but from 2003 to 2013 they were only raised by 66.4%
- In 1993 around 155 thousand persons were working in manufacturing, and by 2013, half of them had lost their job.
- This economic sector employed 77.5 thousand people in 2013, which represent 12% of total non-farm private employment of the island.
- Manufacturing wages represented 14% of Puerto Rico's total wages in 2012, but only 9.8% of the manufacturing national net income.
- The production employment payroll decreased 25% from 2003 to 2013, while the working hours of this type of employees decreased by 39% in the same period.
- The number of establishments diminished from 2,180 in 2003 to 1,829 in 2011, a 16% decline.
- In 2011 55% of manufacturing's firms employed less than 10 workers. In 20006 this percentage was 51.
- 72% of manufacturing companies employed less than 20 employees in 2011.
- 9.3% of manufacturing's firms employed 100 or more workers in 2011. This percentage was 10.13 in 2006 and 11.1 in 2003.
- 73 percent of projects promoted by PRIDCO are from local firms.
- 95% if imports in 2012 were manufacturing products (74% of adjusted imports are raw materials and 20% consumer goods)
- In 2012 the value of the imports of consumer goods was 9,810 millions of dollars.
- In 2012 24% of the island's personal consumption expenditure corresponded to food, alcoholic beverages and tobacco products, and clothing and accessories.

Some indicators of the performance of the manufacturing sector in the island are shown in Table 1. It is important to note that almost all variables have had negative trends since 1993. For example, the monthly payroll of production employees declined from $173,791.8 million in 2003 to 130,620.45 million in 2013, or by 24.5 percent. A reduction in the numbers establishment by 16% may explain parts of the payroll decline. The number of projects startups under PRIDCO incentives programs decreased by 66% from 2003 to 2013.

Only two nominal variables, manufacturing net income and exports, show growth from 2003 to 2013. However, as is evident from Figure 1, the slope of the long-run trend of manufacturing exports has decreased in the recent years becoming negative in 2012. The largest component of this exports are chemical products (see Figure 2).

Table 1
Economic Indicators of Manufacturing Sector

Variable	Level 1993	Level 2003	% change 2003-1993	Level 2013	% Change 2013-2003
Employment†	155.12	118.7	-23.47	77.53	-34.69
Net Income‡	14,462.20	30,679.89	112.14	42,835.48*	**39.62**
Exports‡	19,657	54,690.15	178.22	58,164.64*	**6.35**
Num. establishments	-	2,180	-	1,829**	-16.10
Aggregate monthly payrolls of production and nonsupervisory employees†	143,791.8	173,057.3	20.35	130,620.45	-24.52
Aggregate monthly hours of production and nonsupervisory employees†	20,603.25	16,863.5	-18.15	10,248.83	-39.22
Num. of Pridco's projects startups***	123.0***	152.0	23.58	52.00***	-65.79
-Local	81.0	110.0	35.80	41.00	-62.73

† thousands, ‡ millions of dollars,*2012, **2011,***1995

Sources: PR Planning Board, BLS and PRIDCO.

Figure 1: Manufacturing Exports (1980-2012)

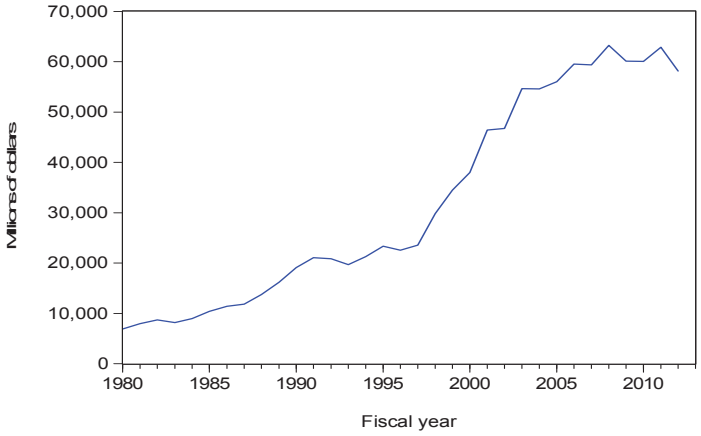
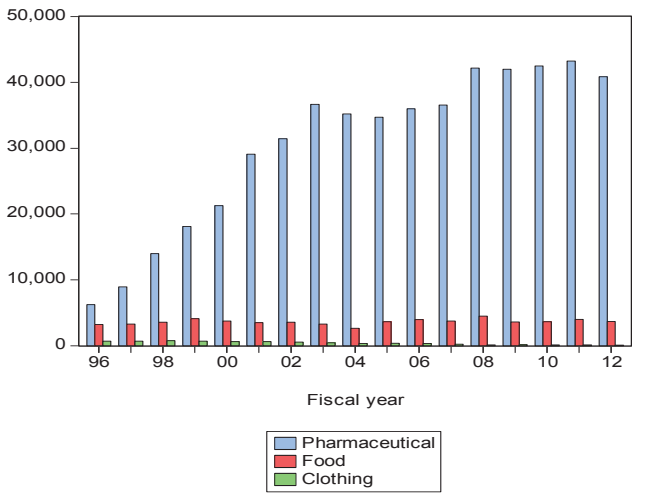


Figure 2: Exports of Food, Pharmaceutical and Clothing Manufacturing



This economic sector has a large impact in the island economy. According to the Puerto Rico's Planning Board the type II employment multiplier of manufacturing sector is 3.3. Thus each additional worker in this sector generates around 2.3 more jobs in the island economy. Therefore there should be a strong positive relationship between the employment in this sector and the total employment in Puerto Rico. Figure 3 presents the scatter diagram of manufacturing employment (LMNF) and the other private employment (LPRIV). The two variables have a relative high positive correlation (the Pearson correlation coefficient is .64).

To further explore the directionality of the relationship between these two variables, the Granger-causality test was used. Strong evidence was found that manufacturing employment "Ganger cause" private employment (excluding manufacturing employment) in Puerto Rico (Table 2). Also it was estimated an elasticity of private employment with respect to manufacturing employment of 0.40. So, on average, one percent increases (decreases) in LMNF increases (decrease) LPRIV by .40 percentage point, according to these estimation[1]. These findings support the proposition that the manufacturing sector is crucial for the economic development of the island.

Figure 3: Total Private and Manufacturing Employment
(Monthly growth rates, 1996-2013)

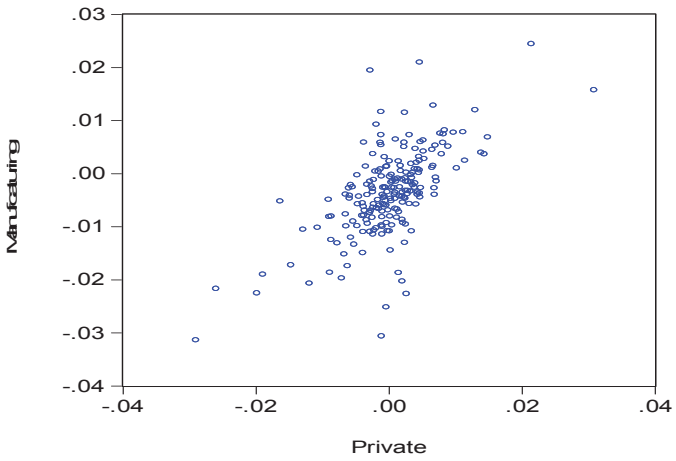


Table 2
Granger causality test: Manufacturing employment and Private Employment

Lag order	Null Hypotheses	F-statistics	P-value
1*	$L_{MNF} \neq\!\!\gg L_{PRIV}$	3.97583	0.0472
	$L_{PRIV} \neq\!\!\gg L_{MNF}$	1.50804	0.2205
2**	$L_{MNF} \neq\!\!\gg L_{PRIV}$	2.65079	0.0725
	$L_{PRIV} \neq\!\!\gg L_{MNF}$	0.85339	0.4272
4**	$L_{MNF} \neq\!\!\gg L_{PRIV}$	2.36818	0.0532
	$L_{PRIV} \neq\!\!\gg L_{MNF}$	3.23432	0.0130

Optimum lag length according to: * Schwartz, ** Hannan-Quinn, and ***Akaike, criterion. Read $\neq\!\!\gg$ *as d*oes not Granger-cause. Note: Private Employment without L_{MNF}.

B. Description of some Key manufacturing sub-sectors

In this section an exploratory data analysis of the most important sub-sectors of Puerto Rico's manufacturing industry is presented. Table 2.1 provides a detailed breakdown of the contribution of different industries to the island's manufacturing sector.

[1] *Table B1.0 in Appendix B has a summary of this estimation. It was estimated a LPRIV/Service employment elasticity of 0.43.*

Chemical manufacturing

This manufacturing sub-sector includes: synthetic materials, agricultural chemicals; paint, coating, and adhesives; cleaning preparations; and pharmaceutical and medicine manufacturing. This is a primarily United States-based industry.

In Puerto Rico, chemical manufacturing firms accounted for 69% (72%) of this sector's net income in 2012 (2001). In 2001, the industries in this sector were responsible for 66% of the total manufacturing exports, while in 2012 this percentage was 76. However, the share of chemical industries in the manufacturing sector employment was only 24% in 2012 (21% in 2001). This is a very capital and knowledge intensive sector that depends on the research and development activities realized in U.S.A. Over 10,000 jobs were reported lost in the chemical manufacturing industry from 2001 to 2012.

Table 3
Some economic indicators of manufacturing sub-sectors
(Fiscal year 2012)

	Employment**	Net Income*	Gross Product*	Exports*	Imports*
Chemical	19.98	29,615.8	31,555.15	44,488.29	20,573.50
Pharmaceutical	16.54	NA	28,047.41	40,848.01	15,503.00
Apparel	9.69	238.3	263.90	89.21	563.80
Medical Equipment	11.27	NA	2,040.62	4,481.60	NA
Beverage & Tobacco	2.51	792.0	1,116.50	285.87	480.30
Food	11.47	699.1	812.84	3,670.40	3,385.20
Non Metallic Mineral	2.00	43.8	114.56	45.80	224.30
Computer & Electronics	5.20	7,933.9	8,041.71	1,575.10	2,415.40
Metal Fabricated Product	3.60	140.3	179.07	86.88	507.70
Plastics and rubber	1.61	59.8	104.43	132.55	958.10
Others	16.14	3,312.50	1,885.07	4,058.40	15,176.50
Total Manufacturing	83.46	42,835.5	46,113.85	58,914.10	44,284.80

*Millions of dollars, **Thousands.

Apparel manufacturing

The clothing industry has a long history in Puerto Rico where it has a strong presence in the production of the U.S.A.'s military apparel and accessories. In 2012 this manufacturing sub-sector accounted for 1/2% of the manufacturing domestic net income and .15% of that sector exports. However, in that year, this sub-sector employed 9,690 workers, almost 60% of the pharmaceutical industry's employment. In the year mentioned, this industry also exported goods with a value of 238 million dollars. It is important to note, also, that the island imported clothing merchandise with a value of 563.80 million of dollars in 2012. In that year, the personal consumption expenditures of clothing and accessories in Puerto Rico were 3, 641.8 millions of dollars, almost 6% of the total consumption expenditure in the island.

Food manufacturing

This sub-sector includes the manufacture of meat and meat products, processed seafood, dairy, processed fruit and vegetables, bakery products and, sugar. In 2012, this industry employed around 11,470 people, 13.7% of the total manufacturing's employment in the island. In that year, the food sector accounted for 6.2 percent of the total manufacturing's exports of the island, and 7.8 of the manufacturing's imports. In 2012 Puerto Ricans spent 8.9 billions of dollars in food (14.6% of total consumption expenditure). A key characteristic of this sector is that it imports a large portion of its raw materials. Thus, this sub-sector does not have a strong link with the agriculture sector of the island.

Medical devices

The medical devices industry is a main sector for the healthcare system. The firms in this industry manufacture medical equipment and supplies, including surgical and medical instruments, dental equipment, and surgical appliances. The population demographics, medical discoveries, and technological advances are some factors that explain the demand of this sector's products. There are around 30 companies in this Puerto Rican industry, according with PRIDCO data. In 2012, Puerto Rico's medical device sub-sector employed 11. 3 thousand people. The value of this industry's exports that year was 4,481.60 million dollars or 4.4 % of the total of Puerto Rico's manufacturing sector's exports. The Gross product of this sector was 2.04 billon of dollars in 2012.

C. Trends and Structural Changes in Puerto Rico's manufacturing sub-sectors

In this section a general analysis of the manufacturing sector is presented. Figures 4 and five, display the evolution of manufacturing sub-sectors' net income from 2000 to 2012. It can be seen that for some sectors this variable has had a negative slope in recent years, even when this is a nominal variable affected by the inflation rate. For example, primary metal, beverage and tobacco and food industries show negative long run trends. On the other hand, the net income of machinery, transportation equipment, computers and electronic products, and electrical equipment manufacturing, has mildly increased from 2001 to 2012. The chemical product's subsector net income series shows a positive trend for the entire period, but had a reduction in 2012. The average (median) annual growth rate for the net income of this sector for the whole period was 5.0% (3.7%), but in 2012 decreased by 4.1 percent.

The dynamics of the manufacturing industries' exports are shown in Figures 6 to 8. None of the sector shows an increasing growth rate of exports from 2001 to 2013, though these are nominal variables. Some of the subsectors with a slightly positive trend in this indicator are: plastic and rubber, primary metal and machinery products. The paper printing products, computers and electronics products and leather products export's growth have a stable behavior during this period. On the other hand, clothing exports have a continuing decrease from 2001 to 2013. The average (median) growth rate of that industry exports was -16.11 (-15.71%). Chemical products, in spite of having a positive average (median) annual growth rate in this period of 5.6% (3.12%), diminished by 9.18% in 2012. Finally the exports of food grew at an average (median) rate of .17% (2.4%) for the whole period. However after 2008, this variable exhibited a negative trend and in 2012 decreased by 8.11%. This series growth rate also shows a high level of volatility with a coefficient of variation equals to 89.54.

Figure 4: NET MANUFACTURING DOMESTIC INCOME
(Some sub-sectors, 2000-2012)

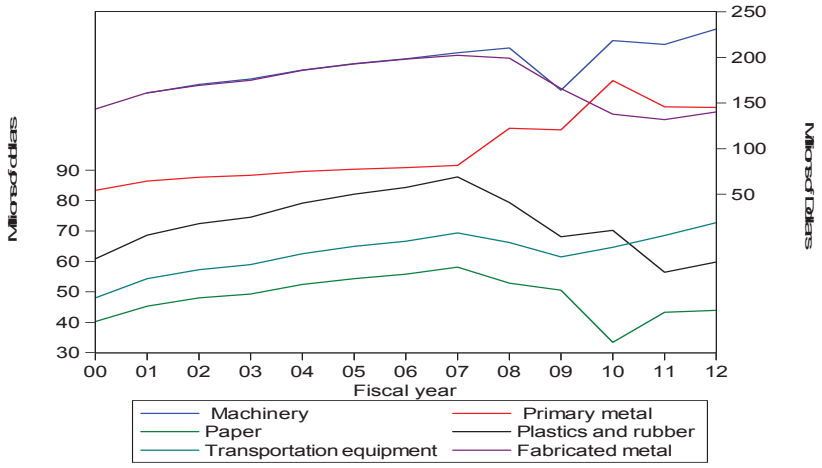


Figure 5: NET MANUFACTURING DOMESTIC INCOME
(Others sub-sectors, 2001-2012)

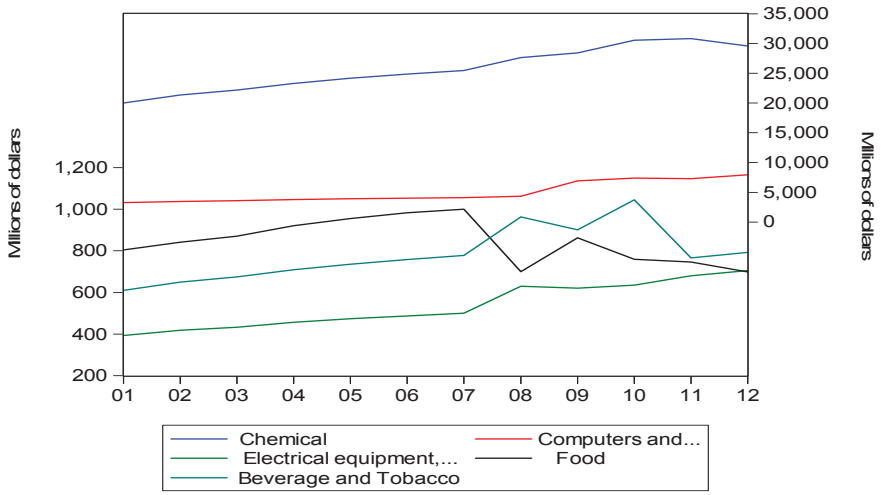


Figure 6: EXPORTS OF RECORDED MERCHANDISE
(Some sectors, 2001-2013)

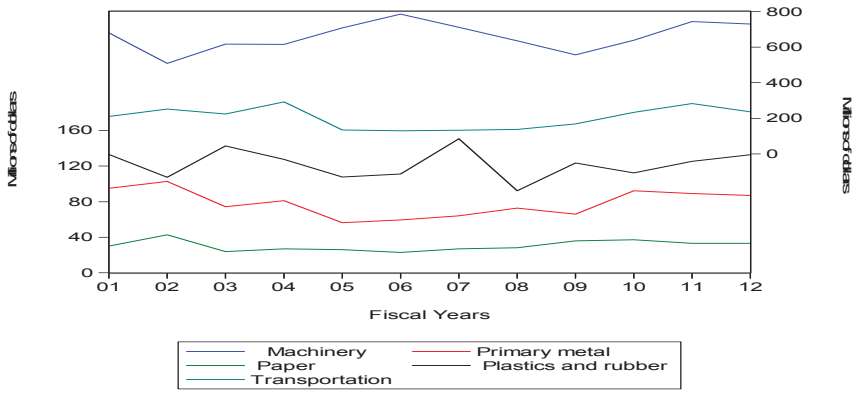


Figure 7: EXPORTS OF RECORDED MERCHANDISE
(Others sub-sectors, 2001-2013)

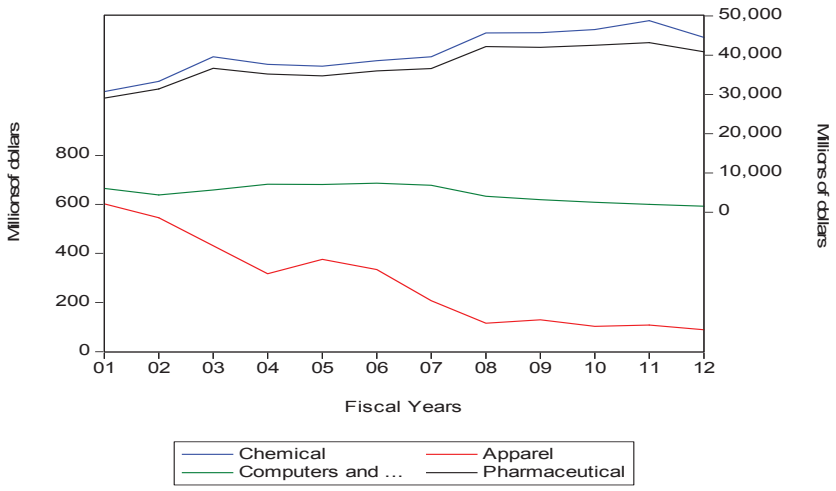
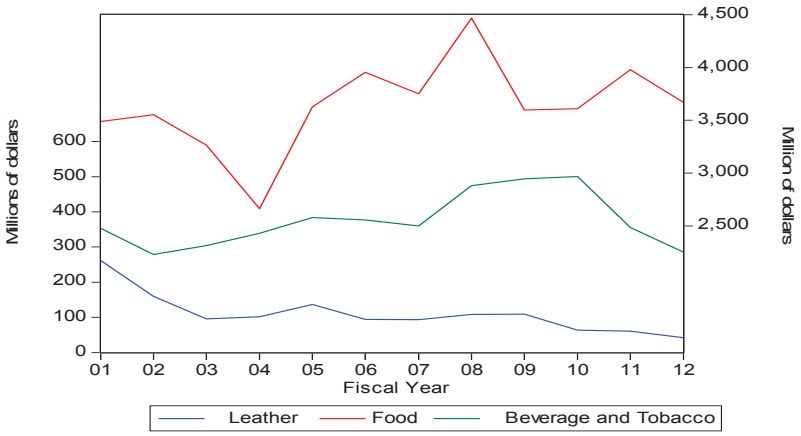


Figure 8: EXPORTS OF RECORDED MERCHANDISE
(More sub-sectors, 2001-2013)



When the growth rate in employment of manufacturing sectors are analyzed we reach the same conclusion that we did with the exam of the two previous indicators. As it is evident from Table 4, from 1996 to 2006 only the Chemical sub-sector shows a positive average growth. All the remaining industries had negative growth trends during those 10 years. However from 2007 to 2013 the level of employment in all sectors decreased. The sub-sectors, also, show a large volatility of their employment growth rate, judging by the coefficient of variation. This may be the result of external shocks that affected the whole manufacturing sector.

Table 4
Descriptive Statistics of Manufacturing Employment Growth Rate by sub-sectors (monthly data)

	1996:01 2006:12		2007:01 2013:03	
	Mean	Coef. of Variation (absolute value)	**Mean**	**Coef. of variation**
Sub-sector				
Chemical	0.000399	3211.46%	-0.0065	161.69%
Pharmaceutical	0.000867	3.31791%	-0.0076	427.665%
Clothing	-0.00982	398.276%	-0.0055	938.858%
Food	-0.00365	762.165%	-0.0015	1092.45%
Beverage and Tobacco	-0.00126	2738.08%	-0.0059	419.12%
Computers and electronic	-0.003644	780.038%	-0.0096	215.961%
Electrical equipment,	-0.00241	1286.82%	-0.0032	629.618%
Fabricated metal	0.00077	4600.15%	-0.0075	451.024%
Non-metallic mineral	-0.000576	5237.72%	-0.0084	629.059%
Plastics and rubber	-0.00477	519.554%	-0.0048	519.554%
Medical equipment	-0.000566	2924.23%	-0.0003	2924.23%

To determine if the dynamics of the manufacturing employment growth rate is the consequence of an aggregate impulse or of sectoral shocks, a principal component analysis over 13 industrial groups was performed [2]. The purpose of this type of multivariate statistical analysis is to obtain a small number of linear combinations of the 13 variables which account for most of the variability in the data. In this case, four components were extracted, since four components had eigenvalues greater than or equal to 1.0. Together they account for 54.71% of the variability in the original data. Thus it can be concluded that impulses that decreased the growth rate of the manufacturing sector had different impact intensity over the individual industry groups: half of the data variability comes from idiosyncratic shocks. The first principal component explains the variation in apparel, food, non-metallic minerals and fabricated metal sub-sectors. These are industries with a high local demand component and with labor intensive production processes. The medical devices and electrical equipment employment series share a common structure, so their variability is explained for the second component. The third component include the pharmaceutical and wood product's industries. These findings suggest that the impact of the impulses that affected the growth path of manufacturing employment does not affect all industries with the same strength. Thus it may be possible to identify manufacturing sub-sectors with high to moderate resistance to external structural shocks.

[2] *Appendix B has a summary of the principal component analysis results.*

To be able to identify the sources of the shocks that have impacted the trends of the manufacturing employment series, it is necessary first, to estimate the dates of those structural changes. The classical test for structural change was developed bay Chow (1960). One limitation of this test is that the date of the structural change must be known in advance. Thus the econometrician has to choose an arbitrary candidate for the date of the break or to pick it based on some prior knowledge. In the first case, according to Hansen (2001) the Chow test may be unhelpful, and in the second case, the results of Chow test can be ambiguous, because the candidate's break date is endogenous -pretest estimator problem- One solution to this dilemma is to treat the date of the structural change as unknown. Quandt (1960) proposed to estimate the Chow statistic over all the series and take the break/date as that with the highest value of Chow-statistics. Andrews (1993) developed several statistics to test the structural break hypothesis. This procedure was applied to some of the Puerto Rico's manufacturing employment series. A linear trend model was used in this procedure. The method developed by Bai (1997) was utilized to construct 95% intervals for the dates of the structural changes.

The estimated dates of the structural changes in the growth trend of five series of employment in the manufacturing sector in Puerto Rico are presented in Table 5. Also a 95 percent interval for those dates are reported in that table. The break in the trend of the series was estimated allowing for a shift in the intercept together with a change in the slope coefficient: the case of a pure structural change. The principal finding of this analysis is that the growth rate of the total manufacturing employment shows a large shift, in June of 1996. As a consequence of this change, the rate of grow of that variable was reduced. This series also has additional breaks in the growth trend in 2001:07 and 2003:1. The following model shows the effects of these structural changes over the manufacturing employment growth path:

R^2= .99, all parameter estimates significant at.001 level, Q(4)= 2.7 with a P-Value of 0.44.

$$L_{MNF} = 217.4 - 0.41t - 0.004d_{9606} \times t - 3.74d_{0107} + 0.004d_{0311} \times t + e$$

As can be seen from the estimation results the model adjusts well the data. The diagnostic checking of the model shows: high determination coefficient, significant estimated parameters and white noise residuals. This finding is broadly in line with the conjecture that the reductions of the U.S.A.'s incentives to manufacturing companies doing business in Puerto Rico is the principal cause of the melt down of this sector's activity. In fact, the structural changes in 1996 have the larger LR-statistics meaning that it was the most important break of the series trend.

The principal results of the application of the Andrews/Quandt structural break identification procedures can be summarized as follows:

1. Three structural breaks were identified in each of the growth trends of the five employment series examined.

2. The total employment in the manufacturing sector had the first break in June of 1996. The effects of this structural change were an increase in the reduction rate of this series. This change in the path of manufacturing employment may be related to the end of the 936 section of the Federal Tax code, and the beginning of NAFTA.

3. The employment for the industries with high level technological production processes (High-Tech.) shows a shift, in 1995:02. This break switches the slope of this variable's trend from positive to negative. The other two structural changes that affected this series occurred in the years 2005 and 2009. The first shifts increased the rate of reduction of this variable while the second one reduced it. A visual examination of the behavior of the High-Tech.'s industry growth path suggest that this series is moving toward a stationary state.

4. Testing for structural changes on monthly data for the pharmaceutical employment series gives three breaks dates: in October of 1996, in August 2004 and in January 2009. The Chow 95 percent confidence interval for the first break/date is [[1996:08, 1996:12], which is fairly tight. The 95 percent confidence intervals for the other two break/dates are [2004:07, 2004:09] and [2008:11, 2009:03] respectively.

5. The other two series, employment in the food and clothing sectors, have significant breaks before 1996. In the apparel sector's employment it was found in 1993:10, while in the food sector the date of the break was 1995:01. These series have similar timing of the structural shifts in their employment in the 21 century that other sectors, as can be seen in Table 5.

In synthesis, it was found that in this study, using a methodology of determining structural breaks without an arbitrary partitioning of the time series based on priors held, that the diminution that is experimenting the manufacturing sector's employment began after 1996. Thus the end of section United States Internal Revenue Code Section 936 seems to be the principal reason for this decline. However, the reductions in the more labor intensive manufacturing sectors happened before and is likely that was related to the loss of competitiveness in this type of production, due to NAFTA and other globalization effects. It was also found that the shocks had permanent impacts on the structure of this economic sector. These results provide some vital clues and building blocks for a narrative on Puerto Rico's manufacturing sector dynamics.

Table 5
Test Statistics, Break Points, and Confidence Intervals for the trends models of employment
(Selected employment Series)

	Date of Break	LR Statistic	P-value	95% interval
Manufacturing				
	2003:01	54.23	0.0000	[2003:10, 2003:12]
	2001:07	90.76	0.0000	[2001:06, 2001:08]
	1996:06	415.48	0.0000	[1996:05, 1996:07]
High technology industries*				
	2009:03	145.45	0.0000	[2009:02, 2009:04]
	2005:01	601.82	0.0000	[2004:12, 2005:02]
	1995:02	394.42	0.0000	[1995:01, 1995:03]
Medicines				
	2009:01	59.36	0.0000	[2008:11, 2009:03]
	2004:08	1338.45	0.0000	[2004:07, 2004:09]
	1996:10	138.92	0.0000	[1996:08, 1996:12]
Clothing				
	2011:08	41.37	0.0000	[2011:05, 2011:11]
	2002:07	963.99	0.0000	[2002:06, 2002:08]
	1993:10	84.89	0.0000	[1993:08, 1993:12]
Food				
	2008:12	130.2898	0.0000	[2008:09 2009:03]
	2001:06	271.07	0.0000	[2001:04, 2001:08]
	1995:01	81.53	0.0000	[1994:11, 1995:3]

Monthly data from 1991:01-2013; 04, SA.
*Defined as the sum of employment in: chemical, computers and electronic, electrical equipment, and medical devices industries.

D. The determinants of Manufacturing Employment in Puerto Rico

In the previous sections of this section, several economic indicators of the manufacturing sector in Puerto Rico were analyzed. However, only descriptive-exploratory analyses were reported. This section presents a causal model of this sector's dynamics. To construct such a model, the sector and sub-sectors' employment series were used. The selection of this variable was based upon two considerations: the availability of a large monthly data set; and, the importance of employment for Puerto Rico's stakeholders. High levels of good quality jobs, other things constant, is an important determinant of social welfare. Thus, this variable is taken as an indicator of Puerto Rican's well-being.

The model is based on the labor demand (Ld) theoretical framework[3]. It is assumed that the principal firms in the manufacturing sector of Puerto Rico operate in a world-wide market. Thus, these firms are not price takers in the output market, but it is supposed that they are price takers in the input markets. It is reasonable, also, to assume that the firms make the decisions about changes in the level of employment at least one period prior to the date when the workers are hired or fired. Adjustment costs associated with the hired/fired process is the justification for this conjecture.

The technology of the representative firm of the sector (industry) may be expressed as:

$$y_t = F\left(L_{i,t}h_{i,t}, K_{j,t}, E_t, M_t\right) + \epsilon_t$$

Where, y is the sector (industry) output, L is the number of employees, h is the hours per period worked by the employees, K stands for capital, E represents energy inputs, M is materials, i and j differentiate types of workers and capital inputs, and ϵ is a pure random shock that affects L.

Assuming that: (i) firms face an inverse demand function that depends on the share of the firms' production to aggregate output (y/Y) and the general price level; (ii) the technology is given by the equation (6); and (iii) that firms have profit maximization (cost-minimizing) behavior, the following labor demand arises:

$$L_{j,t} = F\left(\sum \alpha_i L_{t-i,} \sum \beta_i y_{t-i}\ , g(K_{j,t}, E_t, M_t)\right) + v_t$$

This equation states that in each period, the manufacturing employment will depend on its own lags (because of the adjustment cost assumption), on lag of the sector's output and on the levels of others production inputs. The lag of firms' output reflect the fact that the employment level is determined in advanced and it is necessary to forecast the output level. The level of the others' input will depend upon the price of the labor relative to the other's factor prices. Taking this fact into account, and the assumption that firms want to maximize their share of their respective production to aggregate output (market participation), it can be stated that the following principal factors affect Ld: relative prices, wages, and variables that determine the aggregate demand.

The fact that a large share of Puerto Rico's manufacturing production is exported implies that it is necessary to take into consideration non-local demand factors. Furthermore, because a fraction of the manufacturing sector's labor demand is taken by non-local firms, it is mandatory to include variables that explain the decision of the firms to locate parts of their production outside their national frontiers. The existence of a market abroad that cannot be covered entirely by exporting the merchandises, and the possibility of lower production costs are the two principal reasons that according to the literature, justify that decision.

[3] *This model was developed by Nickel (1984).*

The specific variables used in the estimation of the model are reported in Table 6. These variables are either measures of the costs of the production inputs or indicators of aggregate demand. For example, some of the predictors are: the price of oil, various producer's prices indices from the United States, the cost of electricity in Puerto Rico, the ratio of Puerto Rico's manufacturing compensation to the same variable in U.S. Furthermore, we used as independent variables the local inflation rate, the estimate of total retail sales, the BGF's economic activity index, and the imports in the island, as indicators of the aggregate demands in Puerto Rico. To measure the U.S. aggregate demands, factors such as the inflation rate in that country, the industrial production index, a coincident economic activity index and the manufacturing employment were included in the estimation. The U.S. Recession Probabilities index and the slope of the yield curve were utilized as measures of the anticipation of future aggregate demand levels. An index of recession in four big economics of Europe also was taken into account as proxy for the global aggregate demand. The flows of FDI of United State to Latin America and Asia were taken as indicators of structural changes that have affected the relative competitiveness of different countries. The specific variables used were the FDI from U.S. outflows to region j as the percentage of total U.S. FDI outflows. These variables reflect changes in the international environment that affect the United States' investment abroad. Finally, several dummy variables were used to model some of the structural changes that have affected the Puerto Rico economy.

An Artificial Neural Network model of Manufacturing Employment in Puerto Rico

The labor demand model described above contains many variables so the multicollinearity problem will arise if it is estimated by linear regression. Taking this fact into consideration and to allow for nonlinearities in the relationships between the manufacturing sector employment and the independent variables, the Artificial Neural Network (ANN) technique was used to solve the model.

Artificial Neural Network models, a type of artificial intelligence, is a system which can imitate human brain structure. ANN models are composed of many nonlinear computational elements (neurons or nodes) connected by weights that are calibrated during training to improve the model's performance. Neural networks are typically arranged in layers. Each layer in a network is an array of processing elements or neurons. Information flows through each node in an input-output manner as shown in Figure 9. An example of an artificial neural network is the Multilayer Perceptron (MLP). This type of network usually has three layers of processing elements: inputs, hidden and output layers[4]. The input layer receives the external signal from the independent variables of the system and transmits it to the next layer[5]. The hidden layer sums the activation values it receives and modifies the value based on its transfer function. The activation flows through the network until it reaches the output layer. It is common for networks to have only one target variable, or output node, but there can be more. The output nodes reflect the transformation of the input's neurons to the dependent variable scale.

[4] *It is possible a model with more than one hidden layer.*
[5] *These signals map a relationship between the input nodes or the data and the output nodes or dependent variable.*

Table 6

Description of the Variables Used in the Estimation

Puerto Rico's economic indicators	Symbol	Non-Local economic indicators	Symbol
Employment in manufacturing	LMNF or LMNF sub-sector (ex. LMNFCHEMICAL)	U.S. Recession probabilities	REPROUS
Structural changes dummies variables	D year month (Ex. D9502)	Coincident Economic Activity Index for the United States Source: Federal Reserve Bank of St. Louis	USPHCI
Manufacturing hourly wages (various sub-sectors) Source: BLS	Wrealmnf wmnf	Consumer Price Index for All Urban Consumers: All Item Source: U.S. Department of Labor: Bureau of Labor Statistics	CPIUSALL
BGF's economic index	BGINDEX	US In Federal Reserve Bank of St. Louis industrial Production Index:	INDPRO
Total retail sale estimate	DTSALE	Crude Oil Prices: West Texas Intermediate (WTI) - Cushing, Oklahoma	Poil
Imports	IMPORTOT	Producer Price Index: Crude Materials for Further Processing:	PPICRM
CPI inflation rate.	IINFLPR	Producer Price Index: Finished Goods: Capital Equipment	PPICPE
Productivity indexes	LAMDAs	Producer Price Index: Intermediate Materials: Supplies & Components	PPIITM
Taxes: General Fund tax revenues	GTAXREV	FDI Flows from USA to Latin America (L.A.) and Asia (Five variables) (Percentage of US total FDI outflows) Source: U.S. National Accounts	FFDIOTHRLATREL (Non latin countries (N.L) in L.A.FDILATITHREL (L.A&N.L) FDICENTRREL (Centr. Ame) FDISOUTLA (south ame.) FDIASIAREL
Total bankruptcies	QUIEBTOT	Slope of Yield Curve: 10 year TBill-Fed. Fund rate.	SLOPEYIELDC
Industry electricity cost.	PRECIOELECIND	USA manufacturing employment Source: BLS	LMNFUS
		US Hourly manufacturing wages (Various sectors) Source: BLS	WAGEUS
		OECD based Recession Indicators for Four Big European Countries from OECD	BIGEUROREC
		Federal funds interest Rate	FedFund

Neural networks "learn" by adjusting the strength of the signal coming from the neurons9 in the previous layer. As the neural network becomes better at predicting the independent variable using the input variables, each of the connections between the input neurons and the hidden or intermediate neurons and between the intermediate neurons and the output neurons increases or decreases in strength. Thus, the information about the pattern being learned is encoded in the signals carried to and from the nodes .The activation or transfer function modifies the signal coming into the hidden layer nodes. The sigmoid and hyperbolic tangent functions are the activation functions most frequently used. These are non-linear functions.

The first layer contains the input nodes or data (xi). The second layer nodes, the hidden layer, connects to the output layer. The output layer represents the target or dependent variable(s). As can be seen from this Figure, each node in the input layer connects to each node in the hidden layer and each node in the hidden layer connects to each node in the output layer.

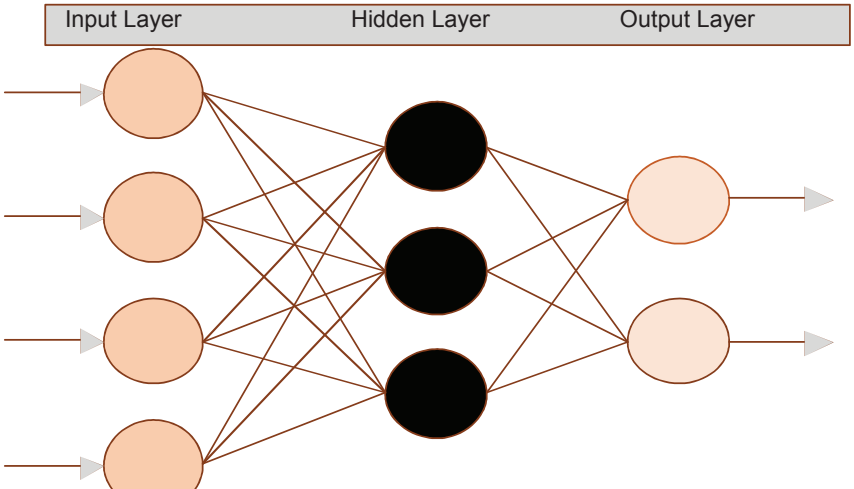


Figure 9: Three Layer Feed-Forward Neural Network

The first layer contains the input nodes or data (x_i). The second layer nodes, the hidden layer, connects to the output layer. The output layer represents the target or dependent variable(s). As can be seen from this Figure, each node in the input layer connects to each node in the hidden layer and each node in the hidden layer connects to each node in the output layer.

The model used in this research may be represented mathematically as:

$$L_{j,t} = f\left[\alpha + \sum \omega_{h0}\psi\left(\beta_h + \sum \omega_{hi}\, x_i\right)\right]$$

In this formula in the hidden layer-- ψ(…) – the βh are the weights for the bias or constant term on each of the hidden neurons, whi are the weights or parameters for the connection between each input xi and each hidden neuron. In the output layer -- f […]-- α is the bias weight and the who give the weights between each hidden neuron and the output. In our model, the activation function ψ is a hyperbolic tangent function and the output function "f" is the identity.

The parameters of the model are chosen to minimize a cost function given by:

$$C_i = \sum(L_{it} - \hat{L}_{it})^2$$

This procedure it is known as network training and yields the optimal parameters of the model. The training is done in a partition of the data, usually 70% of the total observations and the rest of the data points are used for testing the model. ANN analysis is in many ways like linear regression, which can be used to fit a curve to the data. However, unlike linear regression, the relationship between the predicted and target variable in a neural network is nonlinear, therefore a closed form solution to the minimization problem does not exist. In order to minimize the loss function, a numerical technique such as gradient descent is used.

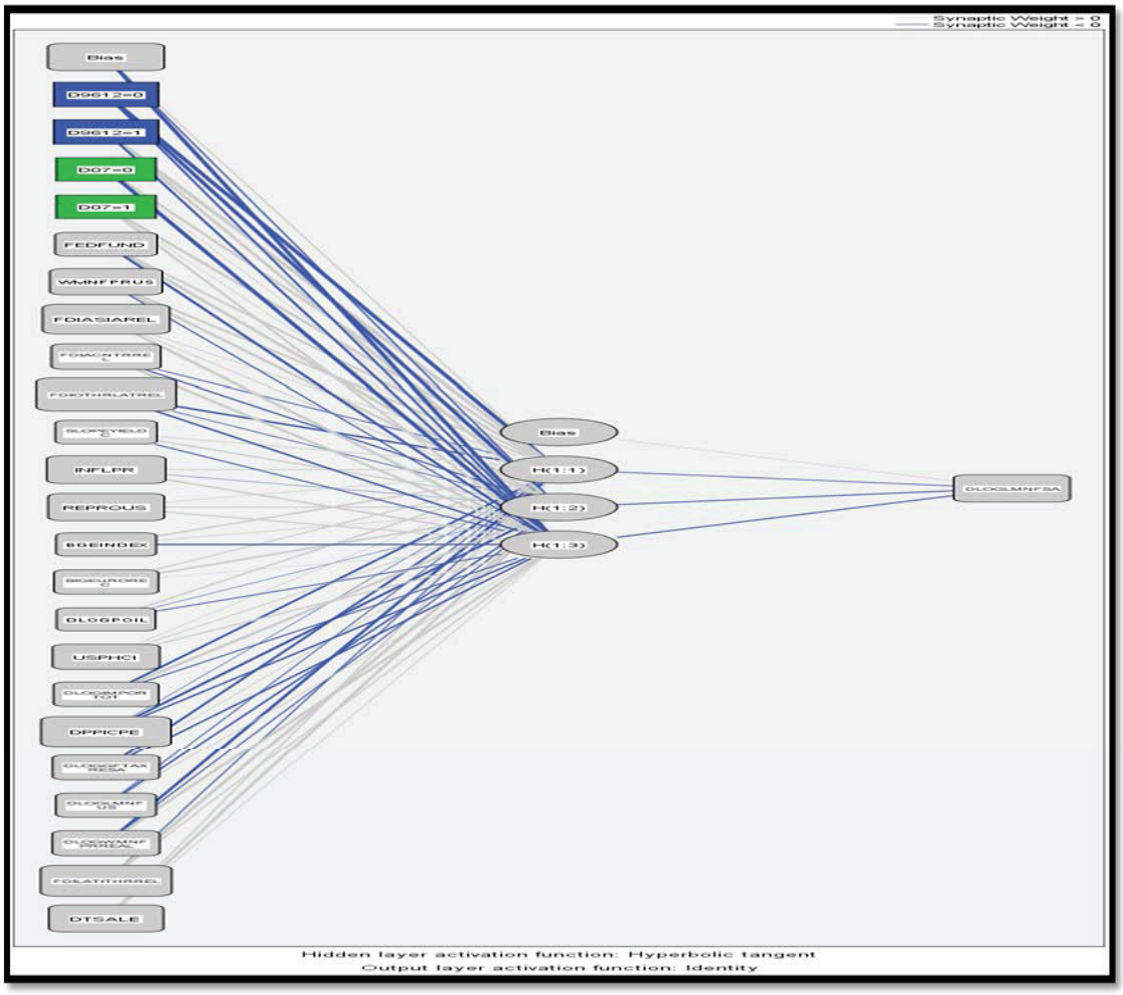
ANN analysis results. This technique was applied to total manufacturing employment in Puerto Rico. Also the employment of several industries in this sector was analyzed. However the results for the individual sub-sector does not vary significantly from those of the total manufacturing employment. For that reason only the results for some key sub-sectors, in addition to the findings for the entire sector, are reported.

The analysis was realized with monthly data from the period 1991:01 to 20013:04[6]. All the data were seasonally adjusted. The original time series had trend components, so the growth rate of the variables was used for the ANN analysis instead of the series' levels. These growth rates were standardized to be able to compare the contribution of each of the independent variables to the employment series variability.

To carry out the Artificial Neural Network experiments, a feed forward neural network with 3 neurons in the hidden layer was trained. It was allowed 15 minutes to do the training of the neurons and the threshold for the relative error of the model was .0001. The training was performed with 71% of the data and the rest 29% was used for testing the model.

Figure 10 shows the structure of ANN model of manufacturing total employment. The model consists of three layers: the input, a hidden and output's layers. The input layer includes two dummy variables that reflect structural changes that impacted the dependent variable in 1996 and 2007. The other 21 input nodes were presented in the previous section[7].

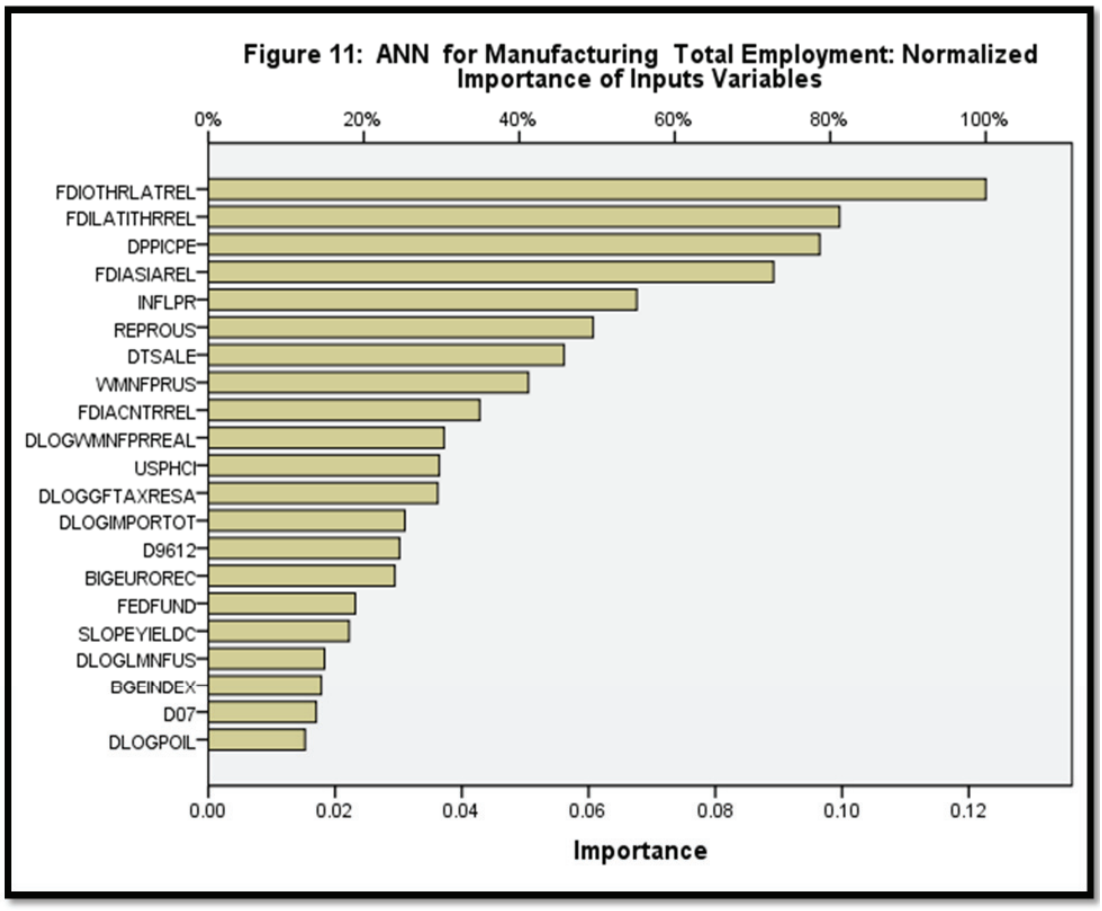
Figure 10: ANN Structure of Total Manufacturing Employment



[6] *For some series the data was available for shorter periods.*

[7] *The parameters estimated for ANN of manufacturing total employment are presented in Table C.1 in Appendix C.*

The relative importance of the independent variables in explaining the growth rates of the total manufacturing employment are displayed in Figure 11. It was found that two of the variables associated with the flows of the United States' foreign direct investment to Latin America and other countries of the region have the two higher weights in the model. The flow of FDI from US to Asia also has a high relative importance for the dependent variable of the ANN. These variables measure the FDI flows to regions as percentages of the total FDI outflows of the U.S.A, as it was mentioned above. Thus, they can be taken as proxies for the United States' trade agreements, as NAFTA and CAFTA, and other changes in global competitiveness.



The U.S. producer's price index growth rate and the inflation in the island are in the top five most relevant predictors of LMNF. Also it was found that the state of the aggregate's economic activity in United States as well as in Puerto Rico has had a relative high impact on Puerto Rico's manufacturing sector performance. These variables may be taken as indicators of the aggregate demand in both of the economies. On the other hand, the cost of labor in the island relative to the United States does not seen to be very important in this model. It ranks 8th in importance in the list of 23 explanatory variables.

The employment in the chemical, food and apparel sub-sectors were also analyzed using the ANN techniques. The principal results of the models that were adjusted are reported in Appendix B. The main conclusions of the models solution analysis may be summarized as follow:

- The dynamics of employment in the chemical sub-sector is very similar to that of the total manufacturing employment. Some differences are: the U.S.'s manufacturing employment seems to be related to this sector's employment, Puerto Rico's real wages occupied the 10th position in importance out of 23 and the slope of yield curve the 14th position.

- The food sector, as it is known, produces for the local markets. Thus the principal independent variables in the ANN model for this sector employment are indicators of the state of Puerto Rico's economy. The island's total retail sales indicator is the most important input variable for this sector's employment. The other top two independent variables are Puerto Rico's personal bankruptcies and the island's inflation rate. Hence, the local demand factor seems to be the principal predictors of LFood.
- The employment in the apparel industry of the island has as principal predictors: the US's manufacturing employment, and Puerto Rico's total retail sale estimate. The third and fourth places in importance belong to U.S. FDI outflows to Asia and Latin America, respectively.

In this section, the results of the solution of various artificial neural network (ANN) models that explain the manufacturing sector and some industries growth rate of monthly employment were discussed. The results of this model are useful to the SWOT analysis of the manufacturing sector that is presented in the next section.

As it is known, in the SWOT analysis ,the strengths, weaknesses, opportunities and threats can be decided by a lot of factors, including some qualitative and quantitative criteria, whose importance are determined by some experts judgments. In this research, however, several artificial intelligence models were introduced (specifically ANN) to help in the estimation of the island's manufacturing conditions objectively. The assessment system contains more than 20 variables, including some relative cost of productions indicators, structural changes variables, proxy variables for U.S.'s international trade policies, Puerto Rico's and the United States' aggregate demand factors, and other relevant predictors of manufacturing employment. A three layer network structure with a hidden layer was the structure chosen to examine the problem posed here.

III. Regional trends

What determine the competitive advantages of Puerto Rico's manufacturing sector? In this section this question is addressed analyzing the following: the wage gap between Puerto Rico and the United States' manufacturing sectors; the manufacturing clusters drivers; the income and employment multipliers, and the participation of each sub-sector in manufacturing exports.

A. A general Analysis

Puerto Rico and the U.S. A. 's Manufacturing Wages. Figure 12 shows the average hourly earnings of production and nonsupervisory workers in the manufacturing sector of Puerto Rico and United States from 2001 to 2013. As is evident from this Figure, there is a gap between the U.S. and Puerto Rico's labor compensation in this economic sector. This gap increased from $4.90 in 2001 to $6.43 in 2012. The manufacturing wages in the island are around 33% lower than in United States.

Table 7 shows the hourly wage rate in Puerto Rico and the United States for some of the manufacturing sub-sectors. Some interesting findings are:

1. The clothing industry wage gap increases from $2.36 in 2001 to $4.37 in 2012. In the more recent year, Puerto Rico's wages for this industry were 34% less than the U.S.A.'s.
2. In the case of the food sub-sector the difference between the two countries' wages decreases from $3.36 in 2001 to $3.03, in 2012. The gap in 2012 implies that the island was 24% lower than in U.S.
3. In the chemical industries the wages difference diminished from 3.36 to 3.03, resulting that in 2012 the island wages were 14% lower than those of the United States.

Table 7
Average Hourly Earnings of Production and Nonsupervisory Workers For Puerto Rico and United States

	Compensation in dollars					
	2001		2006		2012	
Sub-sector	PR	US	PR	US	PR	US
Durables	9.11	14.86	10.57	16.59	12.39	18.15
Non-metallic mineral	10.80	14.86	10.69	16.59	13.90	18.15
Medical Device	NA	12.63	NA	14.45	NA	17.35
Non-Durables	10.41	13.09	12.21	14.55	12.88	16.48
Chemical	14.21	17.57	16.45	19.60	18.42	21.45
Clothing	6.47	8.83	6.61	10.65	8.52	12.89
Food	8.11	12.18	9.93	13.13	11.44	15.02
Total Manufacturing	9.85	14.76	11.48	16.81	12.65	19.08

Source: BLS

It is important to take into account that wages differentials may be larger for high level professional and management employees. Thus the comparative advantage of Puerto Rico in this industry may be higher. Also the competitiveness of the island may increase as its rival countries continue to evolve and move up on the product complexity hill and start to be less competitive on their labor advantage. They, as Puerto Rico did, will look more like developed countries. Thus increasing the labor productivity instead of lowering its compensation may be the key to the island's future economic growth.

Puerto Rico Manufacturing Clusters Drivers. The location of a significant number of similar firms, in a specific geographical area played a major role in the formation of towns and cities in the past. However, the clusters of the past formed spontaneously while the current ones are formed under the promotion of national and regional governments. This section present a general discussion of this topic.

Industrial, business, competitive, productive or porterian clusters are some of the names that have appeared in the literature referring to this type of firms agglomeration. Porter (1990) defines an industrial cluster as a group of companies in the same industry and other organizations interrelated in a national economy, while for Schmitz (1992) it is a geographical and sectoral agglomeration of companies. To Doeringer and Tekla (1995) a cluster is a geographic concentration of businesses that gain advantages in their performances through the co-localization (p. 225).

As we see, Schmitz emphasizes the regional nature of cluster and Porter defines it at a country level. Furthermore, Doeringer and Tekla give emphasis to the notion that the clusters are more than a set of companies indicate that they receive advantages in their performance by being located close to each other. This kind of competitive advantage is known as agglomeration advantages and depends on other institutions in addition to the firms, such as: the government, universities and organizations of merchants and businessmen in general. These advantages mean that the companies within the cluster are higher than other companies in terms of wealth creation, even when compared to others in the same geographic region.

The high level of interaction between companies within a cluster makes Czamanski and Ablas (1979) differentiate between the concept and an industrial complex. According to these authors, a cluster is a subset of businesses with a connection in the flow of goods and services between them that is superior to the one they have with the other sectors of the national economy, while that for an industrial complex to exist, it's only required that there are interrelationships between the businesses and similarity in location patterns. Another difference between these two concepts is that in the business clusters there exist links in the production chain. Jacobs and DeMan (1996) emphasize the spatial accumulation of economic activity around a lead actor (companies, research centers, or universities) and the existence of cooperation between the companies to define business clusters.

An important aspect, which is implicit in the definitions of clusters, is the dynamic interplay of the members of the group, although this aspect is very difficult to measure and is often neglected in the empirical literature on the subject. Because this interaction generates economies of scale or synergy, it is one of the most attractive elements of cluster development. In operational terms, business clusters can be defined, based on some of its features, such as a group of businesses: that similarly affected by aggregate or regional shocks, with similar requirements of the labor input, capital goods or other resources, that produce the same or use the same distribution channels. Based on these features one can distinguish between two types of clusters: vertically integrated and horizontally integrated. The former are linked through buyer-seller relationships, while the latter may share a common market by the end products, use a common technology or labor force, or require the same natural resources (Porter 1990).

The reasons given for the placing of a group of companies in a common location depends on the notion one has about what is an industrial cluster, which, as we already saw, are diverse. In general terms, clusters arise when companies locate in places where there is a workforce with the skills they need, a natural resource, a service infrastructure to support business as professional services, a physical infrastructure, or near research centers. Such clusters may be the result of conversations between industry leaders, perhaps through their business organizations, to create the conditions that will maximize the likelihood of success of their operations. Remember that in general terms, companies locate in places where they get a higher yield of their investment.

Once these clusters arise, they reinforce themselves through processes of technological innovation and knowledge transfer which increases the probability of survival. Part of that knowledge is transferred through employees when they move from one company to another. In addition, as the need for specialized labor rises, the demand for new university degrees will also increase.

These industrial groups can increase the efficiency of others companies offering various types of specialized services such as accounting, law, statistics (quality control), among others, as they can serve a larger group of businesses within the area. Also, with the movement of workers across firms within the cluster, the knowledge spreads, especially tacit knowledge or knowledge that is difficult to codify. The kind of knowledge about how to do a job that is very difficult to explain through written or verbal means, but that can be transmitted through observation, is called tacit knowledge. That kind of knowledge is transferred through employees as they move from one company to another.

On the other hand, when this kind of industrial complex exists, regional planners can focus their strategies to homogeneous groups of firms, which increases the efficiency of the marketing of the place by emphasizing the strengths of the jurisdiction. It is also easier to develop the workforce necessary to meet the requirements of enterprises, so that regional investment can have a higher performance.

The globalization of economies has made financial and information markets, which serve as the basis for production processes, as well as subsidiaries of multinational companies, be located in different parts of the world. These changes in the way of organizing production have led countries to make efforts to improve their competitive position, since it impacts the decision of the companies about where they will locate. So, many jurisdictions, based on the benefits associated with the establishment of clusters, have promoted this type of industrial organization as an alternative to

improve their competitive position. Under this type of scheme, businesses and industries are considered as a system rather than in their individual character. Therefore, the authorities who design the economic policies direct their efforts to identify the clusters and determine their needs to allocate resources in a more efficient way. The promotion of the suppliers of the companies that make industrial clusters generates more economic base that promoting any particular company.

The design and implementation of economic policies to stimulate the formation and strengthening of industrial clusters is a recent trend in economic development programs. This represents a change in the public policy of past decades that was focused on the promotion of individual firms. The desire to have innovative industrial promotion policies explains in part the boom of business clusters[8].

Methodologies used to identify business clusters: As discussed above there are different concepts that define what industrial clusters are. Because of this, different procedures for identification and study of industrial cluster have been developed. Two of the most common quantitative methods used are: principal component analysis on input-output tables and the location quotient (LQ) technique. Because the most recent input-output table for Puerto Rico is from 2002, in this study the LQ method is used to identify the manufacturing clusters in the island.

The localization quotient method: This method is based upon the definition of industrial clusters as a concentration of related businesses in a particular geographic area. To define the cluster, using this methodology, the LQ should be greater than one. This condition implies that the region is specialized in these types of industries.

The location quotient (or locational coefficient) of manufacturing employment (LQ) measures the employment specialization of a local economy. This coefficients, also, may identify export industries in the island. The formula for this indicator is given by:

$$LQ_i = \frac{\frac{L_{PR,i}}{L_{PR,MNF}}}{\frac{L_{US,i}}{L_{US,MNF}}}$$

Where L is employment level, MNF stand for manufacturing sector, PR is Puerto Rico, and US is United States.

When LQj is greater than one, then the local economy has comparative advantage in the production of the goods of industry j, and indicates that Puerto Rico has proportionately more workers than the United States in a specific industry sector. This implies, given the use of similar production technologies, that the area examined is producing more of a product than is consumed by its residents[9]. Sectors with high LQ may have economic potential for exports growth.

On the other extreme, industries with LQs significantly lower than one may point to an opportunity to develop companies in the area to satisfy local demand. Location quotients are excellent indicators for understanding the manufacturing sector in the island and provide information to support the planning efforts. Table 8 presents the LQs and the income and employment multipliers for nine industry groups of Puerto Rico manufacturing sector.

[8] *Some examples of business clusters around the word are presented in Appendix A.*
[9] *However it is possible that, a LQ greater than 1.00 implies excessive local demand for some industrial group products.*

Table 8
Locational Coefficient and Multipliers for Puerto Rico Manufacturing sub-sectors

	LQs			I-O Multipliers2002	
Sub-Sector	2001	2006	2012	Type II Income	Type II Employment
Pharmaceutical	11.08	12.09	8.67	3.84	7.32
Chemical	3.90	4.71	3.63	3.84 to 1.83	2.33 to 7.32
Apparel	4.03	4.61	8.81	1.76	1.63
Medical Equipment	4.48	4.63	5.28	*NA.*	NA
Beverage & Tobacco	2.15	2.18	1.82	1.99 to 2.31	2.62 to 9.40
Food	1.28	1.07	1.17	1.49 to 6.29	1.37 to 10.49
Non Metallic Mineral	1.08	0.99	0.83	1.88	2.03
Computer & Electronics	0.92	1.03	0.67	1.43	1.58
Metal Fabricated Product	0.51	0.47	0.37	1.77	1.70
Plastics	0.50	0.38	0.36	1.38	1.45

This Table shown that the pharmaceutical industry has the highest LQ among the industry examined. The maximum share of the total manufacturing exports also belong to this sub-sector: 70 percent. Nevertheless, the location quotient for this sector diminished from 11.1 in 2001 to 8.7 in 2012, or by 22%. The pharmaceutical sector also has a high economic impact on the other sectors of Puerto Rican economy, judging by the levels of income and the employment multiplier, 3.84 and 7.32 respectively. Another high-technology distinguishing industry is medical devices.

Two additional sectors of Puerto Rico‘s manufacturing that have high location quotients are the apparel and tobacco and beverage sectors. The LQ for the clothing industry doubled from 2001 to 2012. These coefficient increased from 4.13 to 8.70 in that period. On the other hand, the tobacco and beverage sector coefficient of location had a slightly reduction from 2.15 in 2001 to 1.82 in 2012. These sectors have moderate interconnection with the other sectors of the economy exhibiting income multipliers that fluctuates from 1.76 to 2.31 and employment multipliers that lies between 1.63 and 9.40.

Finally the LQ for food sector diminished from 1.28 in 2001 to 1.17 in 2012. This sector has an income multiplier that goes from 1.49 to 6.29 and a type II employment multiplier between 1.37 and 10.49. In 2012, 6.3% of the total manufacturing exports came from the food industries. This is sector has a high growth potential to satisfy the internal demand for this type of commodities..

It is important to point out that in addition to the relative good wages and the value multipliers, this sector affects Puerto Rico’s economy in other ways. This sector has been responsible for a significant amount of taxes collected by Puerto Rican Treasury Department and municipal governments. Also, manufacturing, in spite of the job losses due to the structural changes that have affected its performance, is still an important sector for the island’s economy.

B. A detailed Analysis of Location Quotients[11]

Tables D1 - D4 and Figures D1 - D4 (in Appendix D) show the Industry Location Quotient (LQ) analysis performed for the Manufacturing Sector and Sub-sectors (NAICS 31-33). The LQ, as mentioned above, is a way of quantifying how concentrated an industry is in a region compared to a larger region, in this case Puerto Rico to the United States of America. LQ were calculated for the Number of Employees, Annual Payroll per Employee, and Number of Establishments based on P.R. and U.S. data from the U.S. Census Bureau, County Business Pattern for the year 2011. Table's 1 - 4 shawl for Number of Employees, Number of Establishments, and Total Annual Payroll sorted from largest to smallest values, and Annual Payroll per Employee sorted from smallest to largest value. Those tables show the sub-sectors according to the concentration value of Puerto Rico compared with the United States of America. The Figures illustrate a comparison of LQ between the sub-sectors. Annual Payroll per Employee was also analyzed comparing the data of P.R. with the U.S. as a benchmark.

Manufacturing Sector (NAICS 31-33) - LQ with respect to the Number of Paid Employees for this sector in 2011 was 1.28 meaning that P.R. has 1. 28 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sector in 2011 was 1.26 meaning that P.R. pays $1.26 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sector in 2011 was 1.03 meaning that P.R. has 1.03 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $35,482 and in the U.S. $52,330. This means that, on average, the Annual Payroll per Employee in P.R. is 67.80 percent of what it is in the U.S. which represents a difference of -$16,849.

Food Manufacturing (NAICS 311) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 1.24 meaning that P.R. has 1.24 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 1.21 meaning that P.R. pays $1.21 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 2.68 meaning that P.R. has 2.68 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $24,698 and in the U.S. $38,107. This means that, on average, the Annual Payroll per Employee in P.R. is 64.81 percent of what it is in the U.S. which represents a difference of -$13,409.

Beverage and Tobacco Product Manufacturing (NAICS 312) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 3.51 meaning that P.R. has 3.51 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 1.15 meaning that P.R. pays $1.15 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 2.08 meaning that P.R. has 2.08 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $31,212 and in the U.S. $50,662. This means that, on average, the Annual Payroll per Employee in P.R. is 61.61 percent of what it is in the U.S. which represents a difference of -$19,450.

Textile Mills (NAICS 313) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 0.03 meaning that P.R. has 0.03 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 0.65 meaning that P.R. pays $0.65 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 0.47 meaning that P.R. has 0.47 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $13,238 and in the U.S. $38,028. This means that, on average, the Annual Payroll per Employee in P.R. is 34.81 percent of what it is in the U.S. which represents a difference of -$24,790.

[10] *Table A.4 in Appendix A shows the effects of this structural changes on LQs trends.*
[11] *Locational Quotients (LQ's) for some U.S. States are included in Appendix E.*

Textile Product Mills (NAICS 314) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 2 meaning that P.R. has 2 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 1 meaning that P.R. pays $1 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 1.05 meaning that P.R. has 1.05 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $17,310 and in the U.S. $32,087. This means that, on average, the Annual Payroll per Employee in P.R. is 53.95 percent of what it is in the U.S. which represents a difference of -$14,778.

Apparel Manufacturing (NAICS 315) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 9.07 meaning that P.R. has 9.07 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 1.22 meaning that P.R. pays $1.22 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 1.87 meaning that P.R. has 1.87 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $17,128 and in the U.S. $26,046. This means that, on average, the Annual Payroll per Employee in P.R. is 65.76 percent of what it is in the U.S. which represents a difference of -$8,919.

Leather and Allied Product Manufacturing (NAICS 316) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 7.6 meaning that P.R. has 7.6 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 0.81 meaning that P.R. pays $0.81 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 1.29 meaning that P.R. has 1.29 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $14,636 and in the U.S. $33,425. This means that, on average, the Annual Payroll per Employee in P.R. is 43.79 percent of what it is in the U.S. which represents a difference of -$18,789.

Wood Product Manufacturing (NAICS 321) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 0.32 meaning that P.R. has 0.32 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 1.14 meaning that P.R. pays $1.14 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 0.58 meaning that P.R. has 0.58 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $21,656 and in the U.S. $35,196. This means that, on average, the Annual Payroll per Employee in P.R. is 61.53 percent of what it is in the U.S. which represents a difference of -$13,541.

Paper Manufacturing (NAICS 322) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 0.55 meaning that P.R. has 0.55 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 0.85 meaning that P.R. pays $0.85 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 1.3 meaning that P.R. has 1.3 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $25,094 and in the U.S. $54,874. This means that, on average, the Annual Payroll per Employee in P.R. is 45.73 percent of what it is in the U.S. which represents a difference of -$29,780.

Printing and Related Support Activities (NAICS 323) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 0.76 meaning that P.R. has 0.76 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 1.27 meaning that P.R. pays $1.27 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 0.92 meaning that P.R. has 0.92 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $28,316 and in the U.S. $41,415. This means that, on average, the Annual Payroll per Employee in P.R. is 68.37 percent of what it is in the U.S. which represents a difference of -$13,100.

Petroleum and Coal Products Manufacturing (NAICS 324) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 1.15 meaning that P.R. has 1.15 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 0.72 meaning that P.R. pays $0.72 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 2.47 meaning that P.R. has 2.47 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $34,524 and in the U.S. $89,317. This means that, on average, the Annual Payroll per Employee in P.R. is 38.65 percent of what it is in the U.S. which represents a difference of -$54,793.

Chemical Manufacturing (NAICS 325) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 5.32 meaning that P.R. has 5.32 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 1.47 meaning that P.R. pays $1.47 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 1.69 meaning that P.R. has 1.69 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $56,601 and in the U.S. $71,446. This means that, on average, the Annual Payroll per Employee in P.R. is 79.22 percent of what it is in the U.S. which represents a difference of -$14,845.

Plastics and Rubber Products Manufacturing (NAICS 326) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 0.49 meaning that P.R. has 0.49 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 1.25 meaning that P.R. pays $1.25 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 0.75 meaning that P.R. has 0.75 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $29,320 and in the U.S. $43,660. This means that, on average, the Annual Payroll per Employee in P.R. is 67.16 percent of what it is in the U.S. which represents a difference of -$14,340.

Nonmetallic Mineral Product Manufacturing (NAICS 327) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 1.15 meaning that P.R. has 1.15 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 1.03 meaning that P.R. pays $1.03 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 1.53 meaning that P.R. has 1.53 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $25,990 and in the U.S. $46,819. This means that, on average, the Annual Payroll per Employee in P.R. is 55.51 percent of what it is in the U.S. which represents a difference of -$20,829.

Primary Metal Manufacturing (NAICS 331) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 0.17 meaning that P.R. has 0.17 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 0.6 meaning that P.R. pays $0.6 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 0.83 meaning that P.R. has 0.83 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $18,824 and in the U.S. $58,839. This means that, on average, the Annual Payroll per Employee in P.R. is 31.99 percent of what it is in the U.S. which represents a difference of -$40,015.

Fabricated Metal Product Manufacturing (NAICS 332) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 0.51 meaning that P.R. has 0.51 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 0.84 meaning that P.R. pays $0.84 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 0.68 meaning that P.R. has 0.68 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $21,845 and in the U.S. $48,343. This means that, on average, the Annual Payroll per Employee in P.R. is 45.19 percent of what it is in the U.S. which represents a difference of -$26,498.

Machinery Manufacturing (NAICS 333) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 0.19 meaning that P.R. has 0.19 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 1.05 meaning that P.R. pays $1.05 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 0.36 meaning that P.R. has 0.36 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $32,331 and in the U.S. $57,487. This means that, on average, the Annual Payroll per Employee in P.R. is 56.24 percent of what it is in the U.S. which represents a difference of -$25,157.

Computer and Electronic Product Manufacturing (NAICS 334) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 0.56 meaning that P.R. has 0.56 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 0.97 meaning that P.R. pays $0.97 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 0.38 meaning that P.R. has 0.38 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $39,212 and in the U.S. $75,363. This means that, on average, the Annual Payroll per Employee in P.R. is 52.03 percent of what it is in the U.S. which represents a difference of -$36,152.

Electrical Equipment, Appliance, and Component Manufacturing (NAICS 335) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 2.25 meaning that P.R. has 2.25 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 1.07 meaning that P.R. pays $1.07 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 0.98 meaning that P.R. has 0.98 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $29,869 and in the U.S. $52,052. This means that, on average, the Annual Payroll per Employee in P.R. is 57.38 percent of what it is in the U.S. which represents a difference of -$22,183.

Transportation Equipment Manufacturing (NAICS 336) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 0.14 meaning that P.R. has 0.14 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 0.96 meaning that P.R. pays $0.96 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 0.33 meaning that P.R. has 0.33 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $32,166 and in the U.S. $62,185. This means that, on average, the Annual Payroll per Employee in P.R. is 51.73 percent of what it is in the U.S. which represents a difference of -$30,019.

Furniture and Related Product Manufacturing (NAICS 337) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 0.56 meaning that P.R. has 0.56 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 0.89 meaning that P.R. pays $0.89 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 1.24 meaning that P.R. has 1.24 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $17,624 and in the U.S. $36,711. This means that, on average, the Annual Payroll per Employee in P.R. is 48.01 percent of what it is in the U.S. which represents a difference of -$19,087.

Miscellaneous Manufacturing (NAICS 339) - LQ with respect to the Number of Paid Employees for this sub-sector in 2011 was 4.34 meaning that P.R. has 4.34 paid employees for every 1 paid employee in the U.S. LQ with respect to the Annual Payroll per Employee for this sub-sector in 2011 was 1.25 meaning that P.R. pays $1.25 per employee for every $1 paid per employee in the U.S. LQ with respect to the Number of Establishments for this sub-sector in 2011 was 0.68 meaning that P.R. has 0.68 establishments for every 1 establishment in the U.S. For the year 2011 the Annual Payroll per Employee in P.R. was $34,165 and in the U.S. $51,037. This means that, on average, the Annual Payroll per Employee in P.R. is 66.94 percent of what it is in the U.S. which represents a difference of -$16,872.

C. Sector Comparison Analysis for the Years 2006 and 2011

Figures D5 - D26 (see Appendix D) show data for the Manufacturing Sector and Sub-sectors (NAICS - 31-33) in Puerto Rico for the year 2006 and 2011, obtained from the U.S. Census Bureau, County Business Patterns.

Figure D5 (NAICS 31-33 - Manufacturing Sector) - The number of paid employees for this sector in the year 2006 was 110,050, and 83,712 for the year 2011. This represents a decrease of 26,338 paid employees or 23.93 percent (on average, 4.79 percent per year for 5 years). The payroll per employee for this sector in the year 2006 was $32,576, and $35,482 for the year 2011. This represents an increase of $2,905 on payroll per employee or 8.92 percent (on average, 1.78 percent per year for 5 years). The number of establishments for this sector in the year 2006 was 2,118, and 1,829 for the year 2011. This represents a decrease of 289 establishments or 13.64 percent (on average, 2.73 percent per year for 5 years). The total gross product for this sector in the year 2006 was $36,709,513 thousand, and $46,832,074 thousand for the year 2011. This represents an increase of $10,122,561 thousand in total gross product or 27.57 percent (on average, 5.51 percent per year for 5 years).

Figure D6 (NAICS 311 - Food Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 11,594, and 10,471 for the year 2011. This represents a decrease of 1,123 paid employees or 9.69 percent (on average, 1.94 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $22,491, and $24,698 for the year 2011. This represents an increase of $2,206 on payroll per employee or 9.81 percent (on average, 1.96 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 394, and 410 for the year 2011. This represents an increase of 16 establishments or 4.06 percent (on average, 0.81 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $11,039,963 thousand, and $862,283 thousand for the year 2011. This represents a decrease of $241,680 thousand in total gross product or 21.89 percent (on average, 4.38 percent per year for 5 years).

Figure D7 (NAICS 312 - Beverage and Tobacco Product Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 4,232, and 3,051 for the year 2011. This represents a decrease of 1,181 paid employees or 27.91 percent (on average, 5.58 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $32,726, and $31,212 for the year 2011. This represents a decrease of $1,514 on payroll per employee or 4.63 percent (on average, 0.93 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 56, and 63 for the year 2011. This represents an increase of 7 establishments or 12.5 percent (on average, 2.5 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $909,325 thousand, and $1,091,557 thousand for the year 2011. This represents an increase of $182,232 thousand in total gross product or 20.04 percent (on average, 4.01 percent per year for 5 years).

Figure D8 (NAICS 313 - Textile Mills) - The number of paid employees for this sub-sector in the year 2006 was 129, and 21 for the year 2011. This represents a decrease of 108 paid employees or 83.72 percent (on average, 16.74 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $10,907, and $13,238 for the year 2011. This represents an increase of $2,331 on payroll per employee or 21.37 percent (on average, 4.27 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 19, and 7 for the year 2011. This represents a decrease of 12 establishments or 63.16 percent (on average, 12.63 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $2,454 thousand, and $608 thousand for the year 2011. This represents a decrease of $1,846 thousand in total gross product or 75.21 percent (on average, 15.04 percent per year for 5 years).

Figure D9 (NAICS 314 - Textile Product Mills) - The number of paid employees for this sub-sector in the year 2006 was 2,056, and 1,327 for the year 2011. This represents a decrease of 729 paid employees or 35.46 percent (on average, 7.09 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $12,603, and $17,310 for the year 2011. This represents an increase of $4,707 on payroll per employee or 37.34 percent (on

average, 7.47 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 46, and 39 for the year 2011. This represents a decrease of 7 establishments or 15.22 percent (on average, 3.04 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $14,255 thousand, and $10,003 thousand for the year 2011. This represents a decrease of $4,252 thousand in total gross product or 29.83 percent (on average, 5.97 percent per year for 5 years).

Figure D10 (NAICS 315 - Apparel Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 6,777, and 6,151 for the year 2011. This represents a decrease of 626 paid employees or 9.24 percent (on average, 1.85 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $13,896, and $17,128 for the year 2011. This represents an increase of $3,232 on payroll per employee or 23.26 percent (on average, 4.65 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 97, and 80 for the year 2011. This represents a decrease of 17 establishments or 17.53 percent (on average, 3.51 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $218,237 thousand, and $275,750 thousand for the year 2011. This represents an increase of $57,513 thousand in total gross product or 26.35 percent (on average, 5.27 percent per year for 5 years).

Figure D11 (NAICS 316 - Leather and Allied Product Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 1,349, and 1,295 for the year 2011. This represents a decrease of 54 paid employees or 4 percent (on average, 0.8 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $11,744, and $14,636 for the year 2011. This represents an increase of $2,893 on payroll per employee or 24.63 percent (on average, 4.93 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 10, and 9 for the year 2011. This represents a decrease of 1 establishment or 10 percent (on average, 2 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $18,936 thousand, and $25,156 thousand for the year 2011. This represents an increase of $6,220 thousand in total gross product or 32.85 percent (on average, 6.57 percent per year for 5 years).

Figure D12 (NAICS 321 - Wood Product Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 1,207, and 651 for the year 2011. This represents a decrease of 556 paid employees or 46.06 percent (on average, 9.21 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $17,273, and $21,656 for the year 2011. This represents an increase of $4,383 on payroll per employee or 25.38 percent (on average, 5.08 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 63, and 48 for the year 2011. This represents a decrease of 15 establishments or 23.81 percent (on average, 4.76 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $23,046 thousand, and $17,258 thousand for the year 2011. This represents a decrease of $5,789 thousand in total gross product or 25.12 percent (on average, 5.02 percent per year for 5 years).

Figure D13 (NAICS 322 - Paper Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 1,416, and 1,187 for the year 2011. This represents a decrease of 229 paid employees or 16.17 percent (on average, 3.23 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $21,586, and $25,094 for the year 2011. This represents an increase of $3,507 on payroll per employee or 16.25 percent (on average, 3.25 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 36, and 35 for the year 2011. This represents a decrease of 1 establishment or 2.78 percent (on average, 0.56 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $70,728 thousand, and $56,039 thousand for the year 2011. This represents a decrease of $14,689 thousand in total gross product or 20.77 percent (on average, 4.15 percent per year for 5 years).

Figure D14 (NAICS 323 - Printing and Related Support Activities) - The number of paid employees for this sub-sector in the year 2006 was 2,673, and 2,178 for the year 2011. This represents a decrease of 495 paid employees or 18.52 percent (on average, 3.7 percent per year for 5 years). The payroll per employee for this sub-sector in the year

2006 was $22,952, and $28,316 for the year 2011. This represents an increase of $5,364 on payroll per employee or 23.37 percent (on average, 4.67 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 174, and 154 for the year 2011. This represents a decrease of 20 establishments or 11.49 percent (on average, 2.3 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $125,551 thousand, and $120,700 thousand for the year 2011. This represents a decrease of $4,851 thousand in total gross product or 3.86 percent (on average, 0.77 percent per year for 5 years).

Figure D15 (NAICS 324 - Petroleum and Coal Products Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 988, and 670 for the year 2011. This represents a decrease of 318 paid employees or 32.19 percent (on average, 6.44 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $39,234, and $34,524 for the year 2011. This represents a decrease of $4,710 on payroll per employee or 12 percent (on average, 2.4 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 26, and 33 for the year 2011. This represents an increase of 7 establishments or 26.92 percent (on average, 5.38 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $343,613 thousand, and $367,157 thousand for the year 2011. This represents an increase of $23,544 thousand in total gross product or 6.85 percent (on average, 1.37 percent per year for 5 years).

Figure D16 (NAICS 325 - Chemical Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 34,699, and 22,914 for the year 2011. This represents a decrease of 11,785 paid employees or 33.96 percent (on average, 6.79 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $51,152, and $56,601 for the year 2011. This represents an increase of $5,449 on payroll per employee or 10.65 percent (on average, 2.13 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 152, and 131 for the year 2011. This represents a decrease of 21 establishments or 13.82 percent (on average, 2.76 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $26,095,409 thousand, and $32,871,791 thousand for the year 2011. This represents an increase of $6,776,382 thousand in total gross product or 25.97 percent (on average, 5.19 percent per year for 5 years).

Figure D17 (NAICS 326 - Plastics and Rubber Products Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 2,408, and 1,991 for the year 2011. This represents a decrease of 417 paid employees or 17.32 percent (on average, 3.46 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $22,794, and $29,320 for the year 2011. This represents an increase of $6,526 on payroll per employee or 28.63 percent (on average, 5.73 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 61, and 57 for the year 2011. This represents a decrease of 4 establishments or 6.56 percent (on average, 1.31 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $116,277 thousand, and $100,570 thousand for the year 2011. This represents a decrease of $15,707 thousand in total gross product or 13.51 percent (on average, 2.7 percent per year for 5 years).

Figure D18 (NAICS 327 - Nonmetallic Mineral Product Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 4,104, and 2,324 for the year 2011. This represents a decrease of 1,780 paid employees or 43.37 percent (on average, 8.67 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $21,348, and $25,990 for the year 2011. This represents an increase of $4,641 on payroll per employee or 21.74 percent (on average, 4.35 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 157, and 141 for the year 2011. This represents a decrease of 16 establishments or 10.19 percent (on average, 2.04 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $271,580 thousand, and $113,792 thousand for the year 2011. This represents a decrease of $157,788 thousand in total gross product or 58.1 percent (on average, 11.62 percent per year for 5 years).

Figure D19 (NAICS 331 - Primary Metal Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 593, and 380 for the year 2011. This represents a decrease of 213 paid employees or 35.92 percent (on

average, 7.18 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $22,708, and $18,824 for the year 2011. This represents a decrease of $3,885 on payroll per employee or 17.11 percent (on average, 3.42 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 30, and 23 for the year 2011. This represents a decrease of 7 establishments or 23.33 percent (on average, 4.67 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $100,488 thousand, and $174,252 thousand for the year 2011. This represents an increase of $73,765 thousand in total gross product or 73.41 percent (on average, 14.68 percent per year for 5 years).

Figure D20 (NAICS 332 - Fabricated Metal Product Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 5,931, and 4,057 for the year 2011. This represents a decrease of 1,874 paid employees or 31.6 percent (on average, 6.32 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $18,875, and $21,845 for the year 2011. This represents an increase of $2,970 on payroll per employee or 15.73 percent (on average, 3.15 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 296, and 225 for the year 2011. This represents a decrease of 71 establishments or 23.99 percent (on average, 4.80 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $248,182 thousand, and $169,999 thousand for the year 2011. This represents a decrease of $78,182 thousand in total gross product or 31.5 percent (on average, 6.3 percent per year for 5 years).

Figure D21 (NAICS 333 - Machinery Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 1,746, and 1,092 for the year 2011. This represents a decrease of 654 paid employees or 37.46 percent (on average, 7.49 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $26,406, and $32,331 for the year 2011. This represents an increase of $5,925 on payroll per employee or 22.44 percent (on average, 4.49 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 56, and 52 for the year 2011. This represents a decrease of 4 establishments or 7.14 percent (on average, 1.43 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $227,683 thousand, and $228,153 thousand for the year 2011. This represents an increase of $469 thousand in total gross product or 0.21 percent (on average, 0.04 percent per year for 5 years).

Figure D22 (NAICS 334 - Computer and Electronic Product Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 7,306, and 2,907 for the year 2011. This represents a decrease of 4,399 paid employees or 60.21 percent (on average, 12.04 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $33,730, and $39,212 for the year 2011. This represents an increase of $5,481 on payroll per employee or 16.25 percent (on average, 3.25 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 42, and 30 for the year 2011. This represents a decrease of 12 establishments or 28.57 percent (on average, 5.71 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $4,183,656 thousand, and $7,399,819 thousand for the year 2011. This represents an increase of $3,216,162 thousand in total gross product or 76.87 percent (on average, 15.37 percent per year for 5 years).

Figure D23 (NAICS 335 - Electrical Equipment, Appliance, and Component Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 7,174, and 4,434 for the year 2011. This represents a decrease of 2,740 paid employees or 38.19 percent (on average, 7.64 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $25,689, and $29,869 for the year 2011. This represents an increase of $4,180 on payroll per employee or 16.27 percent (on average, 3.25 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 46, and 34 for the year 2011. This represents a decrease of 12 establishments or 26.09 percent (on average, 5.22 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $525,304 thousand, and $723,982 thousand for the year 2011. This represents an increase of $198,678 thousand in total gross product or 37.82 percent (on average, 7.56 percent per year for 5 years).

Figure D24 (NAICS 336 - Transportation Equipment Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 571, and 1,042 for the year 2011. This represents an increase of 471 paid employees or 82.49 percent (on average, 16.5 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $21,613, and $32,166 for the year 2011. This represents an increase of $10,553 on payroll per employee or 48.83 percent (on average, 9.77 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 29, and 23 for the year 2011. This represents a decrease of 6 establishments or 20.69 percent (on average, 4.14 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $81,001 thousand, and $79,275 thousand for the year 2011. This represents a decrease of $1,726 thousand in total gross product or 2.13 percent (on average, 0.43 percent per year for 5 years).

Figure D25 (NAICS 337 - Furniture and Related Product Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 1,699, and 1,120 for the year 2011. This represents a decrease of 579 paid employees or 34.08 percent (on average, 6.82 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $15,434, and $17,624 for the year 2011. This represents an increase of $2,190 on payroll per employee or 14.19 percent (on average, 2.84 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 185, and 123 for the year 2011. This represents a decrease of 62 establishments or 33.51 percent (on average, 6.7 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $67,875 thousand, and $36,402 thousand for the year 2011. This represents a decrease of $31,472 thousand in total gross product or 46.37 percent (on average, 9.27 percent per year for 5 years).

Figure D26 (NAICS 339 - Miscellaneous Manufacturing) - The number of paid employees for this sub-sector in the year 2006 was 11,398, and 14,449 for the year 2011. This represents an increase of 3,051 paid employees or 26.77 percent (on average, 5.35 percent per year for 5 years). The payroll per employee for this sub-sector in the year 2006 was $29,713, and $34,165 for the year 2011. This represents an increase of $4,452 on payroll per employee or 14.98 percent (on average, 3 percent per year for 5 years). The number of establishments for this sub-sector in the year 2006 was 143, and 112 for the year 2011. This represents a decrease of 31 establishments or 21.68 percent (on average, 4.34 percent per year for 5 years). The total gross product for this sub-sector in the year 2006 was $1,961,948 thousand, and $2,107,526 thousand for the year 2011. This represents an increase of $145,578 thousand in total gross product or 7.42 percent (on average, 1.48 percent per year for 5 years).

D. Choropleth Maps

NAICS 31 - Maps 1A through 22B (see Appendix D): A choropleth map is a thematic map which regions are colored for the purpose of showing a statistical measure, such as population density or per capita income. In this particular case, the choropleth maps highlight the number of establishments for the Manufacturing Sector (NAICS 31) and its Sub-sectors in Puerto Rico for the years 2006 and 2011. This data was obtained from the U.S. Census Bureau, County Business Patterns, for Puerto Rico and its 78 municipalities. The data was divided into categories calculated by the “Natural Breaks Method”, a manual data classification method that seeks to partition data into classes based on natural groups in the data distribution. The categories in the map represent a range of establishments within the municipality, and the frequency refers to the number of municipalities within that category.

Map 1A (NAICS 31 - Manufacturing Sector, 2006) The spatial analysis performed shows 2,118 establishments divided into 5 categories. The first category is composed of 0 to 12 establishments, with a frequency of 31 municipalities. The second category is composed of 13 to 29 establishments, with a frequency of 27 municipalities. The third category is composed of 30 to 70 establishments, with a frequency of 14 municipalities. The fourth category is composed of 71 to 166 establishments, with a frequency of 5 municipalities. The fifth category is composed of 167 to 276 establishments, with a frequency of 1 municipality.

Map 1B (NAICS 31 - Manufacturing Sector, 2011) The spatial analysis performed shows 1,829 establishments divided into 5 categories. The first category is composed of 1 to 11 establishments, with a frequency of 30 municipalities. The second category is composed of 12 to 26 establishments, with a frequency of 31 municipalities. The third category is composed of 27 to 69 establishments, with a frequency of 12 municipalities. The fourth category is composed of 70 to 137 establishments, with a frequency of 4 municipalities. The fifth category is composed of 138 to 220 establishments, with a frequency of 1 municipality.

Map 2B (NAICS 311 - Food Manufacturing Sub-sector, 2011) The spatial analysis performed shows 410 establishments divided into 5 categories. The first category is composed of 0 to 2 establishments, with a frequency of 32 municipalities. The second category is composed of 3 to 7 establishments, with a frequency of 31 municipalities. The third category is composed of 8 to 13 establishments, with a frequency of 10 municipalities. The fourth category is composed of 14 to 21 establishments, with a frequency of 3 municipalities. The fifth category is composed of 22 to 42 establishments, with a frequency of 2 municipalities.

Map 3B (NAICS 312 - Beverage and Tobacco Product Manufacturing Sub-sector, 2011) The spatial analysis performed shows 63 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 46 municipalities. The second category is composed of 1establishment, with a frequency of 18 municipalities. The third category is composed of 2 to 3 establishments, with a frequency of 11 municipalities. The fourth category is composed of 4 to 5 establishments, with a frequency of 2 municipalities. The fifth category is composed of 6 to 9 establishments, with a frequency of 1 municipality.

Map 4B (NAICS 313 - Textile Mills Sub-sector, 2011) The spatial analysis performed shows 7 establishments divided into 2 categories. The first category is composed of 0 establishments, with a frequency of 71 municipalities. The second category is composed of 1establishment, with a frequency of 7 municipalities.

Map 5B (NAICS 314 - Textile Product Mills Sub-sector, 2011) The spatial analysis performed shows 39 establishments divided into 4 categories. The first category is composed of 0 establishments, with a frequency of 58 municipalities. The second category is composed of 1establishment, with a frequency of 14 municipalities. The third category is composed of 2 establishments, with a frequency of 5 municipalities. The fourth category is composed of 3 establishments, with a frequency of 1 municipality.

Map 6B (NAICS 315 - Apparel Manufacturing Sub-sector, 2011) The spatial analysis performed shows 80 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 46 municipalities. The second category is composed of 1 to 2 establishments, with a frequency of 22 municipalities. The third category is composed of 3 to 4 establishments, with a frequency of 7 municipalities. The fourth category is composed of 5 to 7 establishments, with a frequency of 1 municipality. The fifth category is composed of 8 to 11 establishments, with a frequency of 2 municipalities.

Map 7B (NAICS 316 - Leather and Allied Product Manufacturing Sub-sector, 2011) The spatial analysis performed shows 9 establishments divided into 2 categories. The first category is composed of 0 establishments, with a frequency of 69 municipalities. The second category is composed of 1establishment, with a frequency of 9 municipalities.

Map 8B (NAICS 321 - Wood Product Manufacturing Sub-sector, 2011) The spatial analysis performed shows 48 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 53 municipalities. The second category is composed of 1establishment, with a frequency of 14 municipalities. The third category is composed of 2 establishments, with a frequency of 5 municipalities. The fourth category is composed of 3 to 4 establishments, with a frequency of 5 municipalities. The fifth category is composed of 5 to 7 establishments, with a frequency of 1 municipality.

Map 9B (NAICS 322 - Paper Manufacturing Sub-sector, 2011) The spatial analysis performed shows 35 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 55 municipalities. The second category is composed of 1establishment, with a frequency of 15 municipalities. The third category is composed of 2 establishments, with a frequency of 6 municipalities. The fourth category is composed of 3 establishments, with a frequency of 1 municipality. The fifth category is composed of 4 establishments, with a frequency of 1 municipality.

Map 10B (NAICS 323 - Printing and Related Support Activities Sub-sector, 2011) The spatial analysis performed shows 154 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 34 municipalities. The second category is composed of 1 to 2establishments, with a frequency of 28 municipalities. The third category is composed of 3 to 6 establishments, with a frequency of 13 municipalities. The fourth category is composed of 7 to 12 establishments, with a frequency of 2 municipalities. The fifth category is composed of 13 to 48 establishments, with a frequency of 1 municipality.

Map 11B (NAICS 324 - Petroleum and Coal Products Manufacturing Sub-sector, 2011) The spatial analysis performed shows 33 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 57 municipalities. The second category is composed of 1establishment, with a frequency of 14 municipalities. The third category is composed of 2 establishments, with a frequency of 4 municipalities. The fourth category is composed of 3 establishments, with a frequency of 2 municipalities. The fifth category is composed of 4 to 5 establishments, with a frequency of 1 municipality.

Map 12B (NAICS 325 - Chemical Manufacturing Sub-sector, 2011) The spatial analysis performed shows 131 establishments divided into 5 categories. The first category is composed of 0 to 1 establishments, with a frequency of 56 municipalities. The second category is composed of 2 to 3establishments, with a frequency of 12 municipalities. The third category is composed of 4 to 5 establishments, with a frequency of 2 municipalities. The fourth category is composed of 6 to 7 establishments, with a frequency of 3 municipalities. The fifth category is composed of 8 to 12 establishments, with a frequency of 5 municipalities.

Map 13B (NAICS 326 - Plastics and Rubber Products Manufacturing Sub-sector, 2011) The spatial analysis performed shows 57 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 44 municipalities. The second category is composed of 1establishment, with a frequency of 23 municipalities. The third category is composed of 2 establishments, with a frequency of 5 municipalities. The fourth category is composed of 3 to 4 establishments, with a frequency of 4 municipalities. The fifth category is composed of 5 to 6 establishments, with a frequency of 2 municipalities.

Map 14B (NAICS 327 - Nonmetallic Mineral Product Manufacturing Sub-sector, 2011) The spatial analysis performed shows 141 establishments divided into 5 categories. The first category is composed of 0 to 1 establishments, with a frequency of 49 municipalities. The second category is composed of 2 to 3establishments, with a frequency of 16 municipalities. The third category is composed of 4 to 6 establishments, with a frequency of 8 municipalities. The fourth category is composed of 7 to 9 establishments, with a frequency of 4 municipalities. The fifth category is composed of 10 to 12 establishments, with a frequency of 1 municipality.

Map 15B (NAICS 331 - Primary Metal Manufacturing Sub-sector, 2011) The spatial analysis performed shows 23 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 66 municipalities. The second category is composed of 1establishment, with a frequency of 7 municipalities. The third category is composed of 2 establishments, with a frequency of 3 municipalities. The fourth category is composed of 3 to 4 establishments, with a frequency of 1 municipality. The fifth category is composed of 5 to 6 establishments, with a frequency of 1 municipality.

Map 16B (NAICS 332 - Fabricated Metal Product Manufacturing Sub-sector, 2011) The spatial analysis performed shows 225 establishments divided into 5 categories. The first category is composed of 0 to 1 establishments, with a frequency of 40 municipalities. The second category is composed of 2 to 4establishments, with a frequency of 27 municipalities. The third category is composed of 5 to 8 establishments, with a frequency of 5 municipalities. The fourth category is composed of 9 to 14 establishments, with a frequency of 3 municipalities. The fifth category is composed of 15 to 22 establishments, with a frequency of 3 municipalities.

Map 17B (NAICS 333 - Machinery Manufacturing Sub-sector, 2011) The spatial analysis performed shows 52 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 52 municipalities. The second category is composed of 1establishment, with a frequency of 12 municipalities. The third category is composed of 2 establishments, with a frequency of 9 municipalities. The fourth category is composed of 3 to 4 establishments, with a frequency of 4 municipalities. The fifth category is composed of 5 to 7 establishments, with a frequency of 1 municipality.

Map 18B (NAICS 334 - Computer and Electronic Product Manufacturing Sub-sector, 2011) The spatial analysis performed shows 30 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 61 municipalities. The second category is composed of 1establishment, with a frequency of 12 municipalities. The third category is composed of 2 establishments, with a frequency of 1 municipality. The fourth category is composed of 3 establishments, with a frequency of 2 municipalities. The fifth category is composed of 4 to 5 establishments, with a frequency of 2 municipalities.

Map 19B (NAICS 335 - Electrical Equipment, Appliance, and Component Manufacturing Sub-sector, 2011) The spatial analysis performed shows 34 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 57 municipalities. The second category is composed of 1establishment, with a frequency of 14 municipalities. The third category is composed of 2 establishments, with a frequency of 3 municipalities. The fourth category is composed of 3 establishments, with a frequency of 3 municipalities. The fifth category is composed of 4 to 5 establishments, with a frequency of 1 municipality.

Map 20B (NAICS 336 - Transportation Equipment Manufacturing Sub-sector, 2011) The spatial analysis performed shows 23 establishments divided into 4 categories. The first category is composed of 0 establishments, with a frequency of 62 municipalities. The second category is composed of 1establishment, with a frequency of 11 municipalities. The third category is composed of 2 establishments, with a frequency of 4 municipalities. The fourth category is composed of 3 establishments, with a frequency of 1 municipality.

Map 21B (NAICS 337 - Furniture and Related Product Manufacturing Sub-sector, 2011) The spatial analysis performed shows 123 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 35 municipalities. The second category is composed of 1 to 2establishments, with a frequency of 27 municipalities. The third category is composed of 3 to 5 establishments, with a frequency of 11 municipalities. The fourth category is composed of 6 to 8 establishments, with a frequency of 3 municipalities. The fifth category is composed of 9 to 11 establishments, with a frequency of 2 municipalities.

Map 21B (NAICS 339 - Miscellaneous Manufacturing Sub-sector, 2011) The spatial analysis performed shows 112 establishments divided into 5 categories. The first category is composed of 0 establishments, with a frequency of 40 municipalities. The second category is composed of 1 to 2establishments, with a frequency of 28 municipalities. The third category is composed of 3 to 8 establishments, with a frequency of 8 municipalities. The fourth category is composed of 9 to 14 establishments, with a frequency of 1 municipality. The fifth category is composed of 15 to 23 establishments, with a frequency of 1 municipality.

IV. Conclusion

Manufacturing has been very important for our economy and in the past was a dynamic economic sector, which shown steady growth. This crucial sector has been vital to the creation of high quality jobs for Puerto Rico's workers. It is important to point out that manufacturing, in spite of the job losses due to the structural changes that have affected its performance, is still an important sector for the island's economy. The manufacturing sector in Puerto Rico today faces serious challenges, but as it was exposed above, there are some manufacturing sub-sectors with a high possibilities of growing to satisfy the island's markets and others with exporting potentials.

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Appendix A

Review of Literature

Table A. Studies on Puerto Rico's Economy: Principal Recommendations							
	Promote Local Firms: Transfers of technologies Entrepreneurial spirit	To link incentive to Job creations Or other Job creation policies	Imports Substitutions	Incentives by type of industries	Tax incentives or policies	Promote R&D High-Tec Industries Economic of Knowledge	Exports policies
Echenique Report, (1975) Puerto Rico's Economic Development: A Strategy for the Next Decade.	X		X				
Tobin Report, (1976) Report prepared by the Committee for the Study of Puerto Rico's Finances, commissioned by the Governor		X					
Kreps Report, (1979), Economic Study of Puerto Rico			X	X			
Carrión-Ferré Report, (1984) Report by the Sub-Committee for PR's Economic Development							
Strategy for Puerto Rico's Economic Development: Towards our Second Economic Transformation (1989) (Strategy...)	X					X	X
New Model of Economic Development, (1994)	X					X	X
Chamber of Commerce Report (1997)	X						X
Puerto Rico's Economic Future (1999)	X					X	
Towards a Feasible Economy (2003)	X					X	
The Puerto Rico Life Sciences Road Map (2003)							
Project Puerto Rico 2025 (2004)	X				X	X	
CEPAL Study (2005)							X
GAO Report (2006)							
Restoring Growth in Puerto Rico - Brookings Study (2006)							
Economic Development And Government Transformation Plan (2006) For Puerto Rico	X					X	
A New Puerto Rico (2013)	X					X	
Report On The Competitiveness Of Puerto Rico's Economy June 29, 2012, Federal Reserve Bank of New York		X					

Table A. 1 Studies on Puerto Rico's Economy: Principal Recommendations							
	Integration of Universities and others education Policies	Promote foreign investment	Encourage industrial Clusters or Competitive Industrial Groups	Reduce energy cost	Impose a minimum tax on manufacturing firm profits.	Promote local capital (and mkts) or Re-investment of foreign firms	Revise federal minimum wages application
Echenique Report, (1975) Puerto Rico's Economic Development: A Strategy for the Next Decade.				X		X	
Tobin Report, (1976) Report prepared by the Committee for the Study of Puerto Rico's Finances, commissioned by the Governor						X	
Kreps Report, (1979), Economic Study of Puerto Rico					X		
Carrión-Ferré Report, (1984) Report by the Sub-Committee for PR's Economic Development		X	X	X			
Strategy…. (1989)							
New Model of Economic Development, 1994	X						
Chamber of Commerce Report (1997)		X				X	
Puerto Rico's Economic Future (1999)	X					X	
Towards a Feasible Economy (2003)	X	X					
The Puerto Rico Life Sciences Road Map (2003)	X						
Project Puerto Rico 2025 (2004)	X						
CEPAL Study (2005)	X	X	X				
GAO Report (2006)							
Restoring Growth in Puerto Rico - Brookings Study (2006)							
Economic Development And Government Transformation Plan (2006) For Puerto Rico				X		X	
A New Puerto Rico (2013)				X			
Report On The Competitiveness *Of* Puerto Rico's Economy June 29, 2012, Federal Reserve Bank of New York	X			X		X	X

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Table A. 2 Summary of some recommendations for the manufacturing sector from previous development plans for Puerto Rico

Strategy or Recommendation	Paper	Page/Slide
Offer incentives to businesses in order to establish offices in Puerto Rico.	1975 - Puerto Rico's Economic Development: A Strategy for the Next Decade (Informe Echenique)	23, 81
Develop policies directed to retain labor intensive industries.		27
Grant the autonomy to impose tariffs over imports and use the income as subsidies for the local production.		33, 68
Replace exemptions for contribution credit over investment that allows businesses to reduce their future contributions.		35, 37
Implement a salaries subsidy program directed to slow the closing turnover of labor intensive industries.		36
Promote and develop industries that are less sensitive to the costs of labor.		43
Measure the changes in total productivity.		53
Reevaluate the use of natural resource terrains to establish new industrial plants, and establish a penalty system for contamination.		115
Establish cooperatives in rural areas with training programs and productive economic activities focused on agriculture and manufacturing.		125 y 127
Selective policy for bank regulation in favor of industry loan exempting them from contributions.		148
Promote high technology industries.		23
Establish the fabrication of copper and petroleum products in Puerto Rico and limit their contribution exemptions.		81
Increase gasoline taxes to reduce consumption.		110, 139
Improving the Product - Endow Puerto Rico with the best physical, technological, and human capital that will provide a competitive advantage in the global economy.	1994 - New Model of Economic Development	24-25
Puerto Rico Destination and Global Bridge - Adopt strategies that enable and promote a competitive environment at a global scale.		19-20
Government Facilitator - An effective Regulatory framework that promotes coherent visions on economic development and business development.		21
Promoting our people - Promote economic sectors with a trained work force and the ability of adapting to frequent changes in technology and other occupational requirements.		26
Design a future workforce learning resource center	2003 - The Puerto Rico Life Sciences Road Map	9, 109
Recognize the importance of supply chains, promote technology transfers, and the migration from exogenous to endogenous models.	2003 - Towards a Feasible Economy	49
Expand the environmental quality concept and make it applicable to physical infrastructure	2004 - Project Puerto Rico 2025	71
Increase the productivity of local human capital through increasing use of technology		33
Overhaul the systems for promoting exports from Puerto Rico		35
Form strategic clusters for high technology manufacturing and service industries.	2005 - Cepal Study - Globalization and Development	230
Strengthen the local capital industry and project it to external markets.		230
Industrial development policy that translates widely and has a context and object based national innovation system.		230
Export promotion for high technology and particularly sectors that have not had international market exposure and can have competitive advantages.		231
Lowering Dependence on a Shrinking Industry	2012 - Report on the Competitiveness of Puerto Rico's Economy	12
Reinvent traditional industries	2013 - A New Puerto Rico	28

Table A.3 A Sample of the International Studies

Study	Methodology	Some quotes:
Economic Development Plan for the Manufacturing Sector in Manitoba, Provincial Cabinet Ministers and CME-Manitoba Division 2006. (Manitoba is one of Canada's 10 provinces, located on the Prairies.)	Swot based on expert opinions.	"Create a "Made in Manitoba" equivalent of the US Industrial Development Bond program" **Two strategies**: -Promoting industrial clusters. -Promoting Micro Small & Medium sized Enterprises (MSME)
Towards EU membership, 2011-2014 , Turkish industrial strategy, Document, Republic of Turkey Ministry of industry and trade	SWOT analysis based upon a statistical data analysis of the economics activity in the country.	**Objectives:** -Increasing the weight of mid- and high-tech sectors in production and exports -Transition to high added value products in low-tech sectors **Sectoral strategies** for specific industries
Lithuanian National Development Plan for the Implementation of EU Structural Funds, Single Programming Document 2004-2006	SWOT analysis draws on the baseline analysis	"The strategy of the Single Programming Document is to strengthen the preconditions for growth in long-term national economic competitiveness and rapid development of knowledge-based economy…." **Two strategies:** -Increase of Energy Efficiency in Public Sector -Local and Renewable Energy Sources
Measuring Economic Diversification In Hawaii, Research and Economic Analysis Division Department of Business, Economic Development and Tourism State Of Hawaii, (2008)	The study use different indicators to evaluate diversification (LQ is one of them)	"It is widely held that a diversified economy is less sensitive to the ups and downs associated with any particular industry because risk is spread more evenly across a number of industries. With diversification, even if some industries are suffering, other stronger industries will help the …"
Making It In Ireland – Manufacturing, Forfás, Ministry of Jobs, Enterprise and Innovation, (2006)	Descriptive-statistical analysis .	**Objectives**: ""A place where manufacturing is focused on the **customer** – Agile, responsive and collaborative" " A place where **people** make the difference – Multi-disciplinary and highly skilled with a distinctive capability in simplifying the complex"" " A place where **quality** is embedded across business operations, demonstrated by differentiation and a track record in highly regulated sectors"
Human Resource Development for continued Economic Growth: The Singapore Experience, International Labour Organization, (1997).	Narrative and Statistical analysis.	Strategy: "to increases total factor productivity growth (L and K). They identify 3 factors to increase TFP: 1. Manpower development 2. Upgrading and restructuring al industries, 3. Accelerating technical progress, (technological diffusion and application)

Review of Literature: Examples of Industrial Clusters in different countries

A. Historical Clusters that are based on a natural resource

This type of clusters are established in relation to tradition or for historical reasons. In other cases, they came to be established because of the existence of a natural resource in the area, such as land suitable for any type of crop.

The Napa Valley. The Napa Valley is located in the county of the same name located north of the San Francisco Bay in the United States. This county is one of the largest wine producers in the world, comparable to the production of this product in France, Italy, Spain and Chile. Because of this, the Napa Valley is the region that produces wines in the United States. Wine production in this area dates back to the nineteenth century. At the turn of the century there were more than 100 wine producers in this valley, of which still remain: Charles Krug, Shramsburg, Chateau Montelena and Beringer.

B. Technology Clusters: electronics and computers

Some examples of clusters based on computer production are discussed in this section.

The Silicon Valley. In the mid1990s a large group of companies related to computer technology emerged in the Silicon Valley in California. This led to the establishment of new companies in this town. This cluster made engineers and programmers begin to settle there which consecutively made other companies move to the place. The universities Carnegie Mellon, San Jose State, Santa Clara, and Stanford can be found near this industrial cluster.

The Research Triangle Park in North Carolina. This is the largest research park in the United States and it is located near the cities of Durham, Raleigh and Chapel Hill . The park is home to companies such as BASF, Bayer, BE &K; Cisco, Systems, DuPont, General Electric Glaxo Smith Kline, Merck & Co. and Monsanto, among others. The universities that can be found in this cities are Duke University, Central University, North Carolina State University, and the University of North Carolina at Chapel Hill. This park was created in 1959 by the local government and the state of North Carolina.

The Science Park Hsinchu in Taiwan. This park was established by the government of Taiwan in 1980 to stimulate industrial production. In late 2003, the cluster had a total of 370 high-tech companies related to: semi-conductors, computers, and telecommunications. Today this industrial complex is one of the main centers of the semiconductor manufacturing worldwide. Some of the companies in this industry that are in the Hsinchu park are: Manufacturing Company of Taiwan semiconductor (Taiwan Semiconductor Manufacturing Company) and United Microelectronics Corporation. Other companies that are part of the cluster are: AU Optronics, Elan Microelectronics Corporation, Holtek, Lite-On, Logitech, Macronix International Co., Ltd. (MXIC), Media Tek, Microtek, Optodisc, Philips, and Powerchip Semiconductor Corp.

Near this industrial park are two of the leading engineering universities of Taiwan: National Chiao Tung University, and National Tsing Hua University.

C. Cluster Technology: Biotechnology

This section discusses biotechnology clusters; because of the importance of this industry to Puerto Rico several paragraphs are devoted to describe it.

Modern biotechnology began in 1953 when James Watson and Francis Crick published an article describing the double acid axial structure “deoxy - ribonucleic” (DNA). This discovery gave way to the first genetic engineering experiments conducted by Cohen and Boyer in 1973.

Biotechnology is not, in itself, a science; it is a multidisciplinary approach involving multiple disciplines (biology, biochemistry, genetics, virology, agronomy, engineering, chemistry, and veterinary medicine, among others). There are many definitions to describe the concept. Overall, Biotechnology is the use of living organisms or compounds obtained from living organisms to produce value for humanity. A broad definition of biotechnology would be: a set of technological innovations based on the use of microorganisms and microbiological processes for the production of goods and services and for the development of scientific research.

One sector that has been impacted by biotechnology is the pharmaceutical industry with the creation of the bio-pharmaceutical industry. The use of these new techniques has changed the research and development phase and the production process.

The value chain of this industry can be divided into two parts: the pre-approval of the drug and the after the approval stage. In the first stage occur the research and development activities and in the second the new medicine is produced and marketed. Let's examine some of the major clusters created around this industry.

Cambridge cluster. This cluster was formed in the early years of the 1980s in the Science Park at Cambridge, which belongs to the Trinity College of Cambridge at the University of England. This park was built to attract companies in the computer industry as part of a public policy of the UK government to increase the participation of universities in the industrial sector of the economy. This cluster is still growing with the active participation of the University of Cambridge which sells the results of it academic research.

In 2002, the cluster had a total of 162 biotechnology companies, (144 were local and 18 foreign). Some of the companies that, in that year were the cluster were: Bayer plc, Bio Products Laboratory, Celltech Gropup, Dupont, Glaxo Smith Kline and Monsanto.

Funding for the start of business comes from venture capital, both domestically and internationally. Commercial banks play a very small role in financing the beginnings of these businesses by the nature of high risk associated with this type of investment. The financing of the UK government is also not available for these investments. So it is not surprising that the major concern of the companies in the cluster is to obtain funding for their investment projects.

The Heidelberg cluster.This cluster, located in Germany, has a radius of approximately 40 km and is home to more than 30 biotech companies, as well as the participation of various universities and research centers. This cluster involved the University of Heidelberg, the European Molecular Biology Laboratory, the German Research Center for Cancer, among other academic and research centers.

The Heidelberg Technology Park was founded in 1985 with the participation of the city government and the Chamber of Industry and Commerce. The development goals were the creation of jobs, the application of research results and the competitive economic development of the region.

In 2001 the cluster had 82 biotech companies of which 77 were local, 5 foreign and one company is public. Among the companies are: A3D, Abeta, Apogenics; Biocat; Bioleads, and Gene Artist. In that year, there were generated a total of 1,207 jobs in the cluster. In this cluster, contrary to the Cambridge cluster, the main source of funding comes from the government companies.

Aarhus cluster. This cluster is located in the west of Denmark in Aarhus County. This county is the most important center of higher education and research in the western region of the country, with about 30,000 students and 2,000 scientists in 2001.

The clusters consisted of 22 companies in 2001, of which 95 % were originated by universities. 21 of the companies are local and one is foreign. The companies operating in the cluster include: DNA Technology, Loke Diagniostic; CellCure MWG Biotech and Vivox. These companies created 81 jobs in 2001.

The Danish government provides funds to finance new businesses early in a project of industrial incubators. Other funding came from the universities and venture capital.

San Diego cluster. This is one of the bio-technological clusters of the world. In 2001 there were one hundred twenty six companies operating in this cluster and they directly generated 18,360 jobs. In the same year, more than 180 products were in the development phase, while in the period of 1997 to 2001, the cluster recorded more than 200 new patents.

Part of the success of this cluster is due to the excellence of the scientific basis both in universities and in private research institutes. Furthermore, the San Diego area has a long tradition in the health sector, with a large number of pharmaceutical companies among which are: Novartis and Dow Chemicals.

Discussion

The description of different industrial clusters that was presented above reveals some important elements of the geographic location of the firms. First, that there's a wide range of production activities in which companies are located in the form of clusters, that these range from labor intensive agricultural and manufacturing processes to high technology. This indicates that the benefits of forming clusters may occur in production processes with different intensity in the use of capital, knowledge and labor.

Second, the cluster size in terms of number of companies and the number of companies that compose it exhibits high variability. As it might be inferred, the external economies of scale, in many instances, are more important than domestic firms when deciding the location of their operations. On the other hand, the establishment of these industrial complexes in various countries of the world shows how successful it is considered to promote economic growth.

Finally it is noted that the role of government in promoting and financing firms within the cluster is not uniform. Some of the clusters described arose spontaneously, as the Napa Valley and the Silicone Valley in the U.S., and the "haute couture" cluster in France, while that of the Science Park Hsinchu, and the Cambridge cluster were promoted by the governments of Taiwan and the United Kingdom respectively. In the case of Silicon Wadi and the Aarhus cluster, the governments of Israel and Denmark provide them with funds but in the case of the Cambridge cluster, it does not receive any.

Appendix B

Some Estimation Results: Structural Changes Tests

Table B1.0

Dependent Variable: DLOG(LPRIV)
Method: ML - ARCH (Marquardt) - Generalized error distribution (GED)
Date: 09/16/13 Time: 16:26
Sample (adjusted): 1992M03 2013M04
Included observations: 254 after adjustments
Convergence achieved after 27 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(6) + C(7)*RESID(-1)^2 + C(8)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.004326	0.000730	5.924780	0.0000
DLOG(LMNFSA)	0.390494	0.024781	15.75783	0.0000
@TREND	-1.17E-05	3.25E-06	-3.616387	0.0003
AR(1)	-0.194676	0.063795	-3.051606	0.0023
SAR(12)	0.142199	0.046686	3.045885	0.0023
Variance Equation				
C	2.16E-05	5.45E-06	3.953912	0.0001
RESID(-1)^2	0.289009	0.120022	2.407972	0.0160
GARCH(-1)	-0.289152	0.175333	-1.649155	0.0991
GED PARAMETER	1.344743	0.229319	5.864081	0.0000

R-squared	0.462696	Mean dependent var	0.000677
Adjusted R-squared	0.445151	S.D. dependent var	0.006350
S.E. of regression	0.004730	Akaike info criterion	-7.960637
Sum squared resid	0.005482	Schwarz criterion	-7.835298
Log likelihood	1020.001	Hannan-Quinn criter.	-7.910215
F-statistic	26.37251	Durbin-Watson stat	2.143932
Prob(F-statistic)	0.000000		

Q(5)= 5.44
P- Value=0.144

Table B 1.2

Results of Trend Equation Estimation

Dependent Variable: LOG(LHITEC2SA)
Method: Least Squares
Date: 09/04/13 Time: 15:51
Sample (adjusted): 1991M01 2013M04
Included observations: 268 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.921401	0.019714	198.9132	0.0000
@TREND	0.002047	0.000203	10.07481	0.0000
D0711	0.960649	0.041737	23.01691	0.0000
D9807*@TREND	-0.000145	3.92E-05	-3.692847	0.0003
D9502	0.366391	0.023195	15.79588	0.0000
D0711*@TREND	-0.003947	0.000141	-27.91873	0.0000
D9502*@TREND	-0.002671	0.000222	-12.04576	0.0000

R-squared	0.983694	Mean dependent var	4.053971
Adjusted R-squared	0.983319	S.D. dependent var	0.155722
S.E. of regression	0.020112	Akaike info criterion	-4.949218
Sum squared resid	0.105574	Schwarz criterion	-4.855423
Log likelihood	670.1952	Hannan-Quinn criter.	-4.911546
F-statistic	2624.263	Durbin-Watson stat	0.325566
Prob(F-statistic)	0.000000		

Table B 2.1

Principal Components Analysis

Over employment growth rates.

Component Number	*Eigenvalue*	*Percent of Variance*	*Cumulative Percentage*
1	3.1792	24.455	24.455
2	1.59744	12.288	36.743
3	1.26287	9.714	46.458
4	1.07167	8.244	54.701
5	0.992007	7.631	62.332
6	0.861447	6.627	68.959
7	0.846013	6.508	75.466
8	0.733358	5.641	81.108
9	0.583862	4.491	85.599
10	0.562826	4.329	89.928
11	0.50938	3.918	93.847
12	0.437501	3.365	97.212
13	0.36243	2.788	100.000

Table B 2.2
Component Weights

	Component	*Component*	*Component*	*Component*
Employment Growth rate of:	1	2	3	4
Others chemical	**0.377003**	0.059503	0.0503185	-0.200258
CLOTHING	**0.292559**	0.10083	-0.170486	0.133623
Computers and electronic	-0.050044	0.338201	-0.0234247	**-0.365307**
Electrical equipment,	0.0694448	0.187883	**0.676415**	0.0507246
Fabricated metal	**0.420496**	0.099536	-0.0952978	-0.157355
FOOD	**0.386966**	-0.21045	0.0185414	0.0478752
MEDICINES	0.219479	**0.366257**	-0.00960692	-0.201687
Miscellaneous manufacturing	0.217766	-0.495412	0.149791	-0.220569
Non-metallic mineral	**0.375818**	0.159899	-0.114862	0.259998
Plastics and rubber)	0.224985	0.0442812	-0.342968	**0.557649**
Beverage and tobacco)	0.119428	-0.253689	-0.403943	**-0.528572**
Wood product)	0.268944	**0.339882**	0.228939	-0.132531
Medical devices	0.253668	-0.442077	**0.363261**	0.118802

Monthly data from 1990 to 2013.

Table B 2. 3 Test Statistics and Break Points (Trends of coefficient of location)			
Subsectors	**Date of Break**	**LR Statistic**	**P-value**
Chemical	2007M03	1038.434	0.0000
	2001M07	198.5441	0.0000
	1995M12	47.44099	0.0000
	2006M04	24.50538	0.0001
Pharmaceutical			
	2007M03	486.9394	0.0000
	1996M10	77.48187	0.0000
	2001M07	60.56817	0.0000
Food	2001M06	213.4676	0.0000
	1999M06	15.22360	0.0103
	(2008M07	154.2261	0.0000
Clothing			
	2007M07	348.5170	0.0000
	2002M07)	108.6404	0.0000
	1993M10	84.82390	0.0000

Appendix C

Artificial Neural Network Models Solution Results

Table C.1

Parameter Estimates for ANN of Manufacturing

(Total Employment)

Predictor		Predicted			
		Hidden Layer 1			Output Layer
		H(1:1)	H(1:2)	H(1:3)	DLOGLMNFSA
Input Layer	(Bias)	.083	-.084	-.402	
	[D9612=0]	-.482	-.425	-.139	
	[D9612=1]	.507	.367	-.202	
	[D07=0]	.365	.010	-.474	
	[D07=1]	.391	.011	.265	
	FEDFUND	.342	.473	-.339	
	WMNFPRUS	.377	.406	-.097	
	FDIASIAREL	.074	.083	.428	
	FDIACNTRREL	-.131	-.179	.450	
	FDIOTHRLATREL	-.409	-.089	-.332	
	SLOPEYIELDC	.172	.349	-.169	
	INFLPR	.205	-.017	.402	
	REPROUS	.109	.265	.342	
	BGEINDEX	.390	.135	-.376	
	BIGEUROREC	.206	.494	.048	
	DLOGPOIL	.292	-.024	-.160	
	USPHCI	.039	.127	.295	
	DLOGIMPORTOT	-.336	.454	-.135	
	DPPICPE	-.009	-.346	-.226	
	DLOGGFTAXRESA	-.231	.034	-.196	
	DLOGLMNFUS	-.056	-.135	.067	
	DLOGWMNFPRREAL	-.341	-.074	.372	
	FDILATITHRREL	-.069	.392	.123	
	DTSALE	.099	.347	.034	
Hidden Layer 1	(Bias)				.072
	H(1:1)				-.138
	H(1:2)				-.226
	H(1:3)				-.243

Table C.2

Manufacturing Total Employment Model

Independent Variables Importance

	Importance	Normalized Importance
D9612	.030	24.6%
D07	.017	13.9%
FEDFUND	.023	18.9%
WMNFPRUS	.051	41.2%
FDIASIAREL	.089	72.7%
FDIACNTRREL	.043	34.9%
FDIOTHRLATREL	.123	100.0%
SLOPEYIELDC	.022	18.1%
INFLPR	.068	55.1%
REPROUS	.061	49.5%
BGEINDEX	.018	14.5%
BIGEUROREC	.029	24.0%
DLOG(POIL)	.015	12.4%
USPHCI	.036	29.7%
DLOG(IMPORTOT)	.031	25.3%
DPPICPE	.096	78.7%
DLOG(GFTAXRESA)	.036	29.5%
DLOG(LMNFUS)	.018	14.9%
DLOG(WMNFPRREAL)	.037	30.3%
FDILATITHRREL	.100	81.2%
DTSALE	.056	45.8%

Table C. 3.

Employment in the Chemical Sub-sector:

Independent Variables Importance

	Importance	Normalized Importance
D9612	.014	8.9%
D07	.017	10.6%
FEDFUND	.019	11.9%
WMNFPRUS	.048	30.8%
FDIASIAREL	.051	32.5%
FDIACNTRREL	.107	68.1%
FDIOTHRLATREL	.069	44.2%
SLOPEYIELDC	.026	16.5%
REPROUS	.023	14.6%
BGEINDEX	.021	13.2%
BIGEUROREC	.015	9.9%
DLOG(POIL)	.036	23.2%
USPHCI	.067	43.0%
DLOG(IMPORTOT)	.038	24.5%
DPPICPE	.050	31.8%
DLOG(GFTAXRESA)	.043	27.2%
DLOG(WMNFPRREAL)	.071	45.1%
FDILATITHRREL	.157	100.0%
DLOG(LMNFUS)	.103	65.9%
IAMDA4	.027	17.0%

Table C.4 Parameter Estimates for Chemical Industry Employment

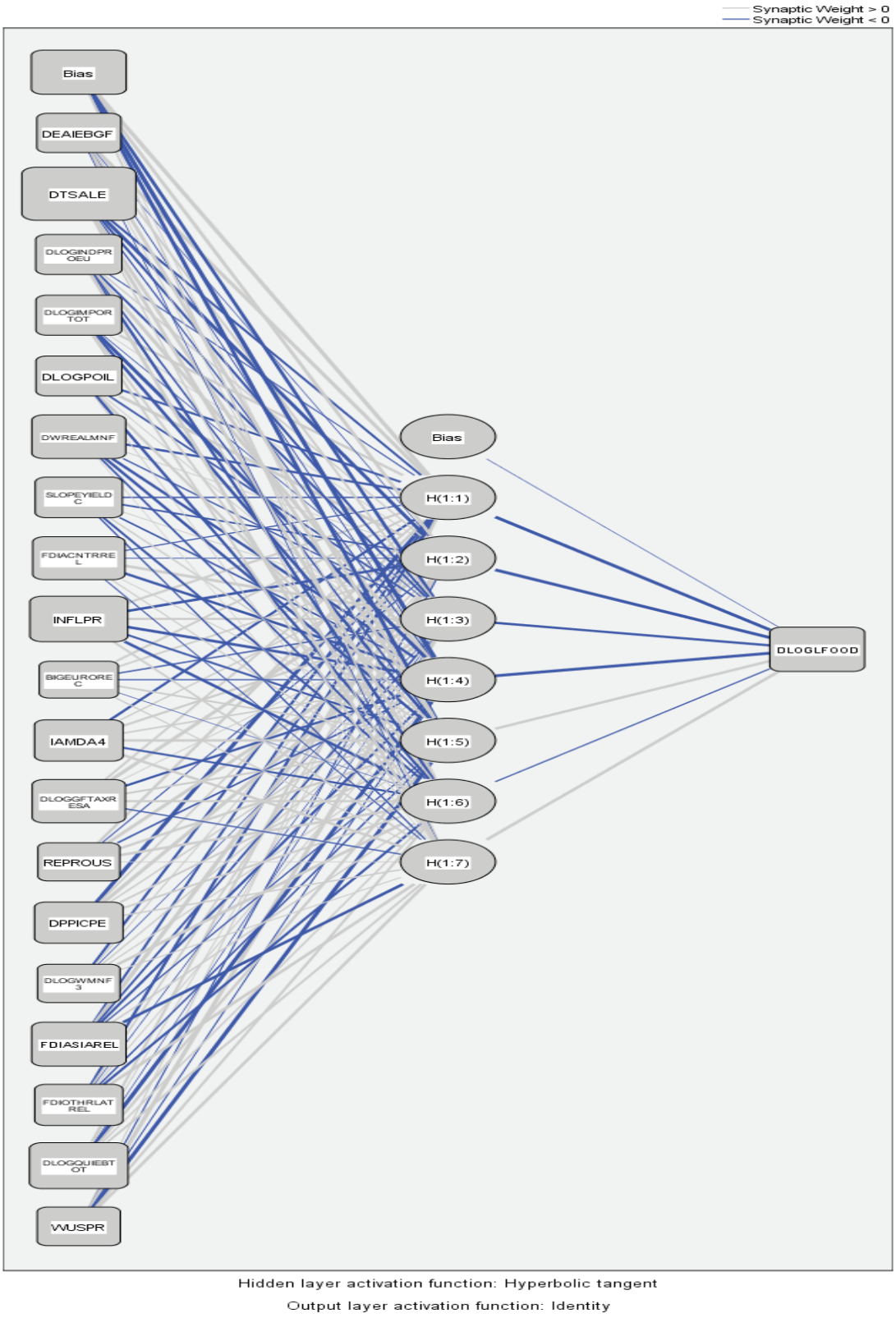
Predictor		Predicted			
		Hidden Layer 1			Output Layer
		H(1:1)	H(1:2)	H(1:3)	DLOGLCHEMICAL
Input Layer	(Bias)	.473	-.122	.858	
	[D9612=0]	.681	.475	.220	
	[D9612=1]	.158	-.484	.110	
	[D07=0]	.563	-.086	-.230	
	[D07=1]	.397	-.011	.485	
	FEDFUND	.441	.068	-.005	
	WMNFPRUS	.701	.151	.176	
	FDIASIAREL	.004	-.469	-.174	
	FDIACNTRREL	-.066	-.391	.179	
	FDIOTHRLATREL	.254	.074	-.320	
	SLOPEYIELDC	-.035	-.404	-.117	
	REPROUS	.783	.069	-.004	
	BGEINDEX	-.056	-.332	-.143	
	BIGEUROREC	-.581	-.102	.256	
	DLOGPOIL	-.154	-.299	-.318	
	USPHCI	-.202	.562	-.150	
	DLOGIMPORTOT	.566	.411	-.030	
	DPPICPE	.121	-.305	-.363	
	DLOGGFTAXRESA	-.503	-.259	.306	
	DLOGWMNFPRREAL	-.262	.401	.531	
	FDILATITHRREL	-.211	.264	-.231	
	DLOGLMNFUS	.664	.219	.577	
	IAMDA4	-.058	.343	.142	
Hidden Layer 1	(Bias)				-.709
	H(1:1)				.433
	H(1:2)				-.533
	H(1:3)				.732

Table C5

Food Sector: Employment Model

Independent Variables Importance

	Importance	Normalized Importance
DEAIEBGF	.031	21.4%
DTSALE	.146	100.0%
DLOG(INDPROEU)	.038	26.2%
DLOG(IMPORTOT)	.038	25.7%
DLOG(POIL)	.038	25.9%
DWREALMNF	.069	47.0%
SLOPEYIELDC	.042	29.0%
FDIACNTRREL	.062	42.7%
INFLPR	.084	57.5%
BIGEUROREC	.011	7.6%
lAMDA4	.048	33.0%
DLOG(GFTAXRESA)	.066	45.1%
REPROUS	.023	15.5%
DPPICPE	.048	32.7%
DLOG(WMNF3)	.025	17.1%
FDIASIAREL	.071	48.6%
FDIOTHRLATREL	.047	32.3%
DLOG(QUIEBTOT)	.086	59.1%
WUSPR	.027	18.7%



Food Sector: Model Structure

Table C6

Employment Model

Of Food Sector

(Parameter Estimates)

Predictor		FOOD sector Predicted							
		Hidden Layer 1							Output Layer
		H(1:1)	H(1:2)	H(1:3)	H(1:4)	H(1:5)	H(1:6)	H(1:7)	DLOGLFOOD
Input Layer	(Bias)	.796	.445	-.426	-.852	-.492	.026	.184	
	DEAIEBGF	.557	-.019	.212	-.062	.449	.062	-.038	
	DTSALE	-.278	-.529	-.282	-.127	.463	.449	.153	
	DLOGINDPROEU	-.106	.164	-.275	.507	-.177	-.342	.432	
	DLOGIMPORTOT	.398	.046	-.041	-.530	-.415	.224	.254	
	DLOGPOIL	-.327	.529	-.212	.077	.335	-.338	.047	
	DWREALMNF	-.417	.082	-.171	-.399	-.390	-.201	.006	
	SLOPEYIELDC	-.190	-.265	.071	-.198	.173	-.285	-.157	
	FDIACNTRREL	-.147	-.084	.666	-.461	.088	.128	-.089	
	INFLPR	.372	-.517	.365	-.570	-.289	-.478	.230	
	BIGEUROREC	.296	.251	-.183	-.135	.282	-.003	.150	
	lAMDA4	-.334	.179	.351	.244	.517	-.327	.454	
	DLOGGFTAXRESA	.258	.709	.082	-.372	.315	.344	-.165	
	REPROUS	.345	-.112	.537	-.194	.420	.494	.057	
	DPPICPE	-.738	.191	.658	.179	.265	.285	.195	
	DLOGWMNF3	-.287	.117	-.025	.158	.145	.498	.121	
	FDIASIAREL	-.271	.674	-.205	-.294	-.136	.180	-.487	
	FDIOTHRLATREL	-.338	.181	-.020	.102	-.173	-.325	.457	
	DLOGQUIEBTOT	.286	.072	-.020	-.626	.333	.178	.276	
	WUSPR	.115	-.123	.601	-.109	-.588	.287	.429	
Hidden Layer 1	(Bias)								-.006
	H(1:1)								-.758
	H(1:2)								-.912
	H(1:3)								-.449
	H(1:4)								-.837
	H(1:5)								.491
	H(1:6)								-.136
	H(1:7)								.484

Table C7

Employment of Apparel industry

Independent Variable Importance

	Importance	Normalized Importance
D9612	.022	13.3%
D07	.006	3.6%
FEDFUND	.019	11.6%
WMNFPRUS	.022	13.2%
FDIASIAREL	.125	76.0%
FDIACNTRREL	.049	29.5%
FDIOTHRLATREL	.119	72.0%
SLOPEYIELDC	.012	7.5%
REPROUS	.008	5.1%
BGEINDEX	.033	19.7%
BIGEUROREC	.010	6.3%
DLOG(POIL)	.006	3.7%
USPHCI	.001	.7%
DLOG(IMPORTOT)	.051	30.8%
DPPICPE	.070	42.7%
DLOG(GFTAXRESA)	.036	21.9%
DLOG(WMNFPRREAL)	.032	19.7%
FDILATITHRREL	.060	36.3%
DLOG(LMNFUS)	.165	100.0%
IAMDA4	.018	10.7%
DTSALE	.135	81.8%

Table C8

Employment of Apparel industry

Parameter Estimates

Predictor		Predicted		
		Hidden Layer 1		Output Layer
		H(1:1)	H(1:2)	DLOGLCLOTHING
Input Layer	(Bias)	.881	1.219	
	[D9612=0]	.310	-.327	
	[D9612=1]	.152	.440	
	[D07=0]	-.307	.280	
	[D07=1]	.858	.081	
	FEDFUND	-.026	-.224	
	WMNFPRUS	-.253	-.247	
	FDIASIAREL	.045	-.570	
	FDIACNTRREL	-.128	-.196	
	FDIOTHRLATREL	-.201	.384	
	SLOPEYIELDC	-.218	-.146	
	REPROUS	.130	-.073	
	BGEINDEX	.048	-.384	
	BIGEUROREC	.037	-.212	
	DLOGPOIL	-.253	.033	
	USPHCI	.233	.011	
	DLOGIMPORTOT	-.496	-.331	
	DPPICPE	.170	.393	
	DLOGGFTAXRESA	.342	.288	
	DLOGWMNFPRREAL	.301	.133	
	FDILATITHRREL	.153	.163	
	DLOGLMNFUS	-.337	.965	
	IAMDA4	-.032	.193	
	DTSALE	-.109	.729	
Hidden Layer 1	(Bias)			-.569
	H(1:1)			-.024
	H(1:2)			.841

Appendix D
LQ's Tables and Figures and Choropleth Maps

NAICS 31-33 Manufacturing

Table D1: Location Quotient of Number of Employees Manufacturing (NAICS 31-33)

Sector by NAICS	Location Quotient
3162 - Footwear manufacturing	17.55
3254 - Pharmaceutical and medicine manufacturing	13.69
3152 - Cut and sew apparel manufacturing	11.29
3391 - Medical equipment and supplies manufacturing	8.26
3353 - Electrical equipment manufacturing	4.44
3255 - Paint, coating, and adhesive manufacturing	3.85
3118 - Bakeries and tortilla manufacturing	2.70
3121 - Beverage manufacturing	2.43
3273 - Cement and concrete product manufacturing	2.38
3256 - Soap, cleaning compound, and toilet preparation manufacturing	2.14
3115 - Dairy product manufacturing	1.86
3119 - Other food manufacturing	1.68
3359 - Other electrical equipment and component manufacturing	1.43
3323 - Architectural and structural metals manufacturing	1.34
3111 - Animal food manufacturing	1.19
3379 - Other furniture related product manufacturing	1.16
3241 - Petroleum and coal products manufacturing	1.15
3324 - Boiler, tank, and shipping container manufacturing	1.04
3112 - Grain and oilseed milling	1.02

Table D2: Location Quotient of Annual Payroll Per Employee Manufacturing (NAICS 31-33)

Sector by NAICS	Location Quotient
3311 - Iron and steel mills and ferroalloy manufacturing	0.50
3345 - Navigational, measuring, electromedical, and control instruments manufacturing	0.63
3335 - Metalworking machinery manufacturing	0.66
3279 - Other nonmetallic mineral product manufacturing	0.68
3241 - Petroleum and coal products manufacturing	0.72
3321 - Forging and stamping	0.73
3363 - Motor vehicle parts manufacturing	0.78
3359 - Other electrical equipment and component manufacturing	0.82
3329 - Other fabricated metal product manufacturing	0.83
3323 - Architectural and structural metals manufacturing	0.83
3327 - Machine shops; turned product; and screw, nut, and bolt manufacturing	0.84
3162 - Footwear manufacturing	0.86
3371 - Household and institutional furniture and kitchen cabinet manufacturing	0.86
3315 - Foundries	0.91
3372 - Office furniture (including fixtures) manufacturing	0.91
3255 - Paint, coating, and adhesive manufacturing	0.92
3112 - Grain and oilseed milling	0.92
3399 - Other miscellaneous manufacturing	0.93
3259 - Other chemical product and preparation manufacturing	0.93
3251 - Basic chemical manufacturing	0.95
3324 - Boiler, tank, and shipping container manufacturing	0.95
3113 - Sugar and confectionery product manufacturing	0.97
3222 - Converted paper product manufacturing	0.99

NAICS 31-33 Manufacturing

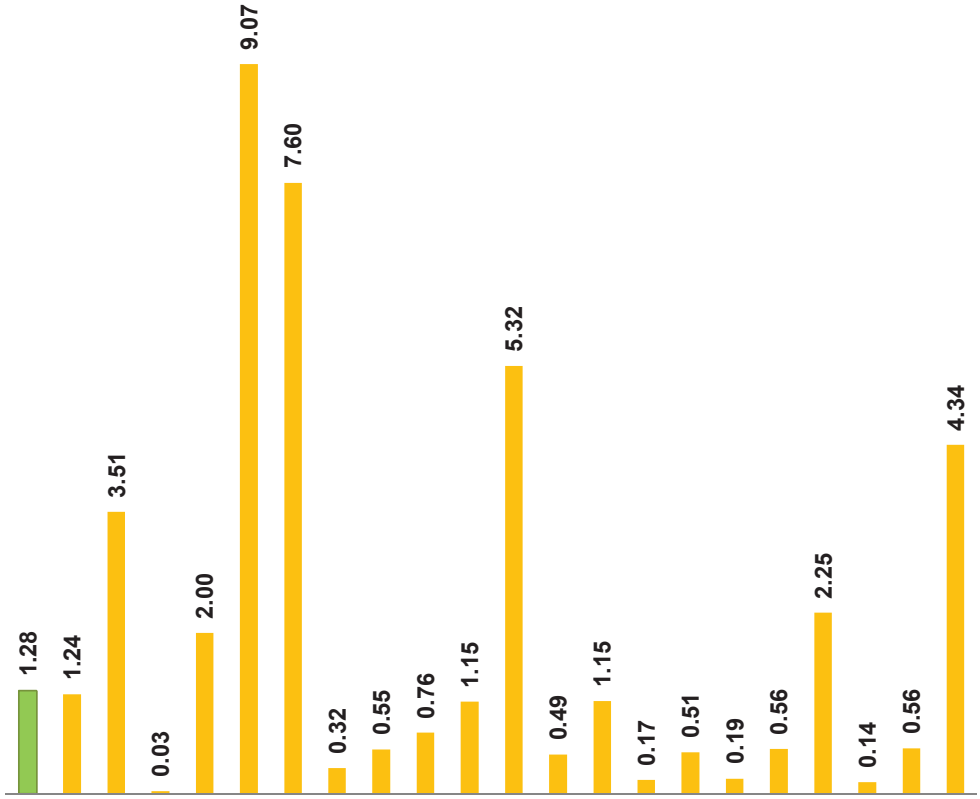
Table D3: Location Quotient of Number of Establishments Manufacturing (NAICS 31-33)

Sector by NAICS	Location Quotient
3254 - Pharmaceutical and medicine manufacturing	4.66
3118 - Bakeries and tortilla manufacturing	4.17
3162 - Footwear manufacturing	3.57
3379 - Other furniture related product manufacturing	3.56
3115 - Dairy product manufacturing	2.73
3241 - Petroleum and coal products manufacturing	2.47
3113 - Sugar and confectionery product manufacturing	2.30
3119 - Other food manufacturing	2.17
3273 - Cement and concrete product manufacturing	2.10
3121 - Beverage manufacturing	2.07
3255 - Paint, coating, and adhesive manufacturing	2.06
3151 - Apparel knitting mills	2.06
3152 - Cut and sew apparel manufacturing	1.99
3256 - Soap, cleaning compound, and toilet preparation manufacturing	1.75
3112 - Grain and oilseed milling	1.69
3323 - Architectural and structural metals manufacturing	1.61
3324 - Boiler, tank, and shipping container manufacturing	1.46
3141 - Textile furnishings mills	1.43
3311 - Iron and steel mills and ferroalloy manufacturing	1.41
3371 - Household and institutional furniture and kitchen cabinet manufacturing	1.33
3353 - Electrical equipment manufacturing	1.30
3222 - Converted paper product manufacturing	1.24
3251 - Basic chemical manufacturing	1.03

Table D4: Location Quotient of Total Annual Payroll Manufacturing (NAICS 31-33)

Sector by NAICS	Location Quotient
3254 - Pharmaceutical and medicine manufacturing	18.82
3162 - Footwear manufacturing	15.06
3152 - Cut and sew apparel manufacturing	12.23
3391 - Medical equipment and supplies manufacturing	9.17
3353 - Electrical equipment manufacturing	4.92
3255 - Paint, coating, and adhesive manufacturing	3.53
3121 - Beverage manufacturing	3.28
3256 - Soap, cleaning compound, and toilet preparation manufacturing	2.87
3118 - Bakeries and tortilla manufacturing	2.83
3119 - Other food manufacturing	2.78
3273 - Cement and concrete product manufacturing	2.56
3115 - Dairy product manufacturing	2.30
3151 - Apparel knitting mills	1.84
3111 - Animal food manufacturing	1.65
3379 - Other furniture related product manufacturing	1.27
3359 - Other electrical equipment and component manufacturing	1.17
3323 - Architectural and structural metals manufacturing	1.11
3141 - Textile furnishings mills	1.08

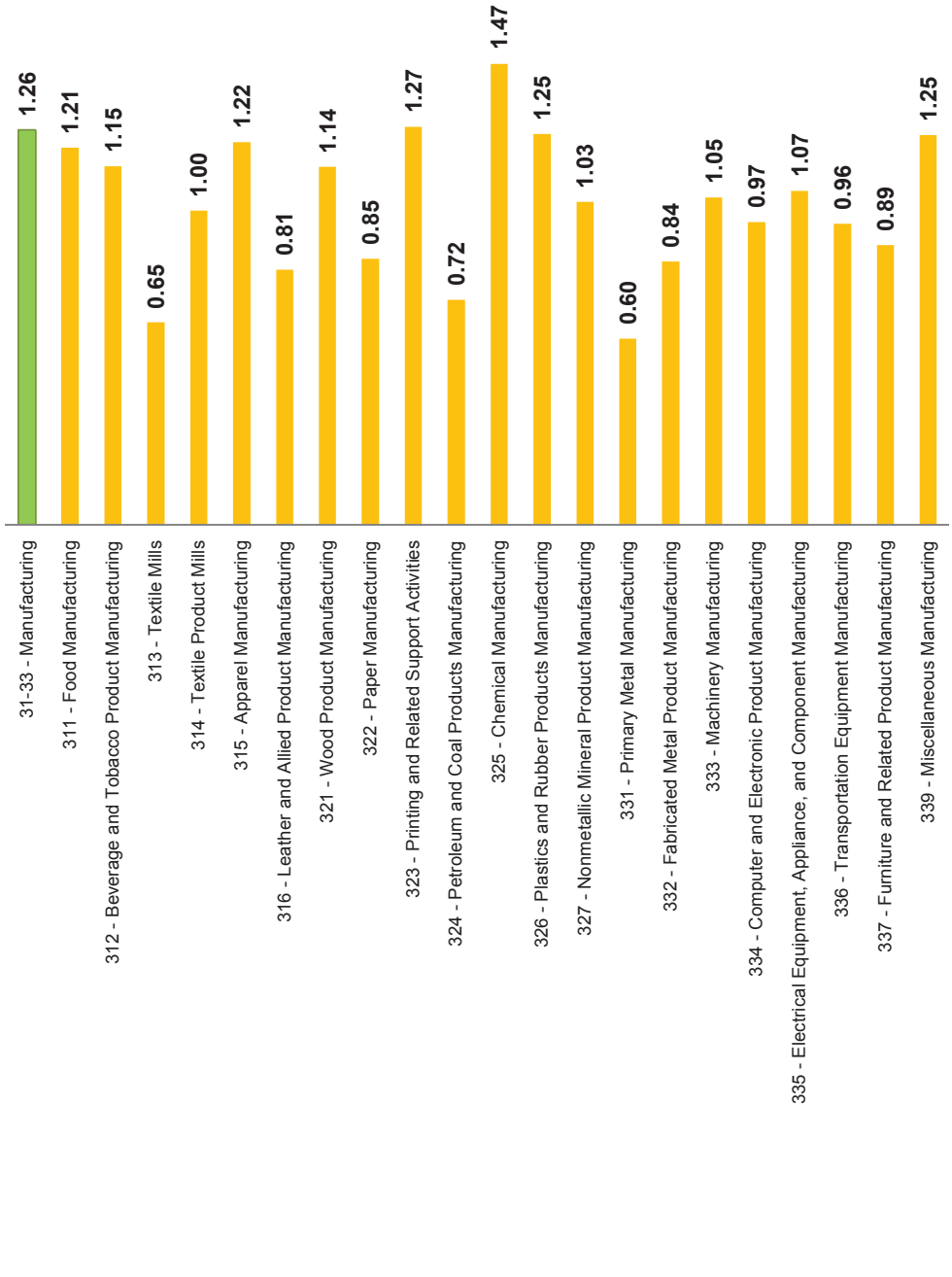
Location Quotient for Number of Employees
NAICS 31-33 Manufacturing Sector and Sub-Sectors
P.R. and U.S. 2011



Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Figure - D1

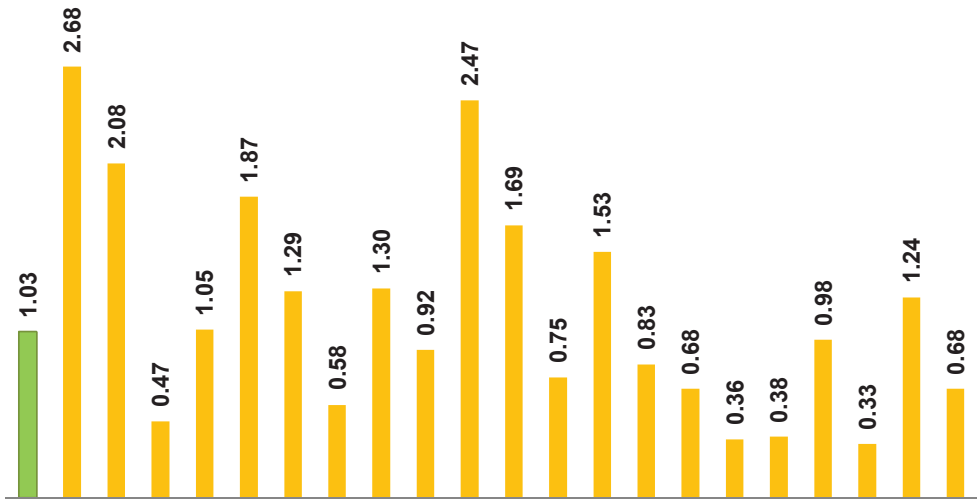
Location Quotient for Annual Payroll per Employees
NAICS 31-33 Manufacturing Sector and Sub-Sectors
P.R. and U.S. 2011



Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Figure - D2

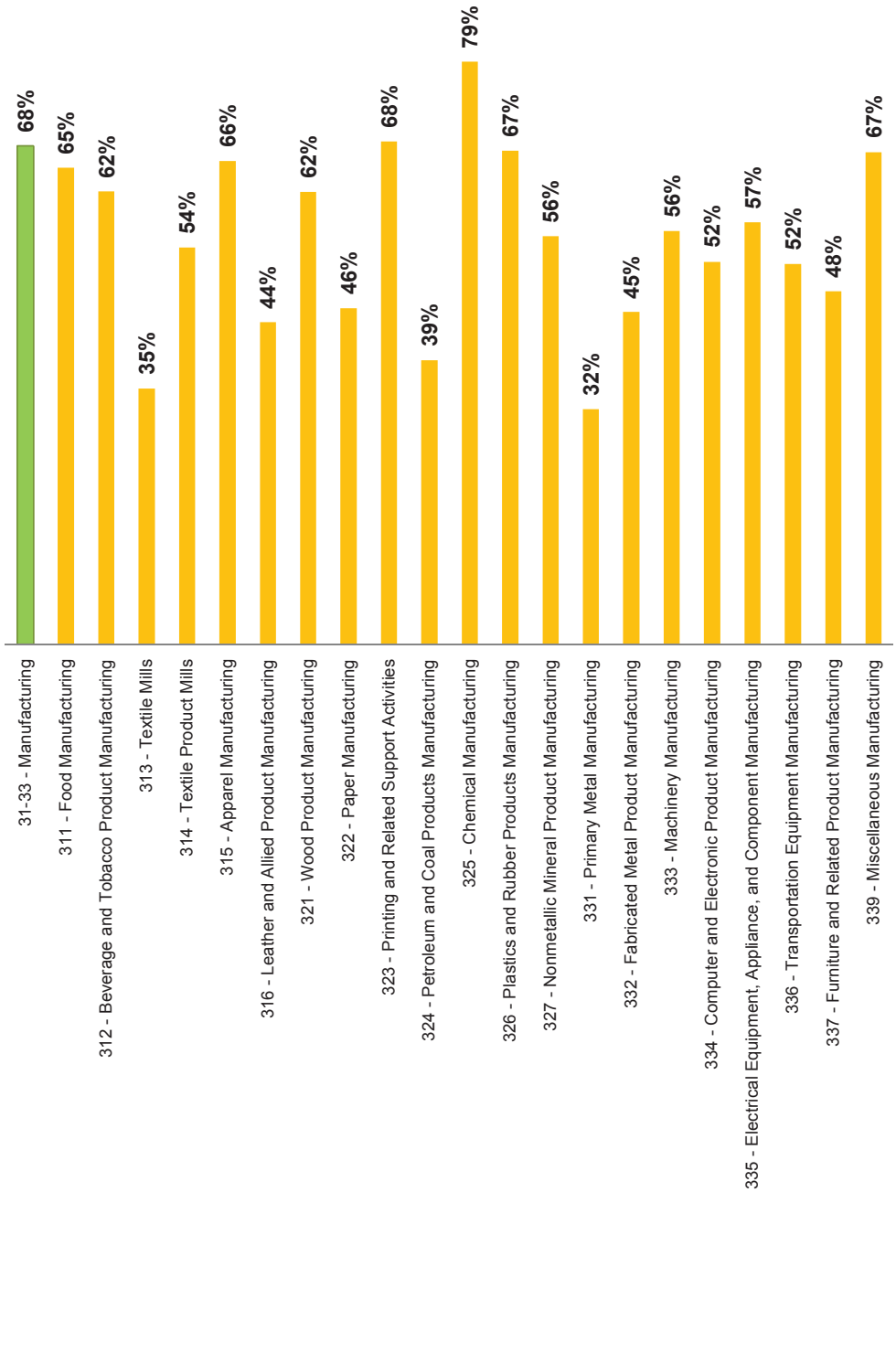
Location Quotient for Number of Establishments
NAICS 31-33 Manufacturing Sector and Sub-Sectors
P.R. and U.S. 2011



Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Figure - D3

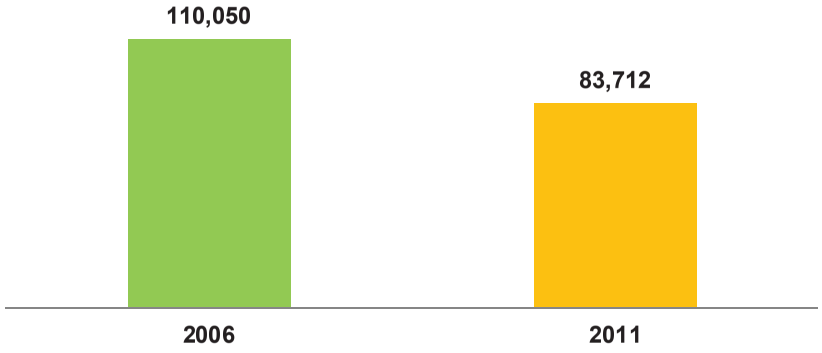
P.R. Annual Payroll per Employee as a Percentage of U.S. Annual Payroll per Employee
NAICS 31-33 Manufacturing Sector and Sub-Sectors
P.R. and U.S. 2011



Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

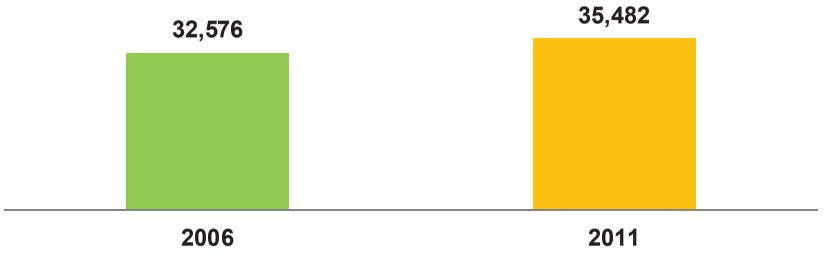
Figure - D4

Number of Paid Employees
NAICS 31 - Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 31 - Manufacturing
Puerto Rico 2006, 2011

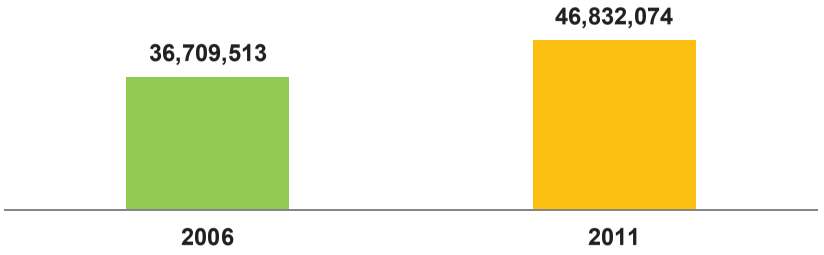


Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 31 - Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

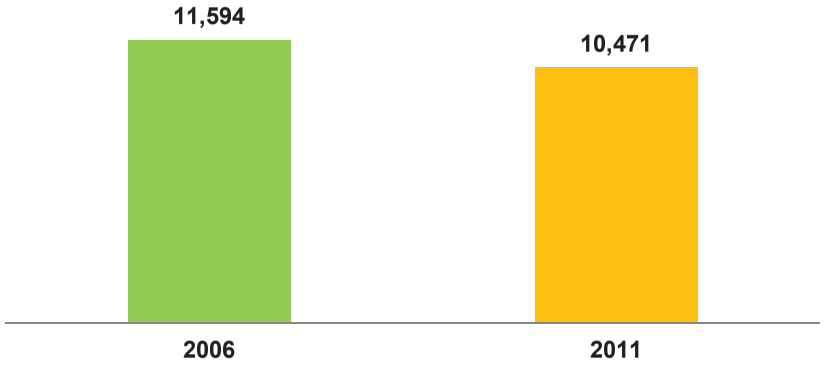
Gross Product ($1,000)
NAICS 31 - Manufacturing
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

Figure - D5

Number of Paid Employees
NAICS 311 - Food Manufacturing
Puerto Rico 2006, 2011

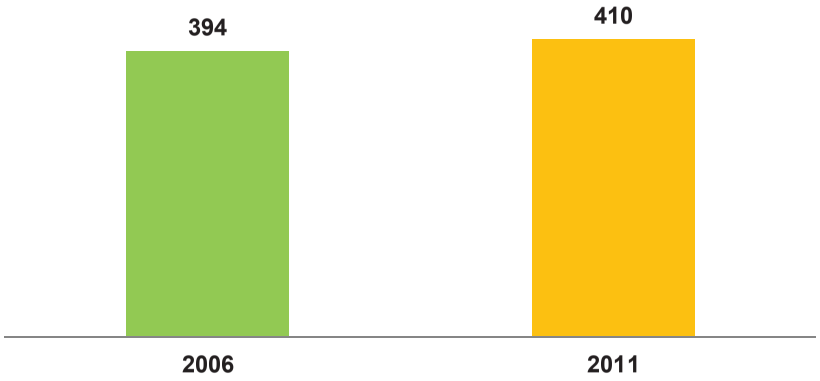


Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 311 - Food Manufacturing
Puerto Rico 2006, 2011

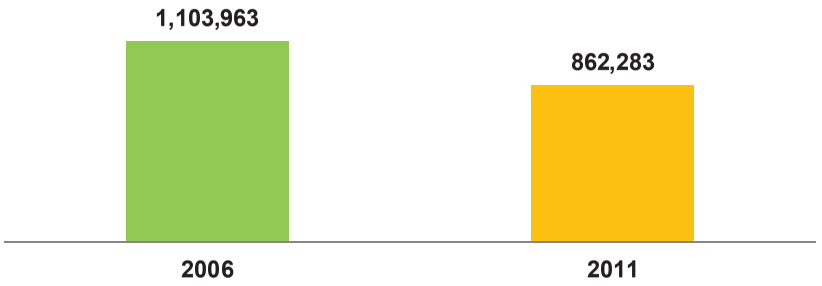
Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 311 - Food Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

Gross Product ($1,000)
NAICS 311 - Food Manufacturing
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

Figure - D6

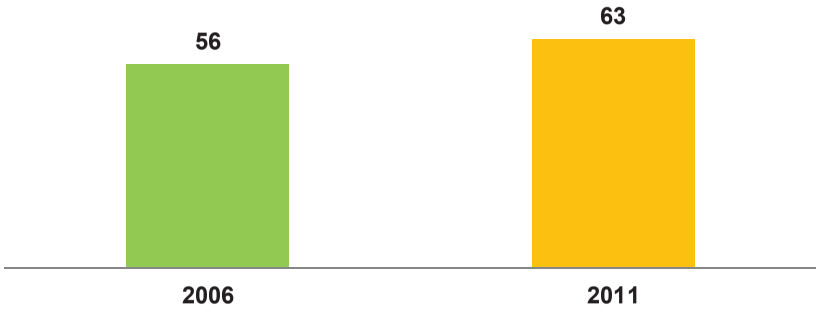
Number of Paid Employees
NAICS 312 - Beverage and Tobacco Product Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 312 - Beverage and Tobacco Product Manufacturing
Puerto Rico 2006, 2011

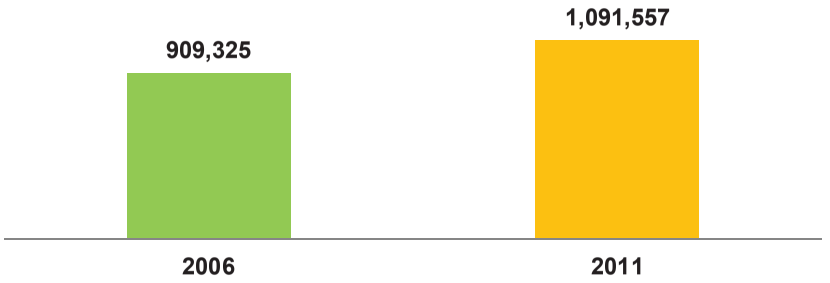
Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 312 - Beverage and Tobacco Product Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

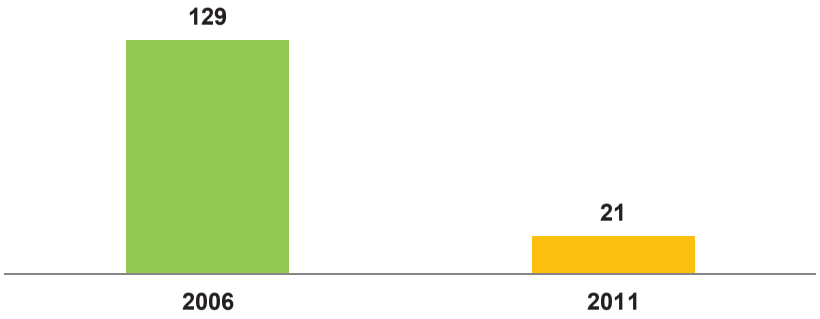
Gross Product ($1,000)
NAICS 312 - Beverage and Tobacco Product Manufacturing
Puerto Rico2006, 2011



Source: Puerto Rico Planning Board

Figure - D7

Number of Paid Employees
NAICS 313 - Textile Mills
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

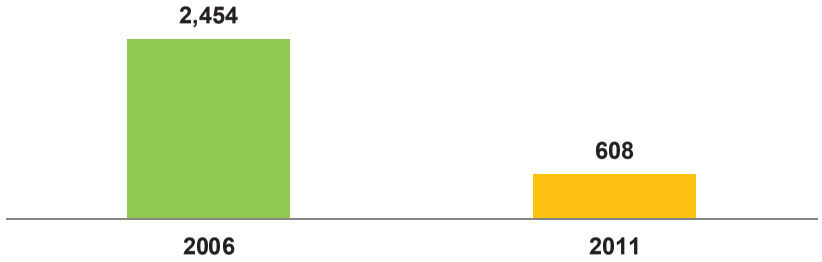
Annual Payroll per Employee ($)
NAICS 313 - Textile Mills
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 313 - Textile Mills
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Gross Product ($1,000)
NAICS 313 - Textile Mills
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

Figure - D8

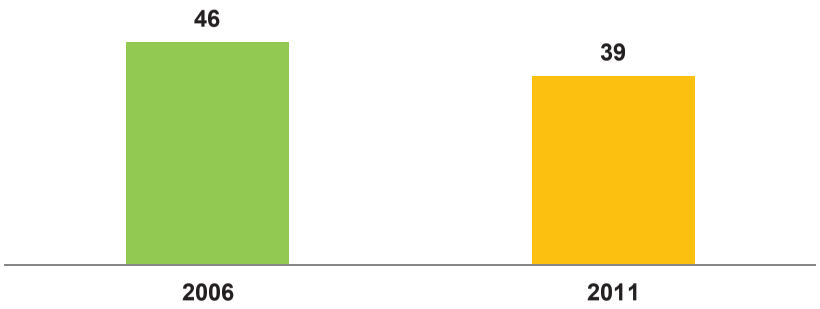
Number of Paid Employees
NAICS 314 - Textile Product Mills
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 314 - Textile Product Mills
Puerto Rico 2006, 2011

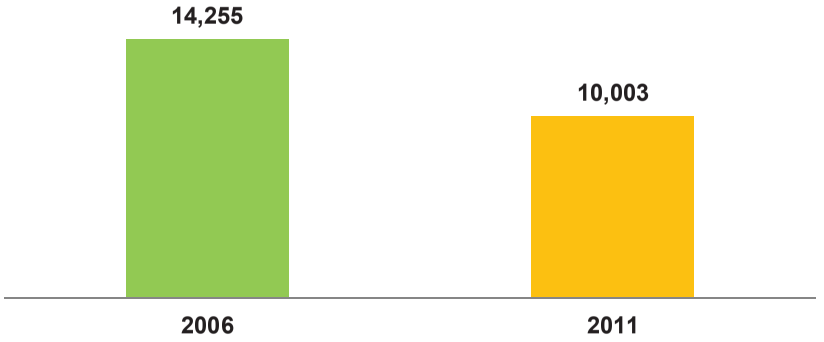
Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 314 - Textile Product Mills
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

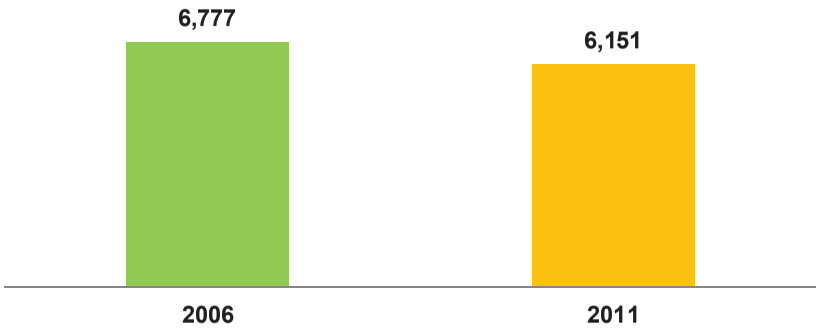
Gross Product ($1,000)
NAICS 314 - Textile Product Mills
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

Figure - D9

Number of Paid Employees
NAICS 315 - Apparel Manufacturing
Puerto Rico 2006, 2011

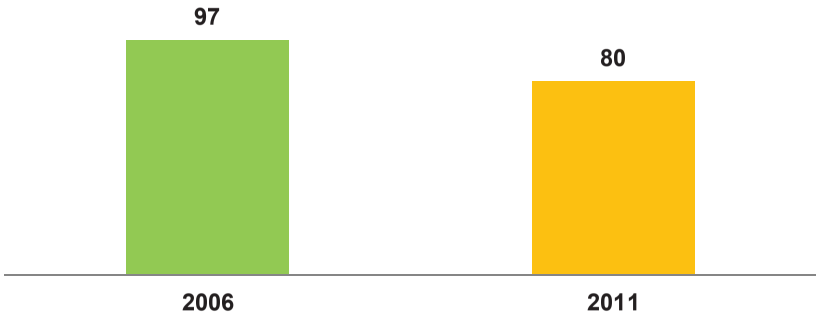


Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 315 - Apparel Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 315 - Apparel Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

Gross Product ($1,000)
NAICS 315 - Apparel Manufacturing
Puerto Rico 2006, 2011

Source: Puerto Rico Planning Board

Figure - D10

Number of Paid Employees
NAICS 316 - Leather and Allied Product Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

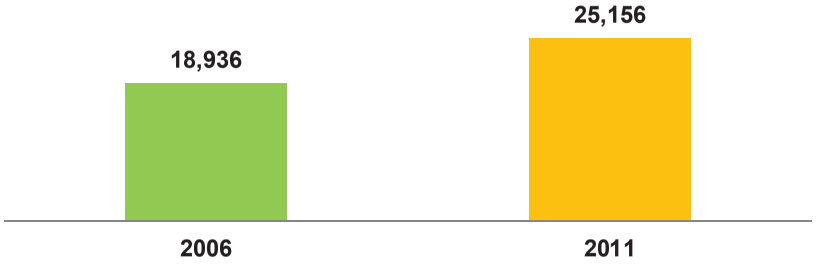
Annual Payroll per Employee ($)
NAICS 316 - Leather and Allied Product Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 316 - Leather and Allied Product Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Gross Product ($1,000)
NAICS 316 - Leather and Allied Product Manufacturing
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

Figure - D11

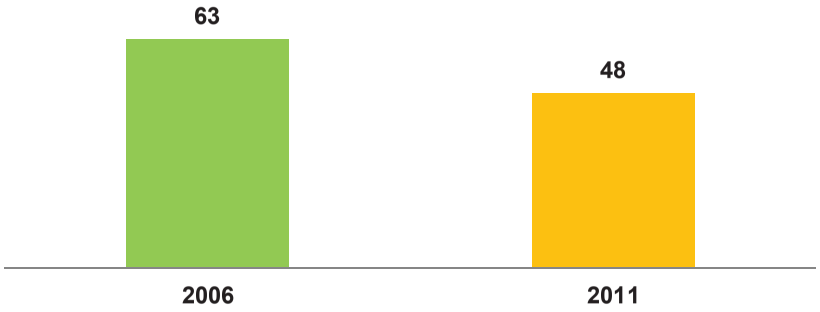
Number of Paid Employees
NAICS 321 - Wood Product Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 321 - Wood Product Manufacturing
Puerto Rico 2006, 2011

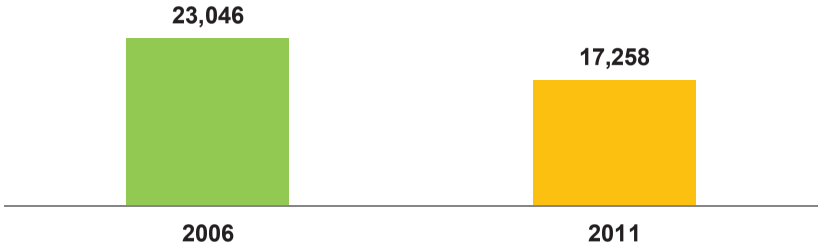
Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 321 - Wood Product Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

Gross Product ($1,000)
NAICS 321 - Wood Product Manufacturing
Puerto Rico2006, 2011



Source: Puerto Rico Planning Board

Figure - D12

Number of Paid Employees
NAICS 322 - Paper Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

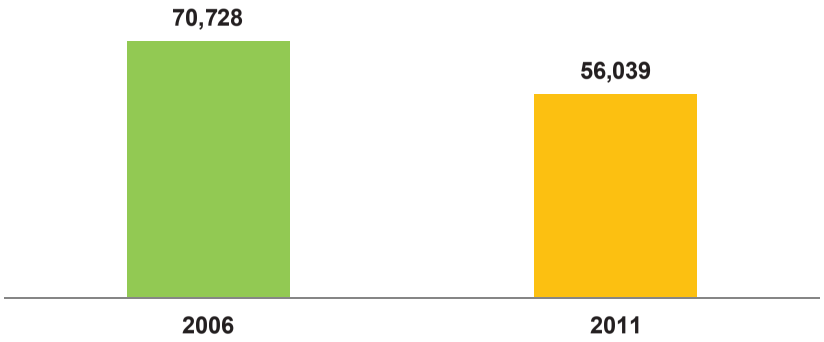
Annual Payroll per Employee ($)
NAICS 322 - Paper Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 322 - Paper Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

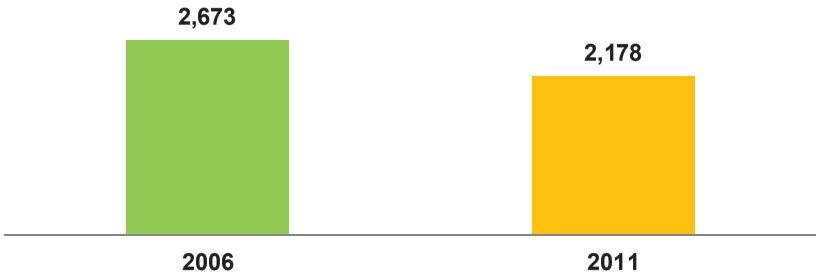
Gross Product ($1,000)
NAICS 322 - Paper Manufacturing
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

Figure - D13

Number of Paid Employees
NAICS 323 - Printing and Related Support Activities
Puerto Rico 2006, 2011

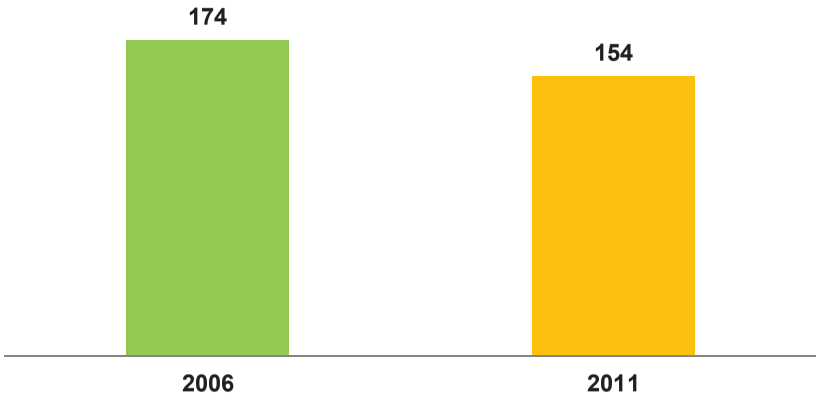


Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 323 - Printing and Related Support Activities
Puerto Rico 2006, 2011

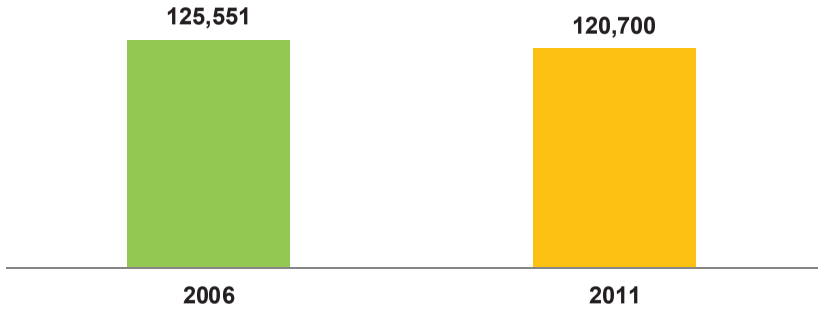
Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 323 - Printing and Related Support Activities
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

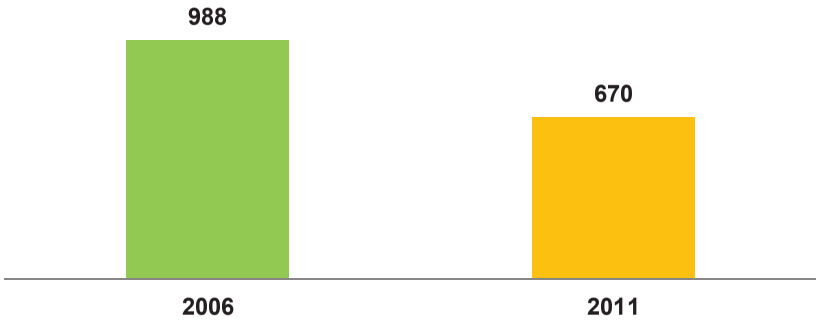
Gross Product ($1,000)
NAICS 323 - Printing and Related Support Activities
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

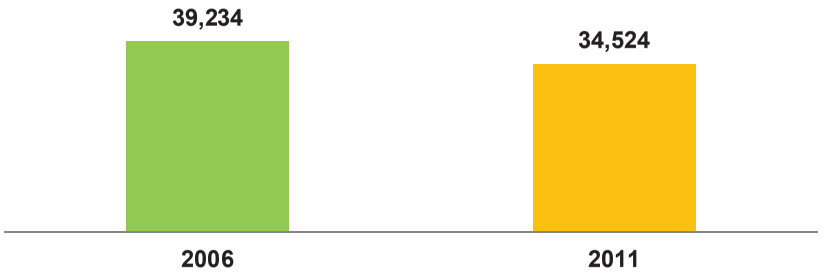
Figure - D14

Number of Paid Employees
NAICS 324 - Petroleum and Coal Products Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 324 - Petroleum and Coal Products Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 324 - Petroleum and Coal Products Manufacturing
Puerto Rico 2006, 2011

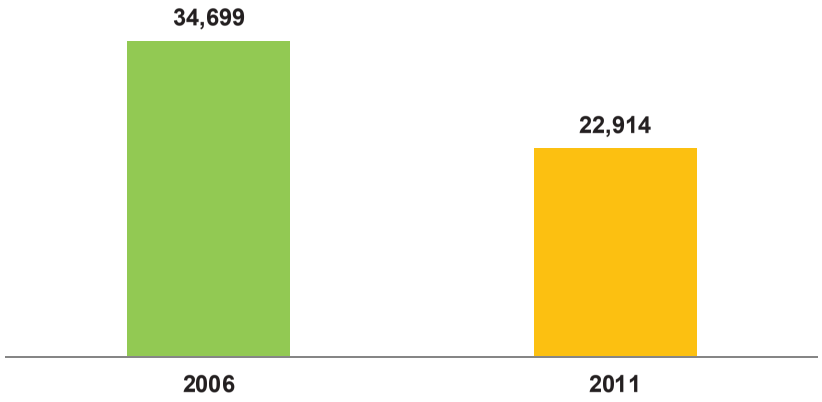
Source: U.S. Census Bureau, County Business Patterns

Gross Product ($1,000)
NAICS 324 - Petroleum and Coal Products Manufacturing
Puerto Rico 2006, 2011

Source: Puerto Rico Planning Board

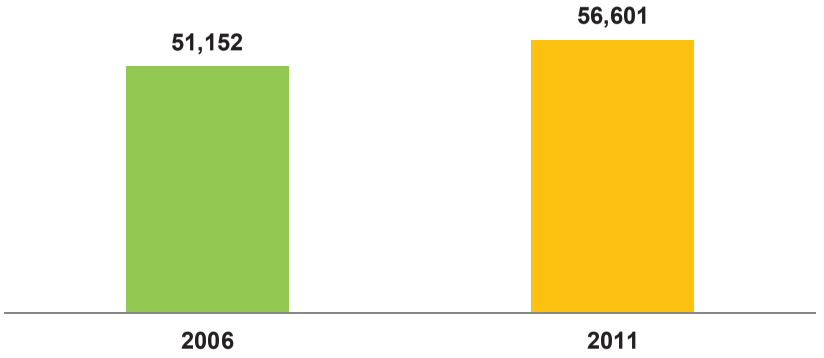
Figure - D15

Number of Paid Employees
NAICS 325 - Chemical Manufacturing
Puerto Rico 2006, 2011



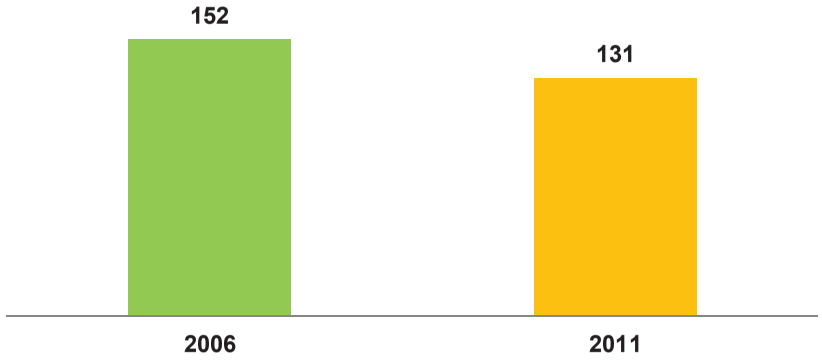
Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 325 - Chemical Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 325 - Chemical Manufacturing
Puerto Rico 2006, 2011



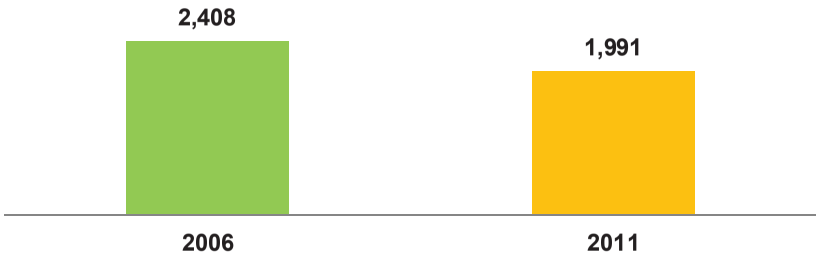
Source: U.S. Census Bureau, County Business Patterns

Gross Product ($1,000)
NAICS 325 - Chemical Manufacturing
Puerto Rico 2006, 2011

Source: Puerto Rico Planning Board

Figure - D16

Number of Paid Employees
NAICS 326 - Plastics and Rubber Products Manufacturing
Puerto Rico 2006, 2011

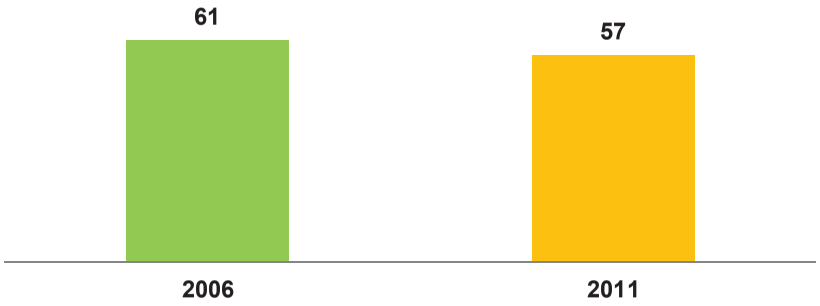


Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 326 - Plastics and Rubber Products Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 326 - Plastics and Rubber Products Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

Gross Product ($1,000)
NAICS 326 - Plastics and Rubber Products Manufacturing
Puerto Rico 2006, 2011

Source: Puerto Rico Planning Board

Figure - D17

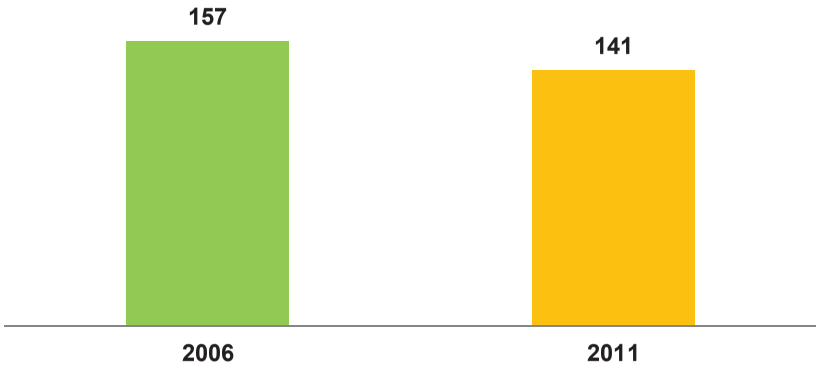
Number of Paid Employees
NAICS 327 - Nonmetallic Mineral Product Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 327 - Nonmetallic Mineral Product Manufacturing
Puerto Rico 2006, 2011

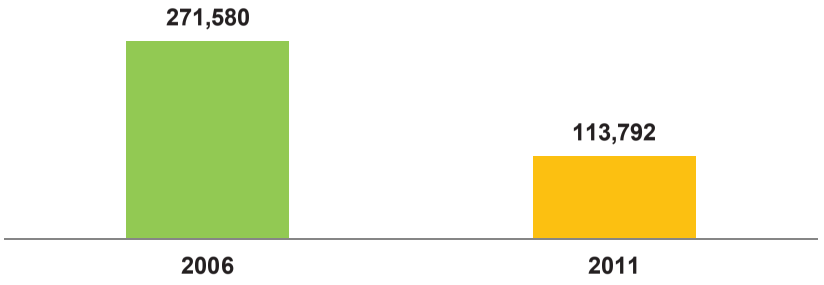
Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 327 - Nonmetallic Mineral Product Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

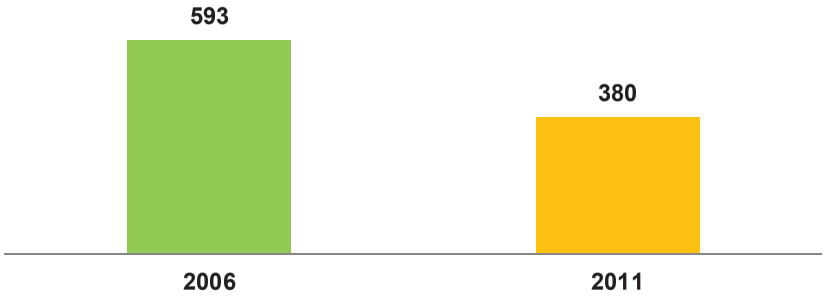
Gross Product ($1,000)
NAICS 327 - Nonmetallic Mineral Product Manufacturing
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

Figure - D18

Number of Paid Employees
NAICS 331 - Primary Metal Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 331 - Primary Metal Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 331 - Primary Metal Manufacturing
Puerto Rico 2006, 2011

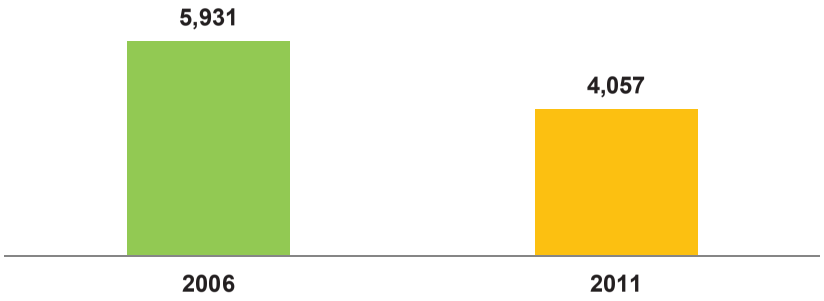
Source: U.S. Census Bureau, County Business Patterns

Gross Product ($1,000)
NAICS 331 - Primary Metal Manufacturing
Puerto Rico 2006, 2011

Source: Puerto Rico Planning Board

Figure - D19

Number of Paid Employees
NAICS 332 - Fabricated Metal Product Manufacturing
Puerto Rico 2006, 2011

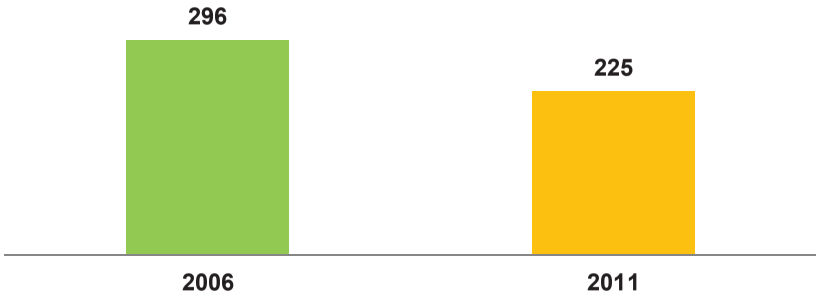


Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 332 - Fabricated Metal Product Manufacturing
Puerto Rico 2006, 2011

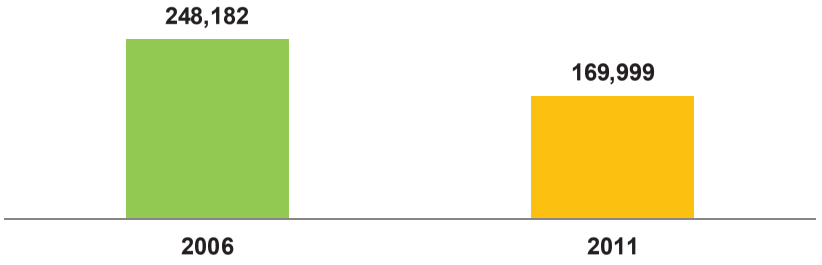
Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 332 - Fabricated Metal Product Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

Gross Product ($1,000)
NAICS 332 - Fabricated Metal Product Manufacturing
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

Figure - D20

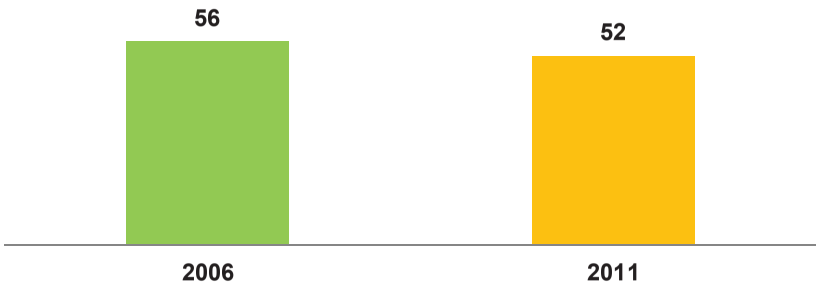
Number of Paid Employees
NAICS 333 - Machinery Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 333 - Machinery Manufacturing
Puerto Rico 2006, 2011

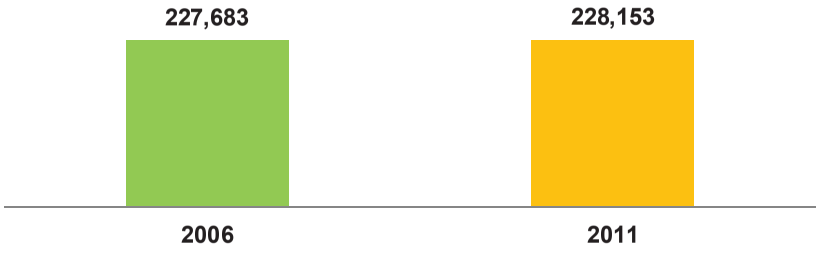
Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 333 - Machinery Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

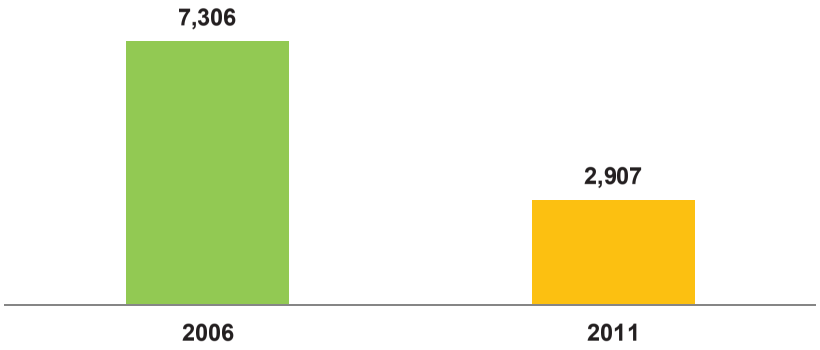
Gross Product ($1,000)
NAICS 333 - Machinery Manufacturing
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

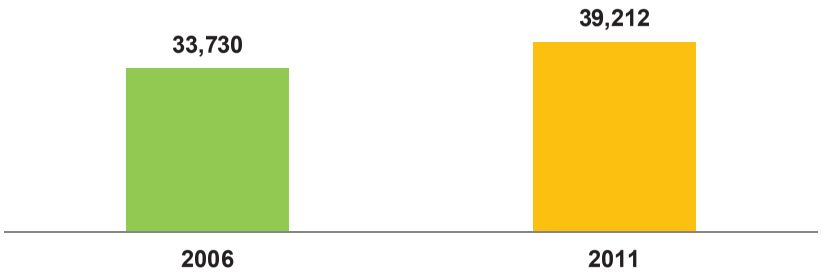
Figure - D21

Number of Paid Employees
NAICS 334 - Computer and Electronic Product Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 334 - Computer and Electronic Product Manufacturing
Puerto Rico 2006, 2011

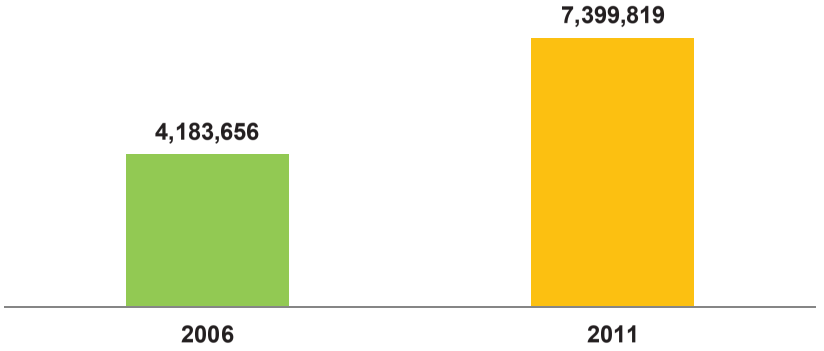


Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 334 - Computer and Electronic Product Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

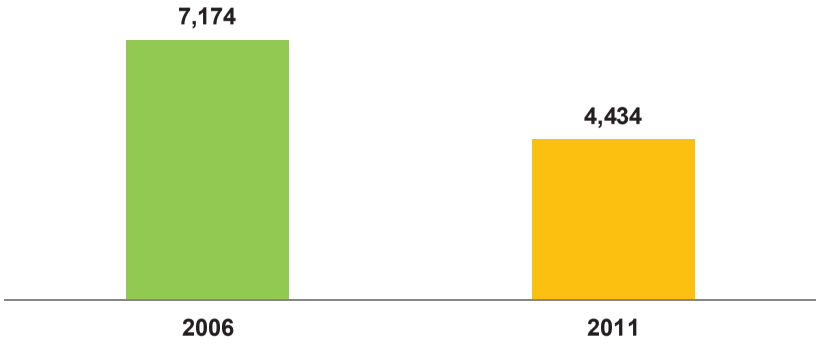
Gross Product ($1,000)
NAICS 334 - Computer and Electronic Product Manufacturing
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

Figure - D22

Number of Paid Employees
NAICS 335 - Electrical equipment, Appliance, and Component Manufacturing
Puerto Rico 2006, 2011

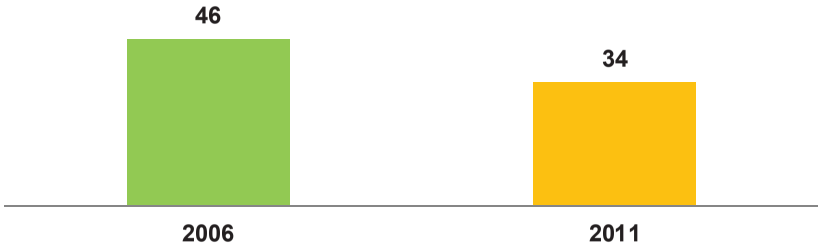


Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 335 - Electrical equipment, Appliance, and Component Manufacturing
Puerto Rico 2006, 2011

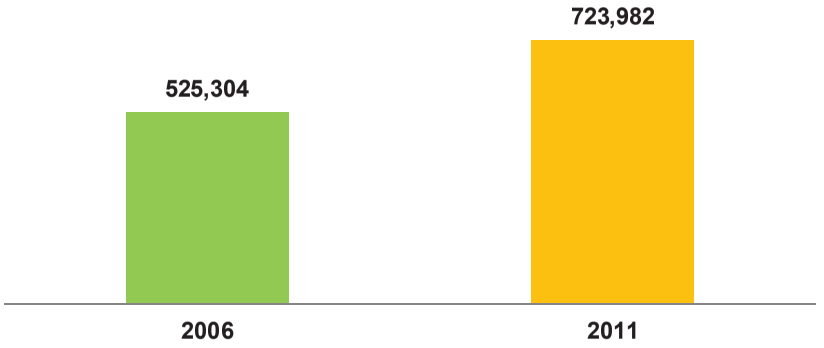
Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 335 - Electrical equipment, Appliance, and Component Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

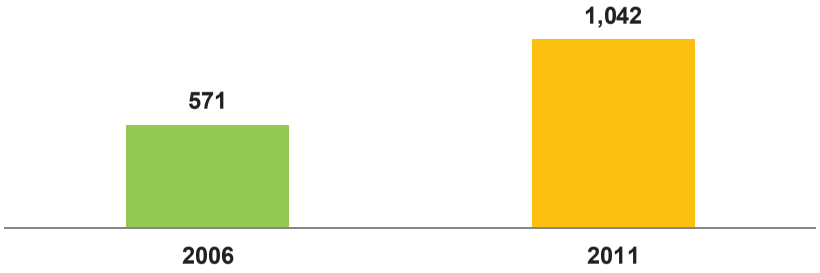
Gross Product ($1,000)
NAICS 335 - Electrical equipment, Appliance, and Component Manufacturing
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

Figure - D23

Number of Paid Employees
NAICS 336 - Transportation Equipment Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

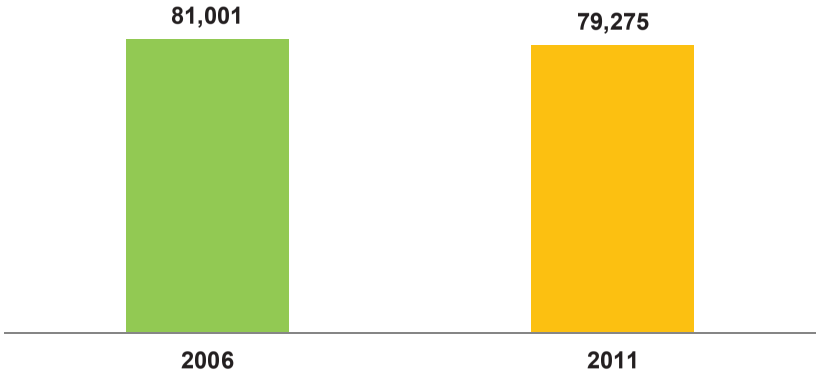
Annual Payroll per Employee ($)
NAICS 336 - Transportation Equipment Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 336 - Transportation Equipment Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Gross Product ($1,000)
NAICS 336 - Transportation Equipment Manufacturing
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

Figure - D24

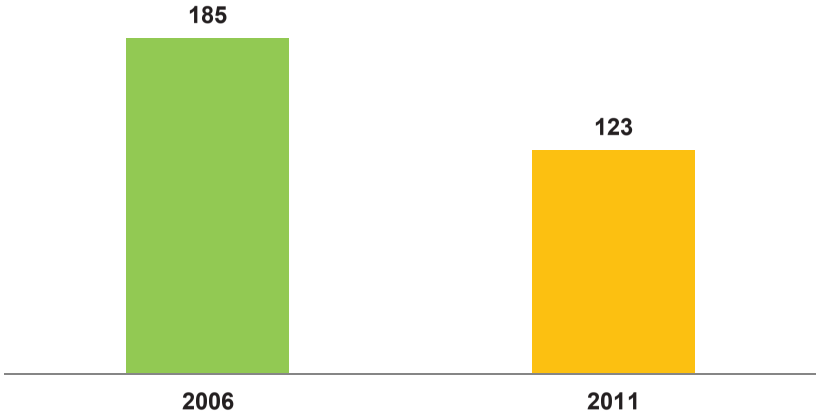
Number of Paid Employees
NAICS 337 - Furniture and Related Product Manufacturing
Puerto Rico 2006, 2011

Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 337 - Furniture and Related Product Manufacturing
Puerto Rico 2006, 2011

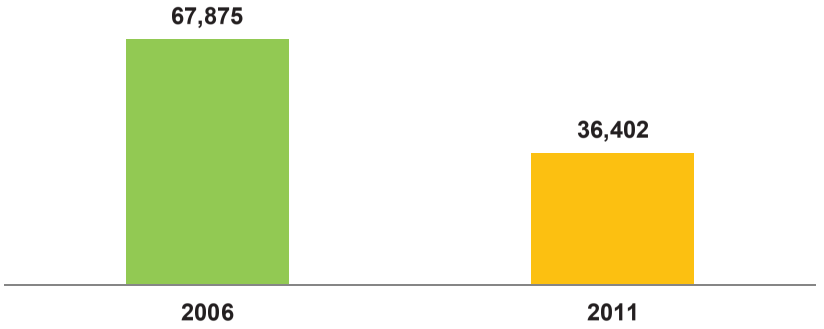
Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 337 - Furniture and Related Product Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

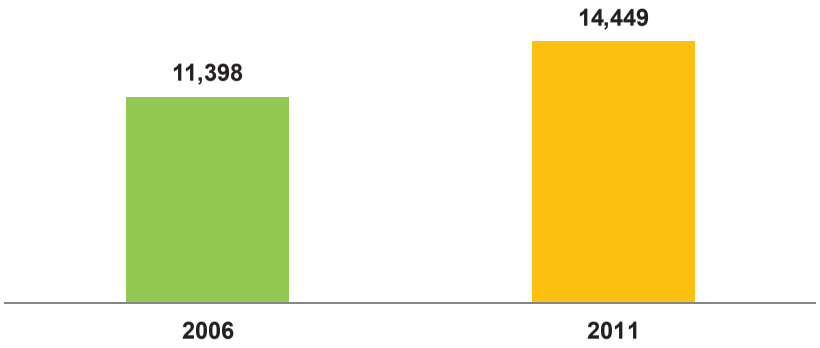
Gross Product ($1,000)
NAICS 337 - Furniture and Related Product Manufacturing
Puerto Rico 2006, 2011



Source: Puerto Rico Planning Board

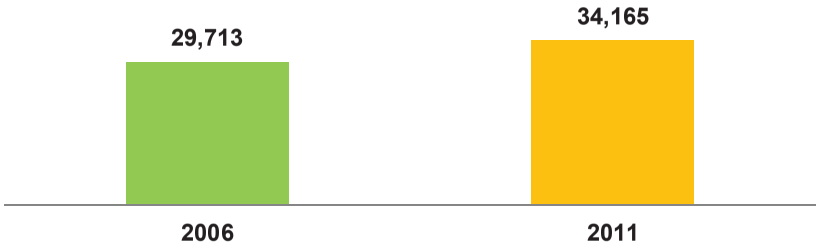
Figure - D25

Number of Paid Employees
NAICS 339 - Miscellaneous Manufacturing
Puerto Rico 2006, 2011



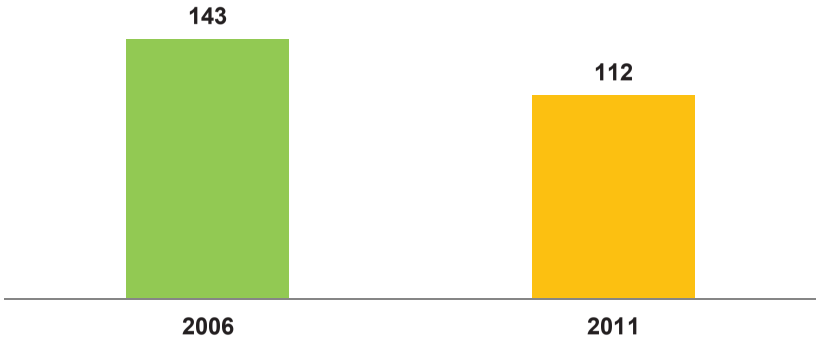
Source: U.S. Census Bureau, County Business Patterns

Annual Payroll per Employee ($)
NAICS 339 - Miscellaneous Manufacturing
Puerto Rico 2006, 2011



Source: U.S. Census Bureau, County Business Patterns

Number of Establishments
NAICS 339 - Miscellaneous Manufacturing
Puerto Rico 2006, 2011



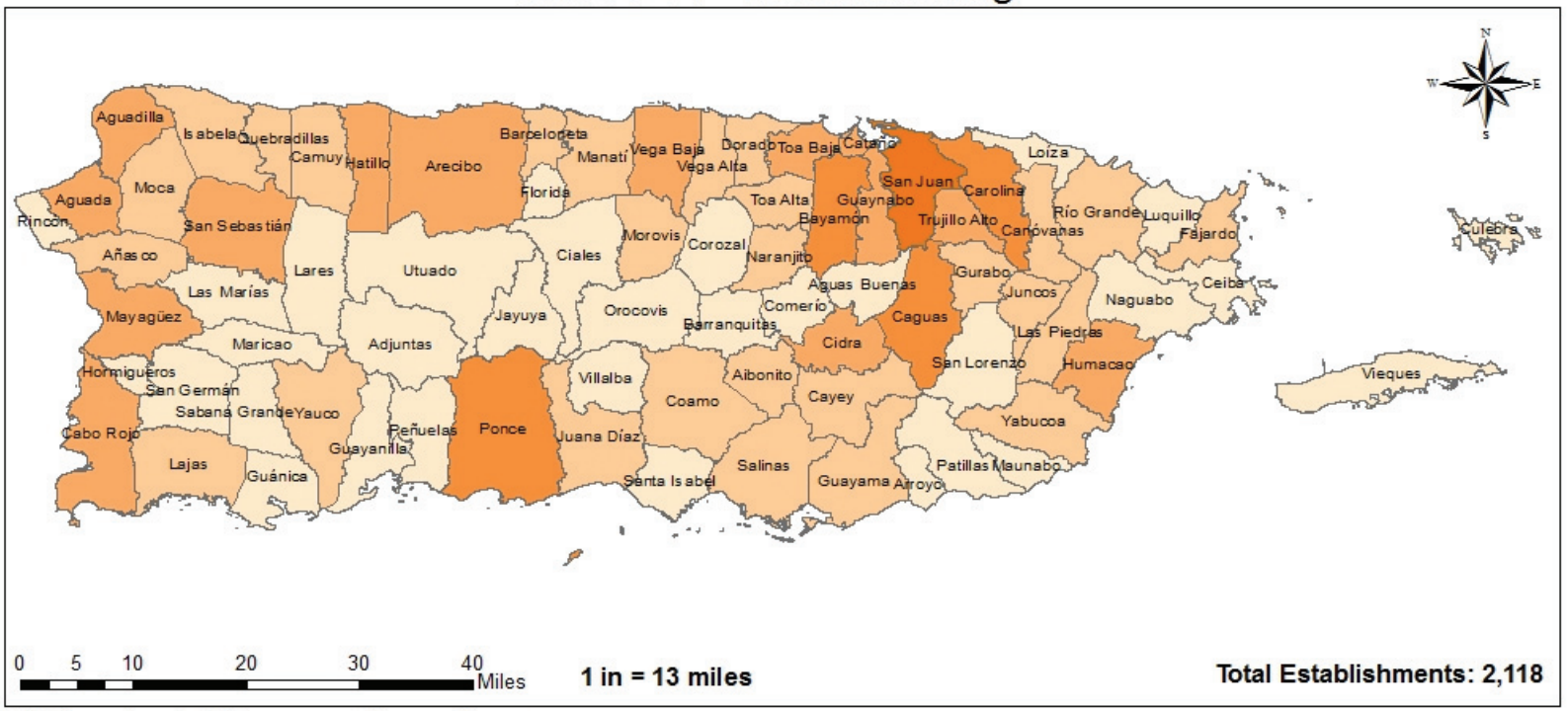
Source: U.S. Census Bureau, County Business Patterns

Gross Product ($1,000)
NAICS 339 - Miscellaneous Manufacturing
Puerto Rico 2006, 2011

Source: Puerto Rico Planning Board

Figure - D26

Number of Establishments in Puerto Rico, 2006
NAICS 31 - Manufacturing

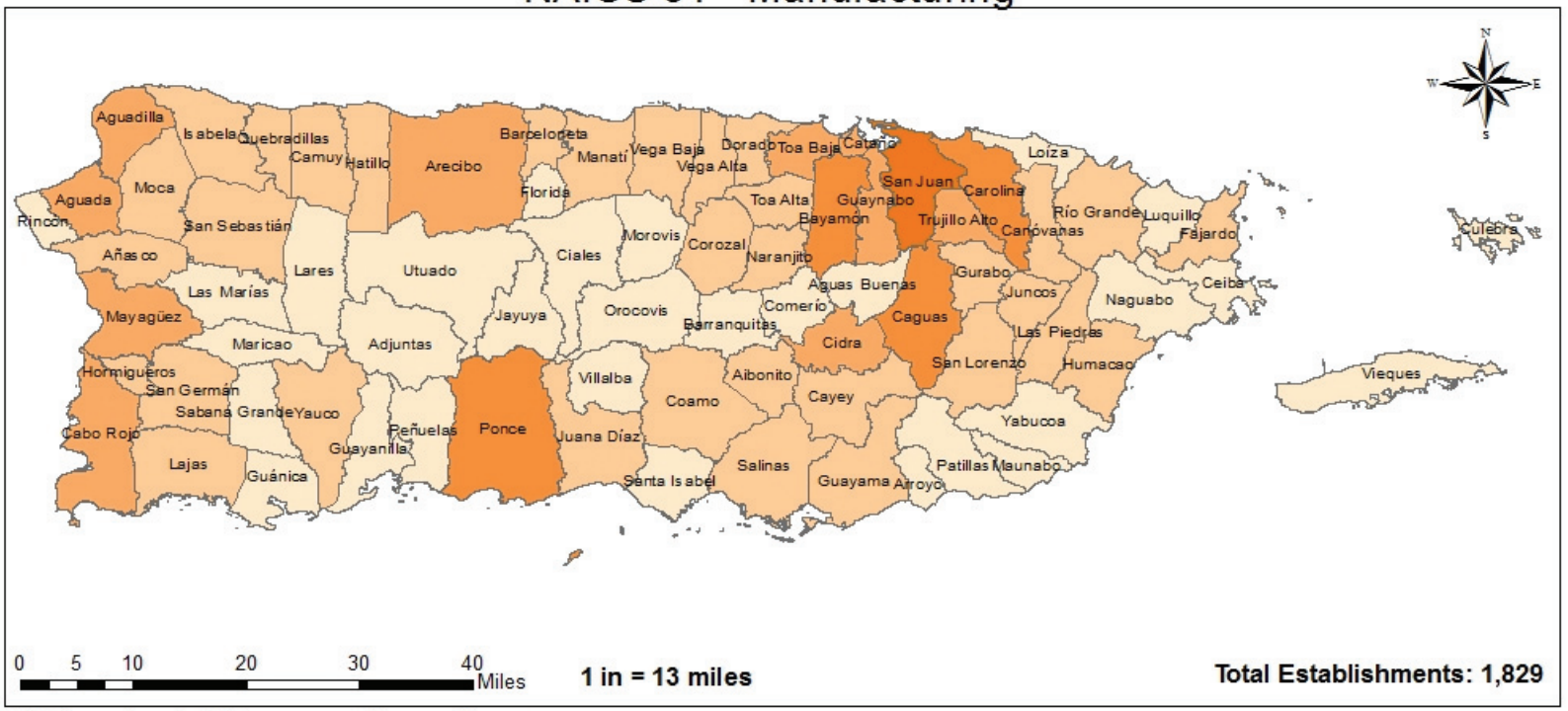


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0 - 12	31
13 - 29	27
30 - 70	14
71 - 166	5
167 - 276	1

Map – 1A

Number of Establishments in Puerto Rico, 2011
NAICS 31 - Manufacturing

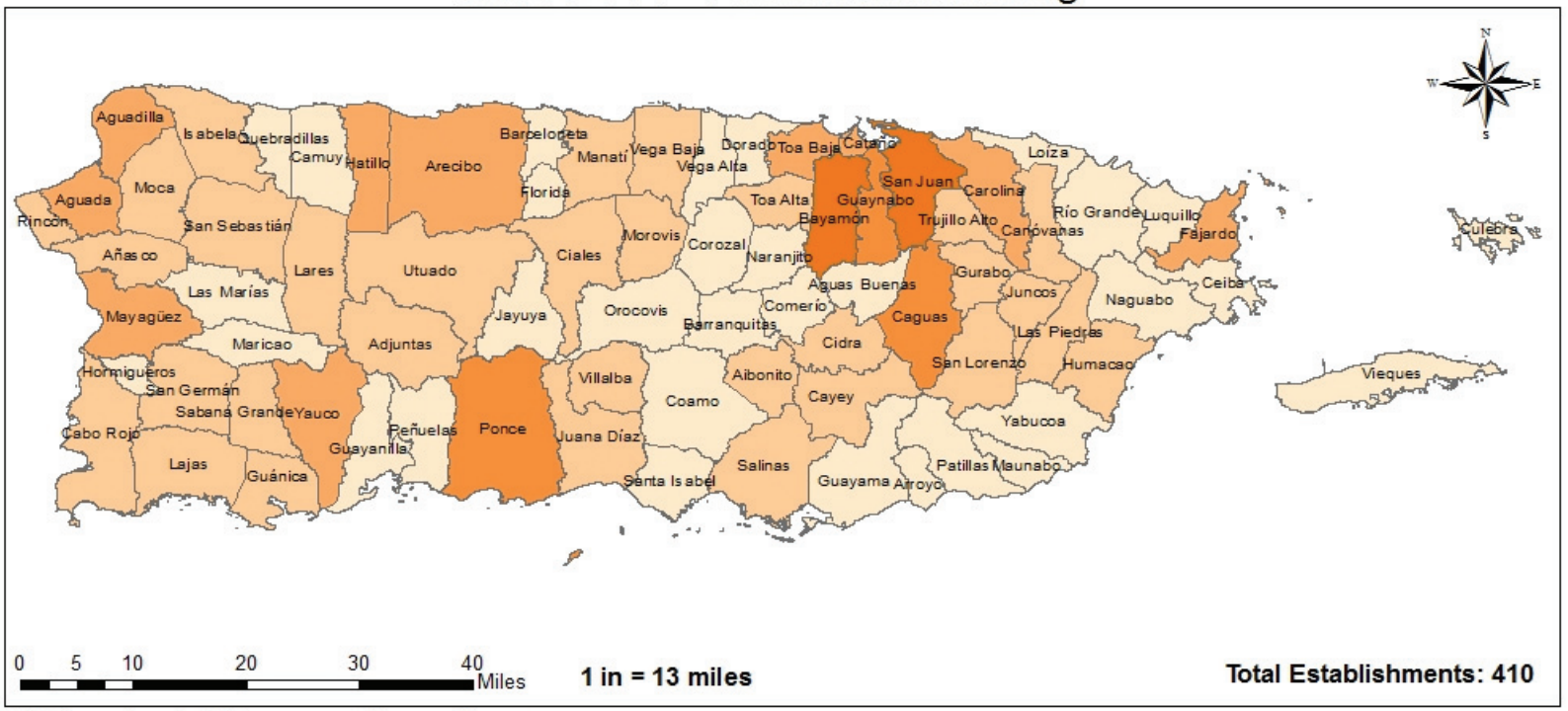


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
1 - 11	30
12 - 26	31
27 - 69	12
70 - 137	4
138 - 220	1

Map – 1B

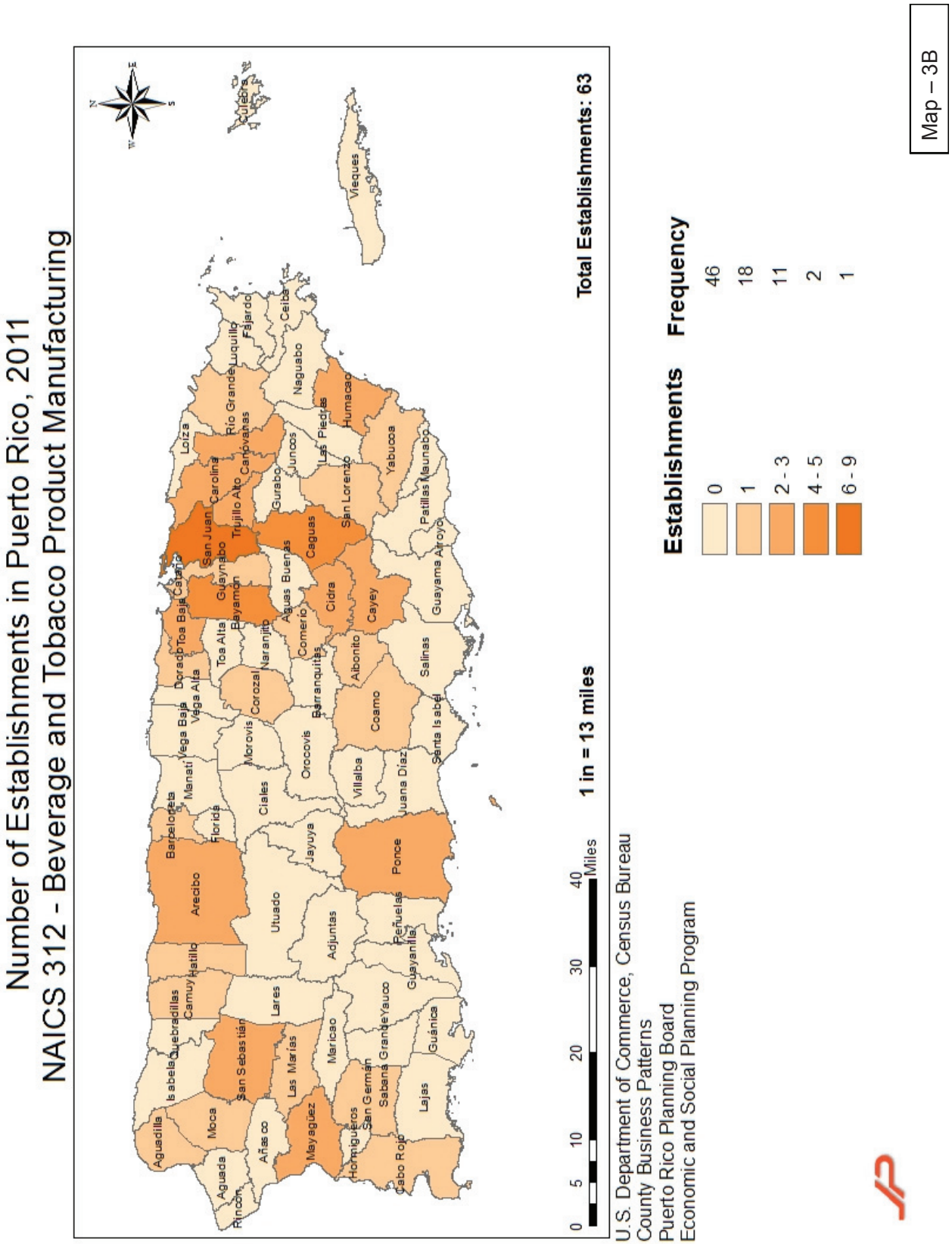
Number of Establishments in Puerto Rico, 2011
NAICS 311 - Food Manufacturing



U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

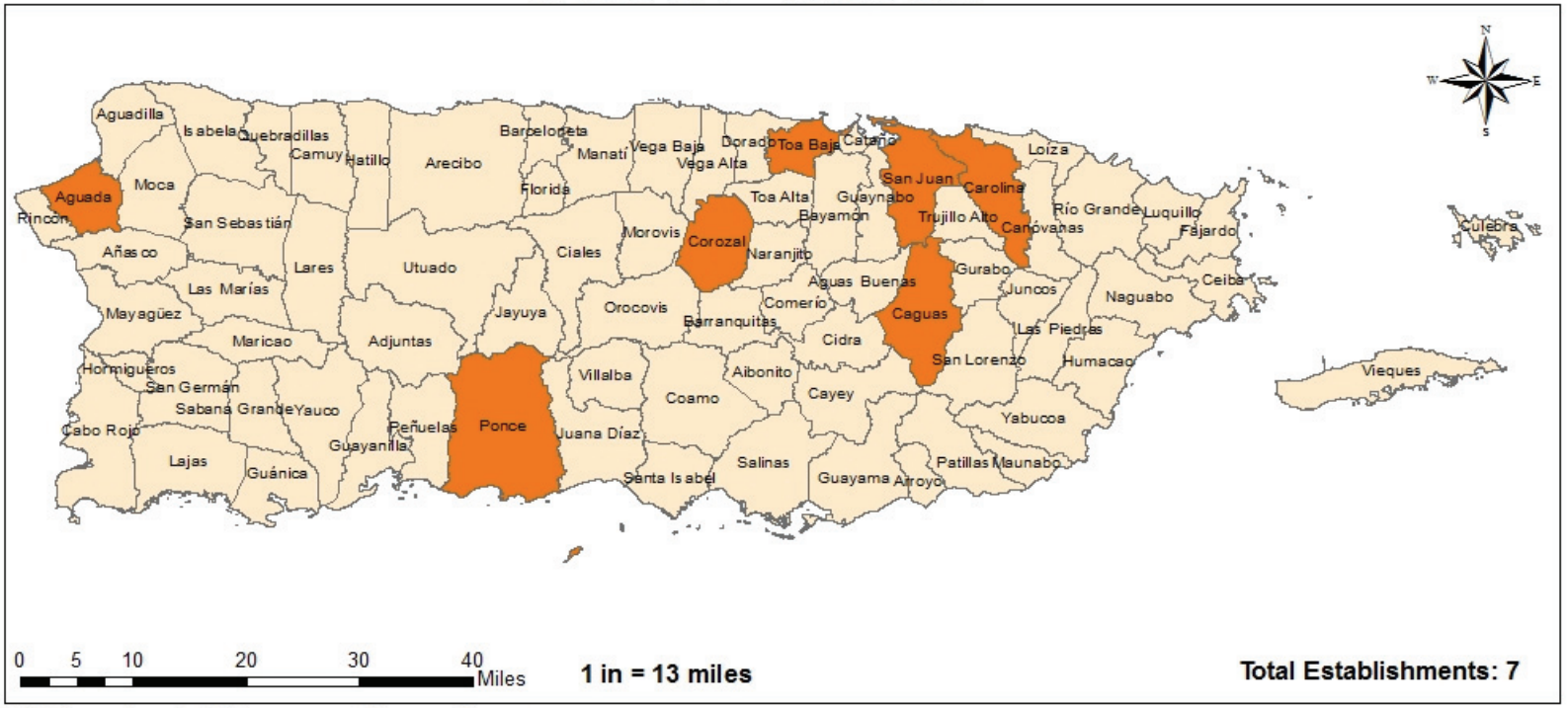
Establishments	Frequency
0 - 2	32
3 - 7	31
8 - 13	10
14 - 21	3
22 - 42	2

Map – 2B


Number of Establishments in Puerto Rico, 2011
NAICS 312 - Beverage and Tobacco Product Manufacturing
Total Establishments: 63
1 in = 13 miles
0 5 10 20 30 40 Miles
Establishments Frequency
0 46
1 18
2 - 3 11
4 - 5 2
6 - 9 1
U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Map – 3B

Number of Establishments in Puerto Rico, 2011
NAICS 313 - Textile Mills

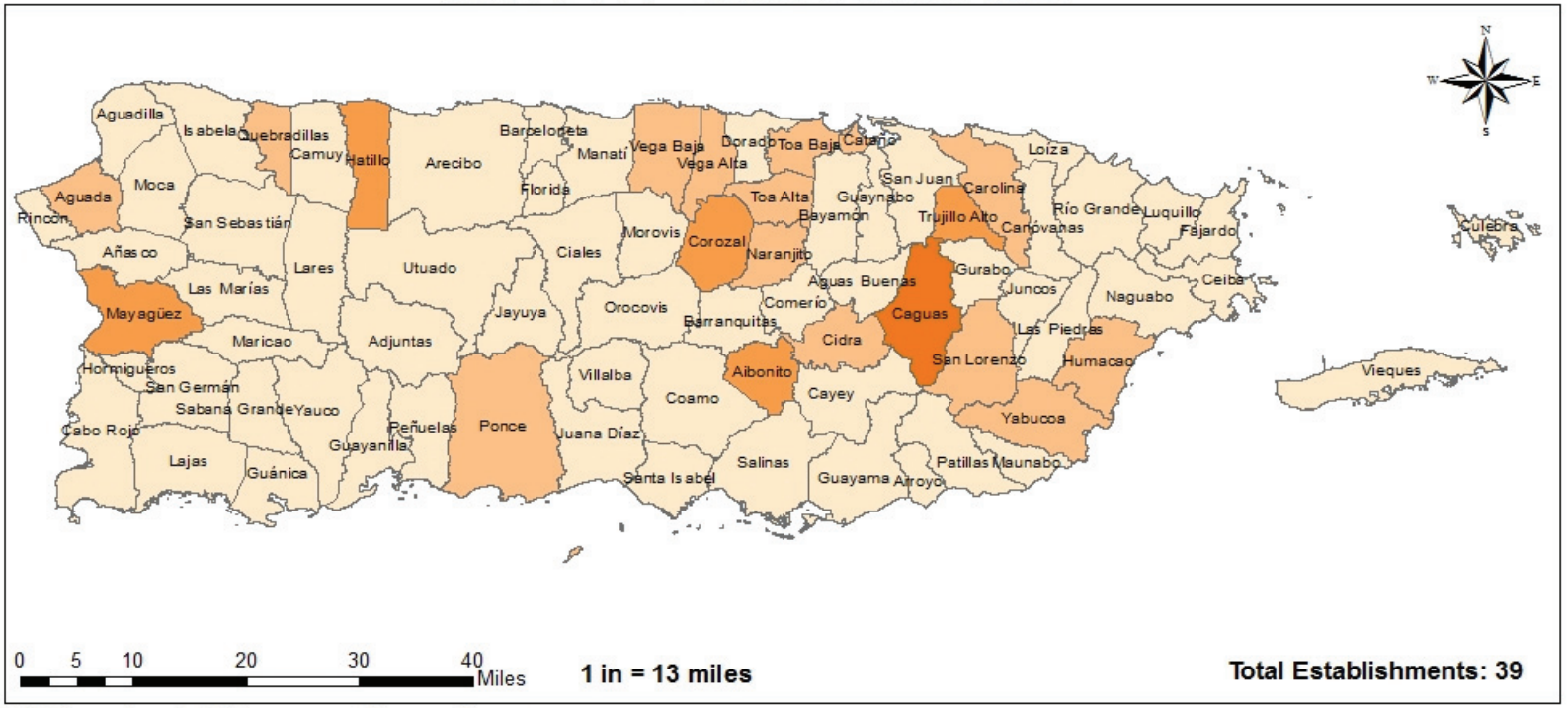


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	71
1	7

Map – 4B

Number of Establishments in Puerto Rico, 2011
NAICS 314 - Textile Product Mills

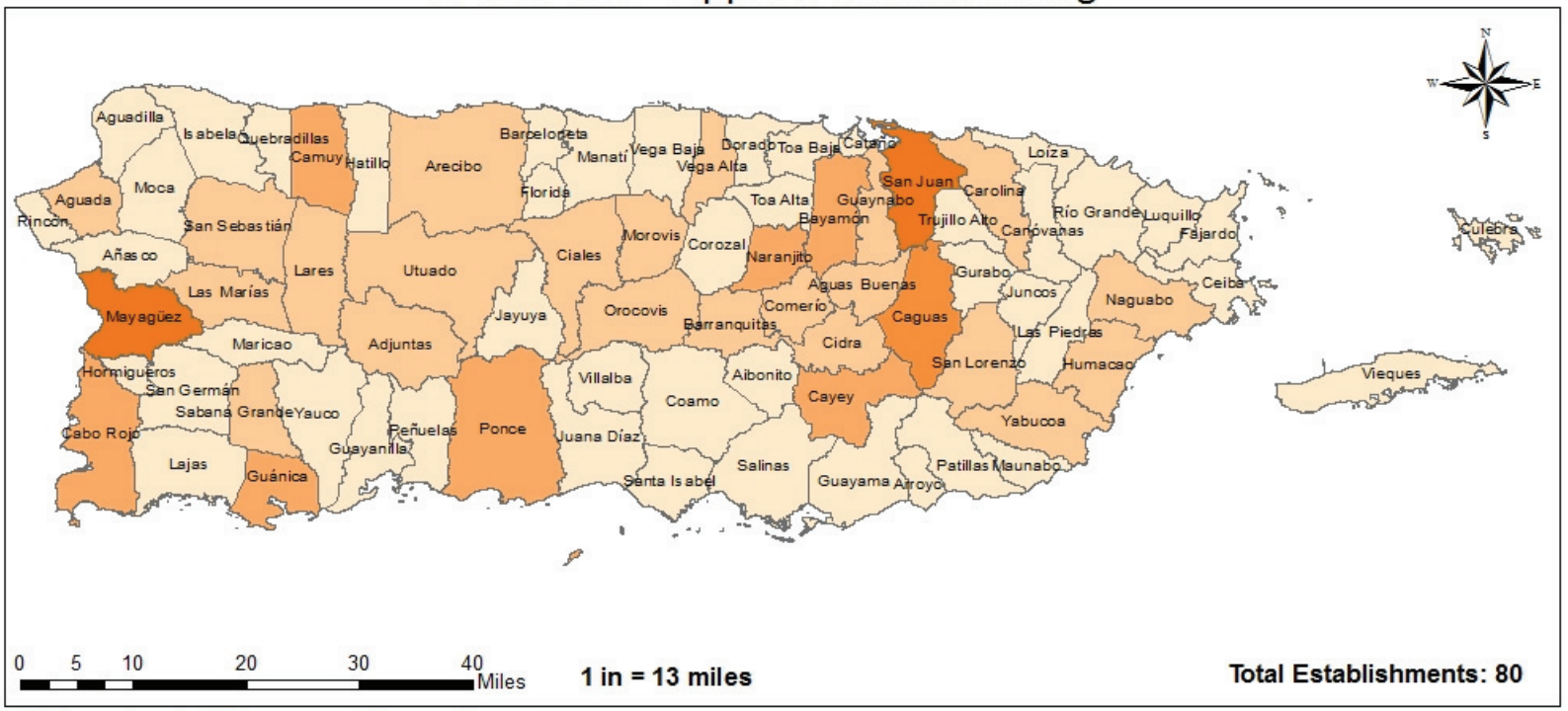


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	58
1	14
2	5
3	1

Map – 5B

Number of Establishments in Puerto Rico, 2011
NAICS 315 - Apparel Manufacturing

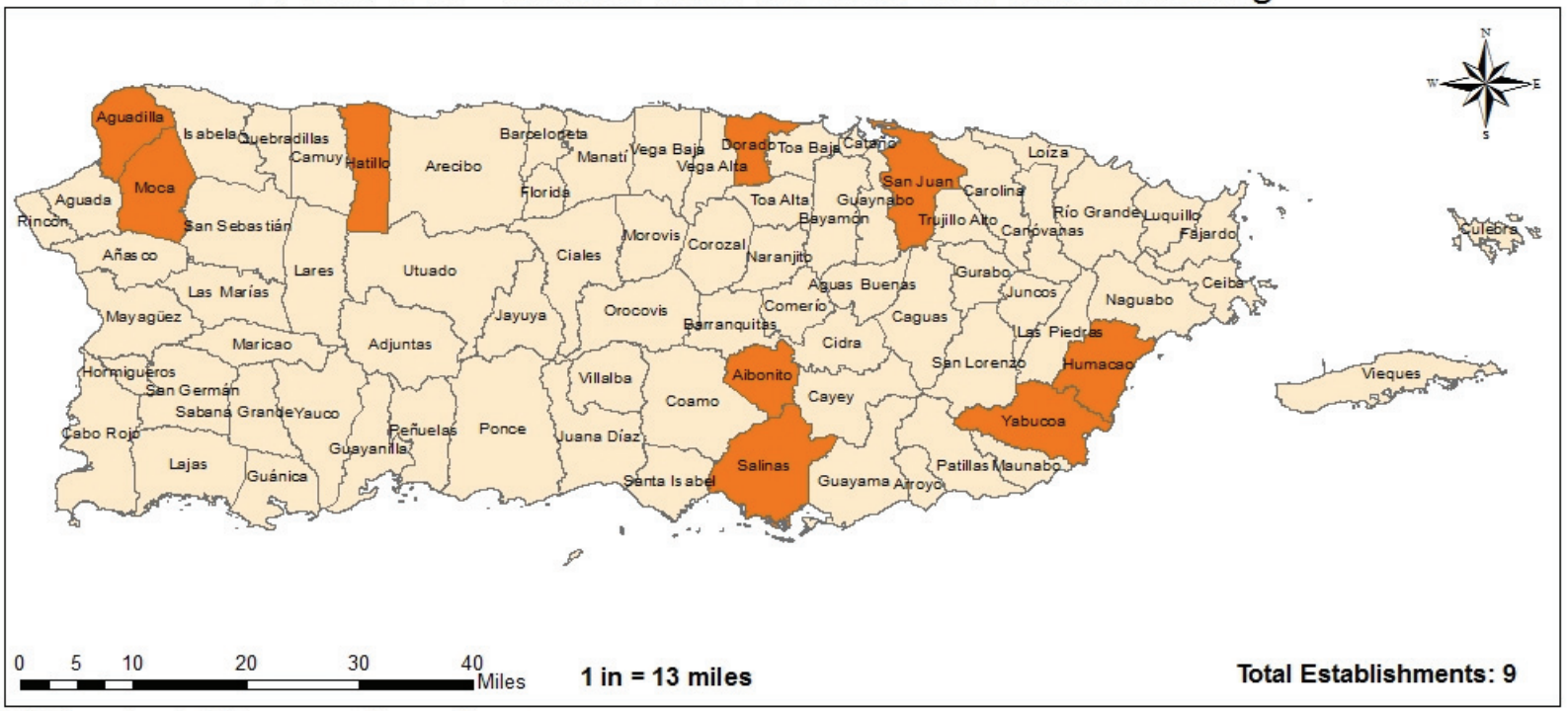


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	46
1 - 2	22
3 - 4	7
5 - 7	1
8 - 11	2

Map – 6B

Number of Establishments in Puerto Rico, 2011
NAICS 316 - Leather and Allied Product Manufacturing

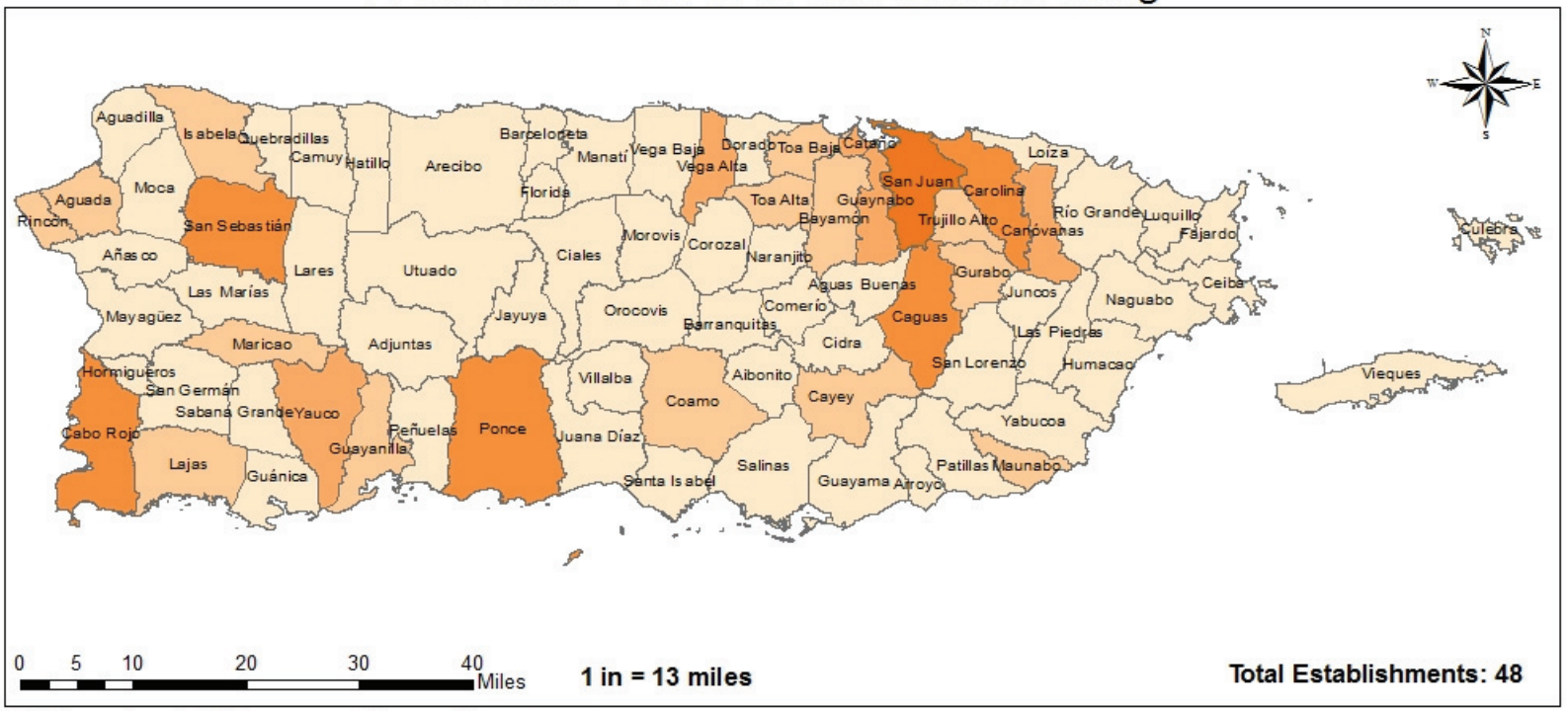


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	69
1	9

Map – 7B

Number of Establishments in Puerto Rico, 2011
NAICS 321 - Wood Product Manufacturing

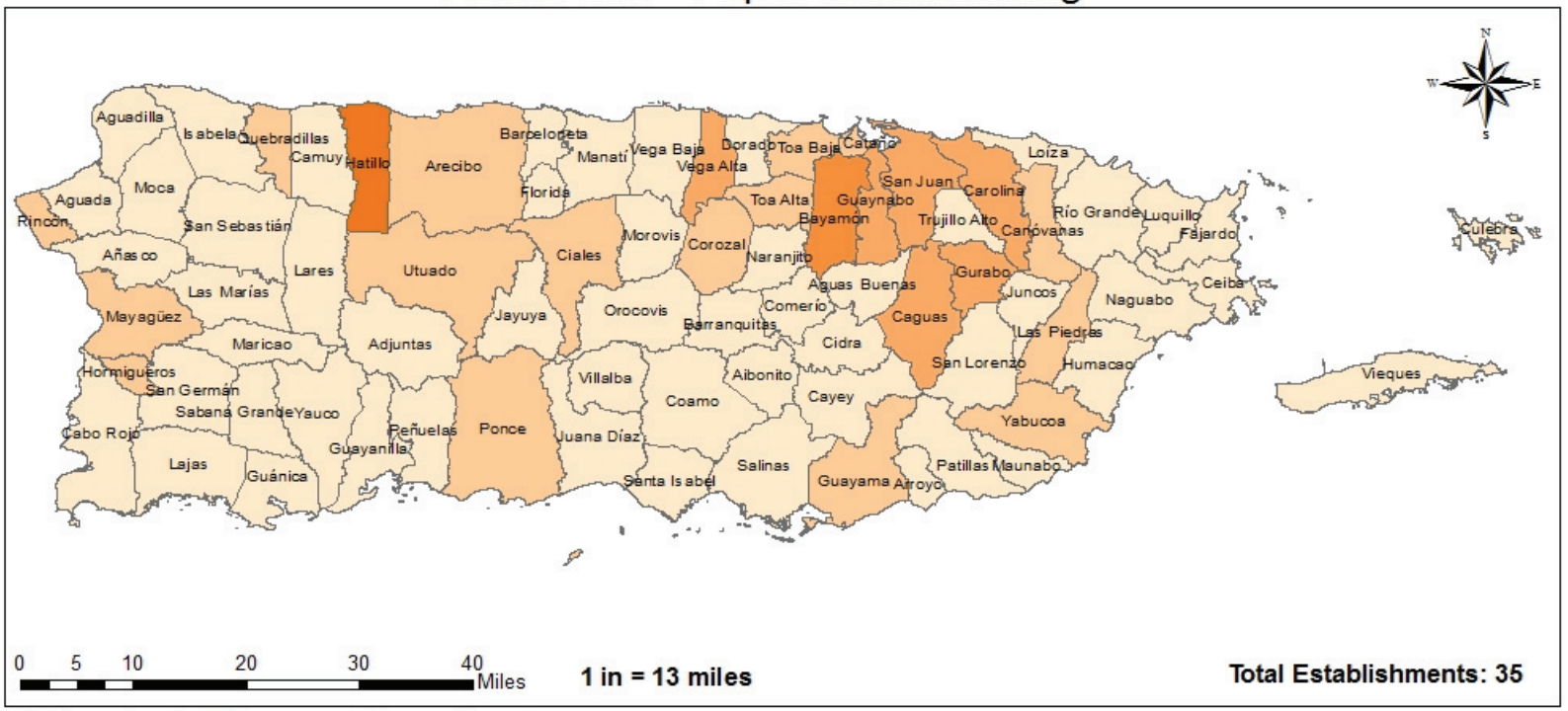


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	53
1	14
2	5
3 - 4	5
5 - 7	1

Map – 8B

Number of Establishments in Puerto Rico, 2011
NAICS 322 - Paper Manufacturing

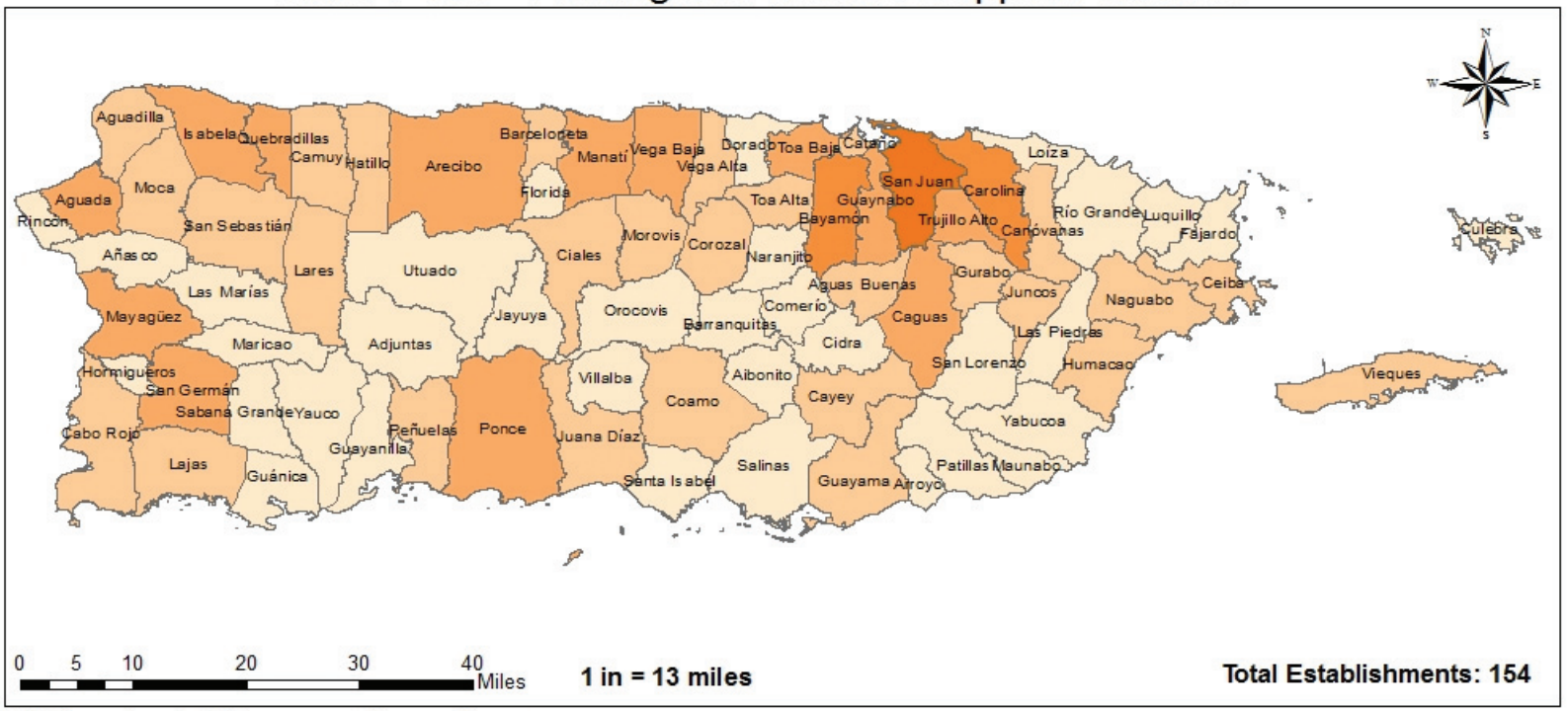


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	55
1	15
2	6
3	1
4	1

Map – 9B

Number of Establishments in Puerto Rico, 2011
NAICS 323 - Printing and Related Support Activities

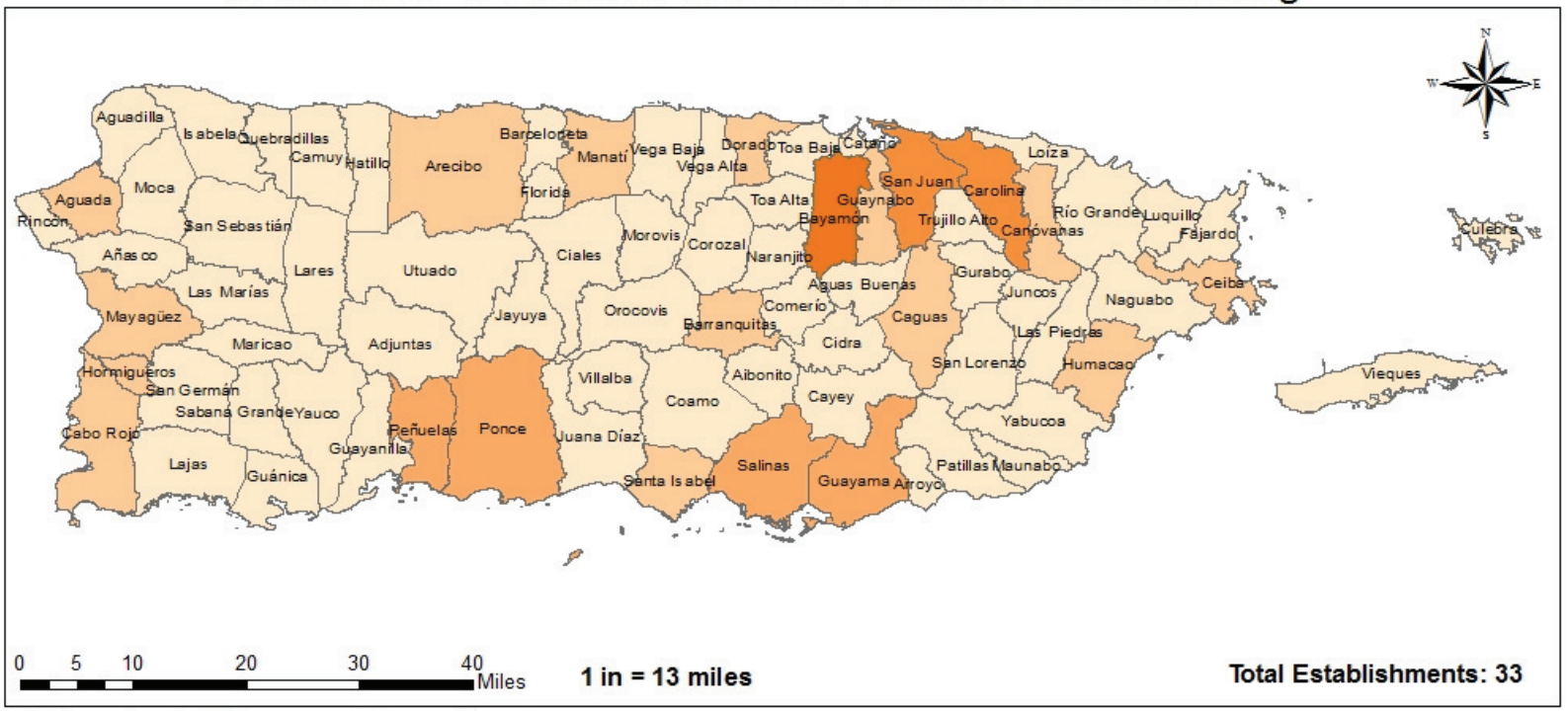


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	34
1 - 2	28
3 - 6	13
7 - 12	2
13 - 48	1

Map – 10B

Number of Establishments in Puerto Rico, 2011
NAICS 324 - Petroleum and Coal Products Manufacturing

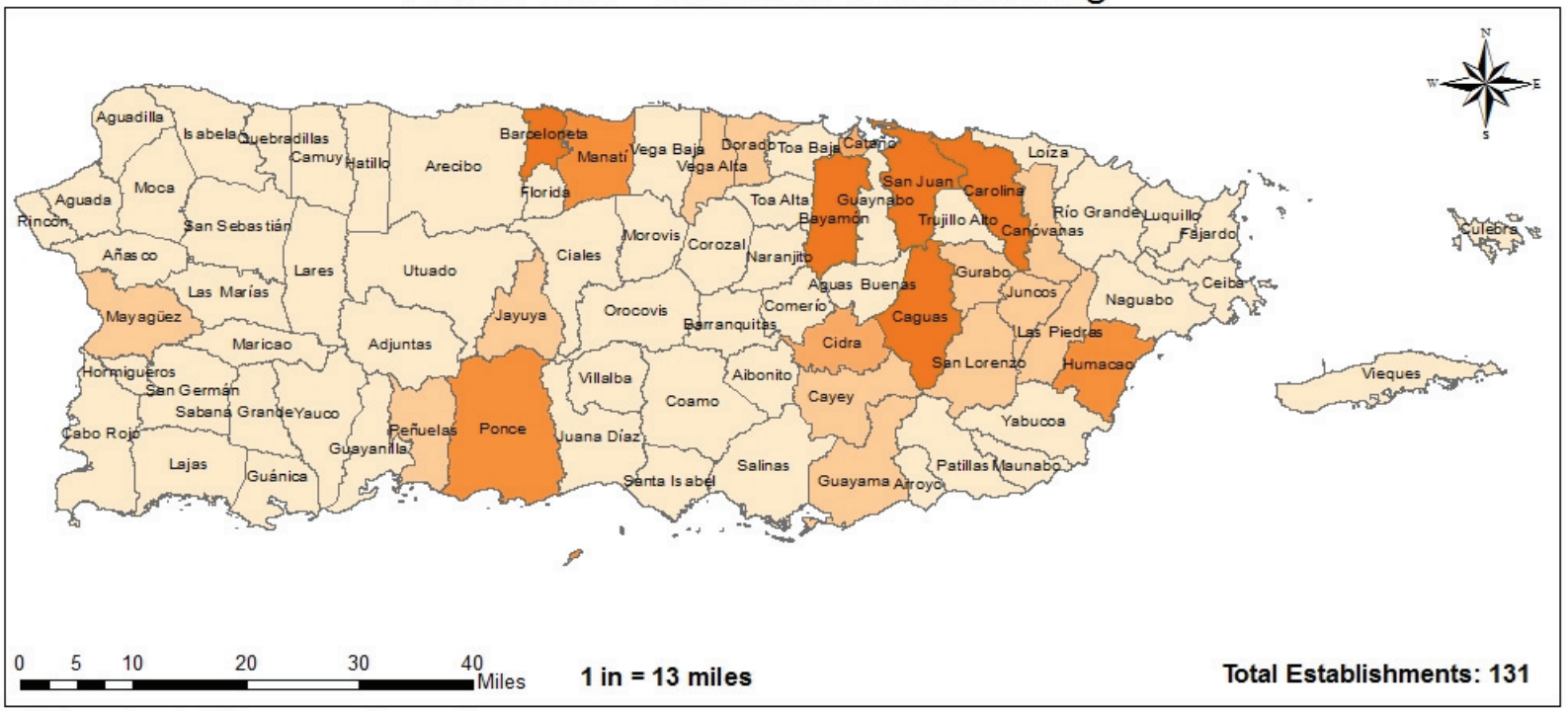


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	57
1	14
2	4
3	2
4 - 5	1

Map – 11B

Number of Establishments in Puerto Rico, 2011
NAICS 325 - Chemical Manufacturing

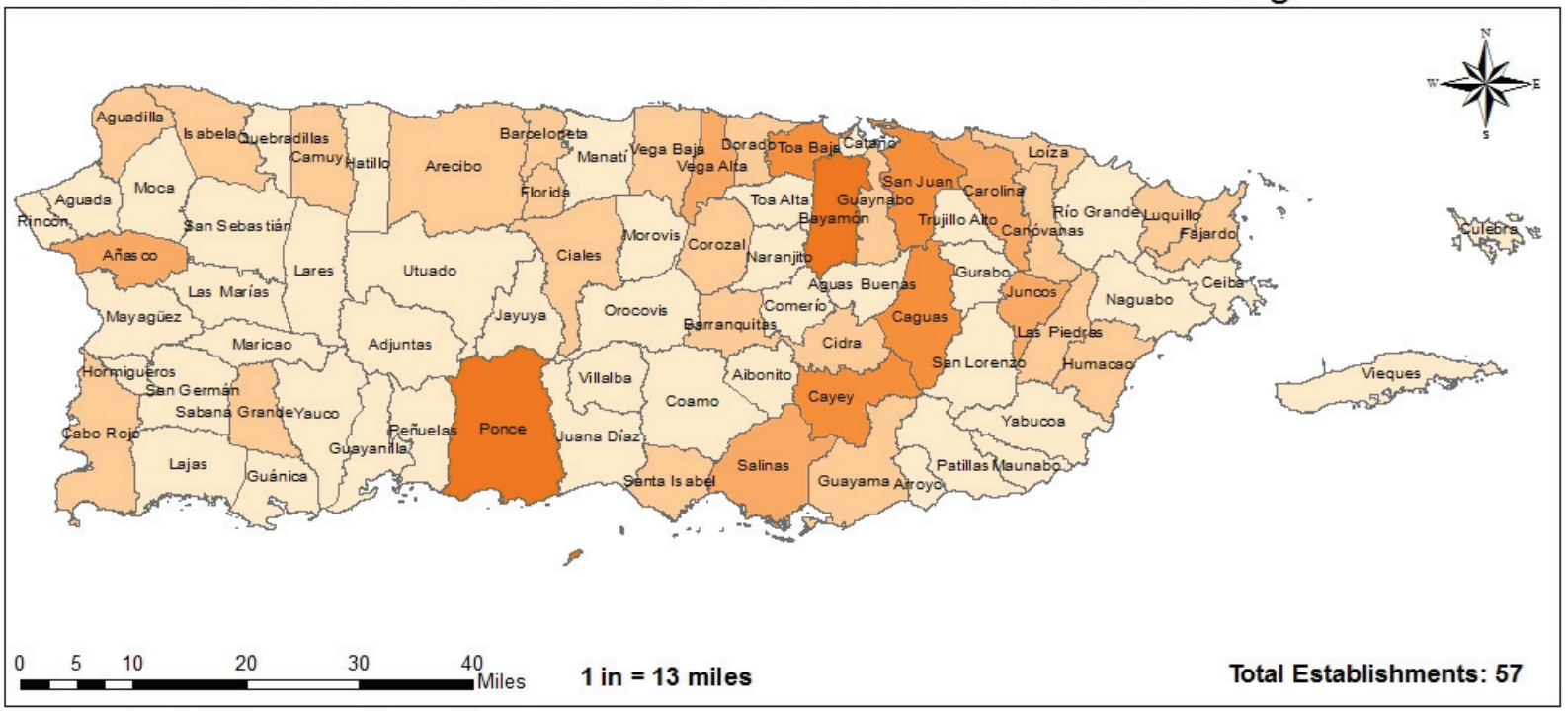


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0 - 1	56
2 - 3	12
4 - 5	2
6 - 7	3
8 - 12	5

Map – 12B

Number of Establishments in Puerto Rico, 2011
NAICS 326 - Plastics and Rubber Products Manufacturing

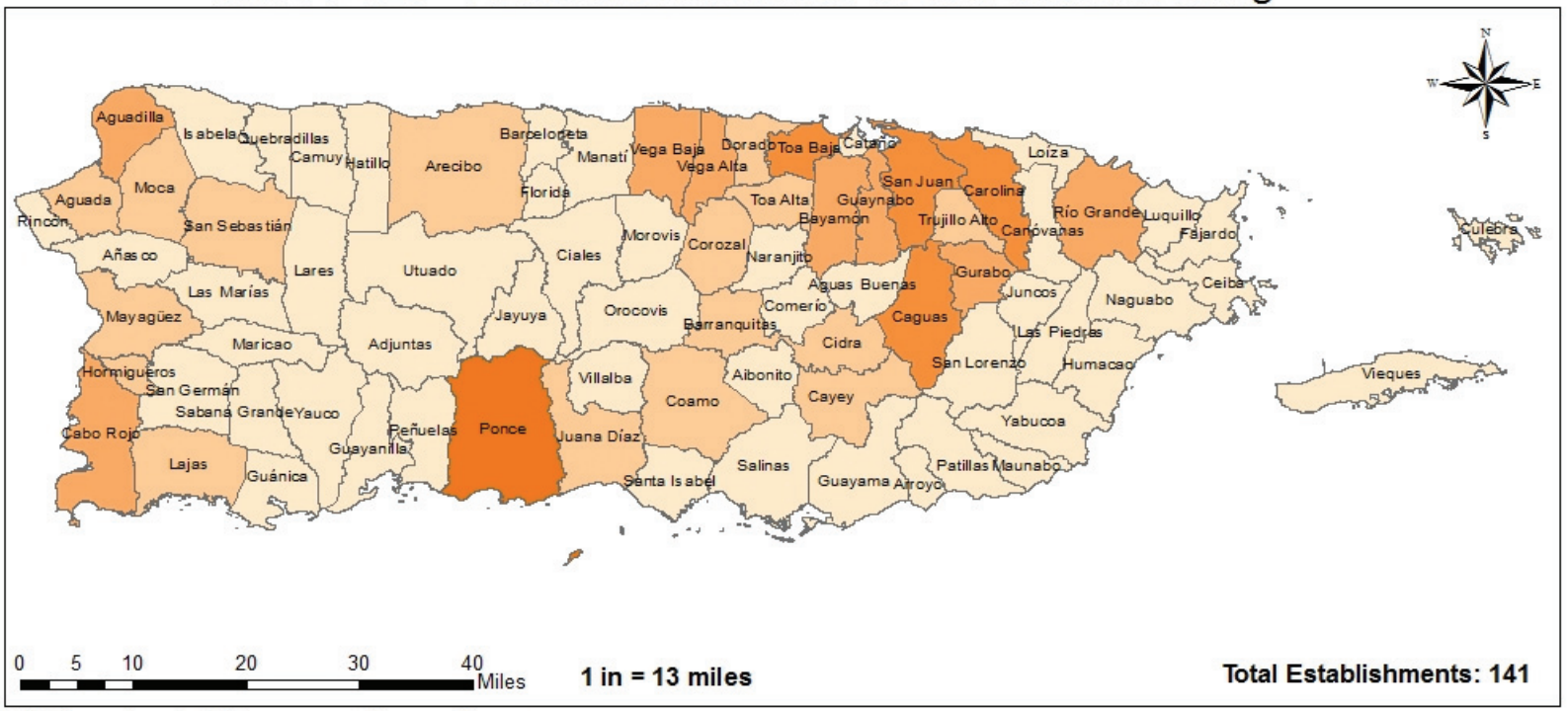


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	44
1	23
2	5
3 - 4	4
5 - 6	2

Map – 13B

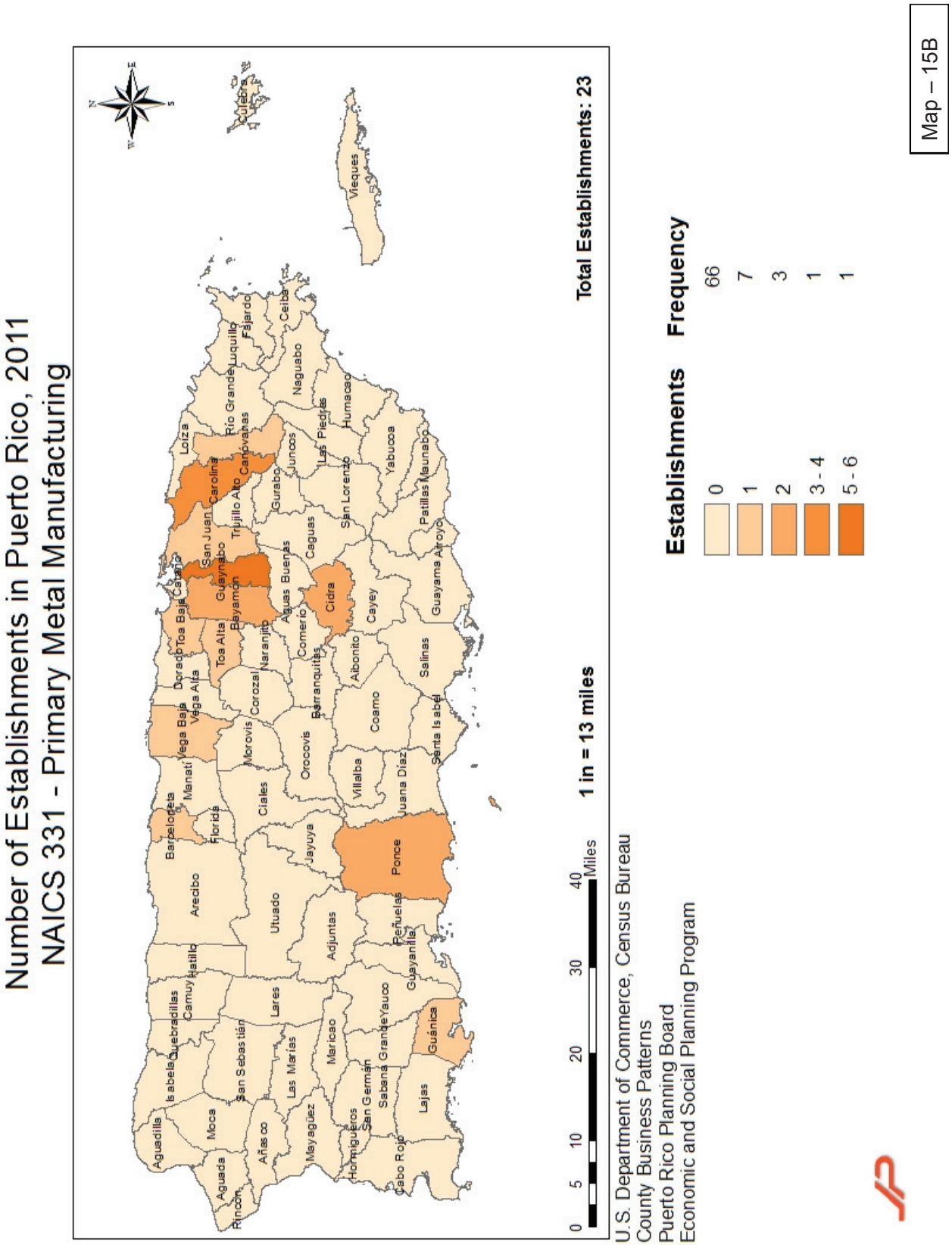
Number of Establishments in Puerto Rico, 2011
NAICS 327 - Nonmetallic Mineral Product Manufacturing



U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

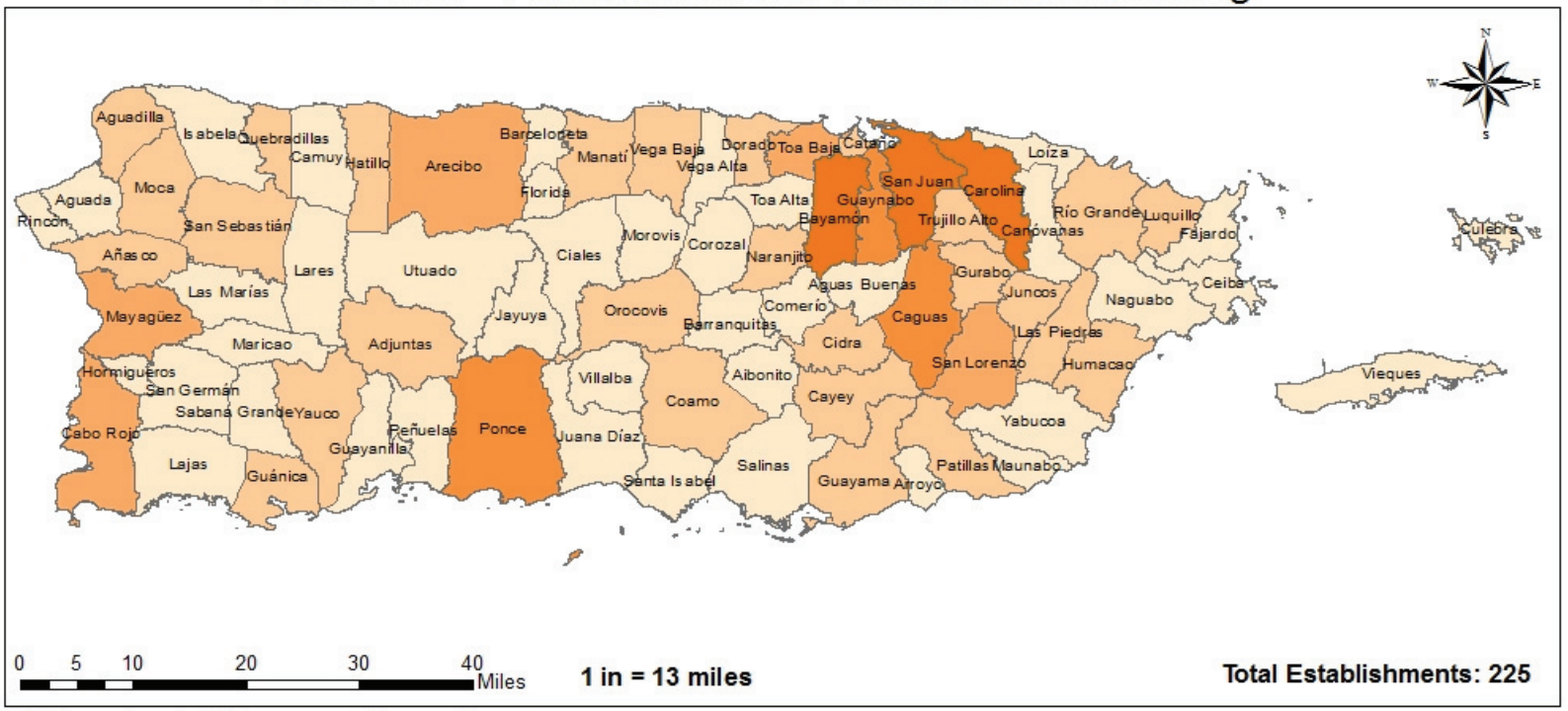
Establishments	Frequency
0 - 1	49
2 - 3	16
4 - 6	8
7 - 9	4
10 - 12	1

Map – 14B


Number of Establishments in Puerto Rico, 2011
NAICS 331 - Primary Metal Manufacturing
Total Establishments: 23
1 in = 13 miles
0 5 10 20 30 40 Miles
Establishments Frequency
0 66
1 7
2 3
3 - 4 1
5 - 6 1
U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Map – 15B

Number of Establishments in Puerto Rico, 2011
NAICS 332 - Fabricated Metal Product Manufacturing

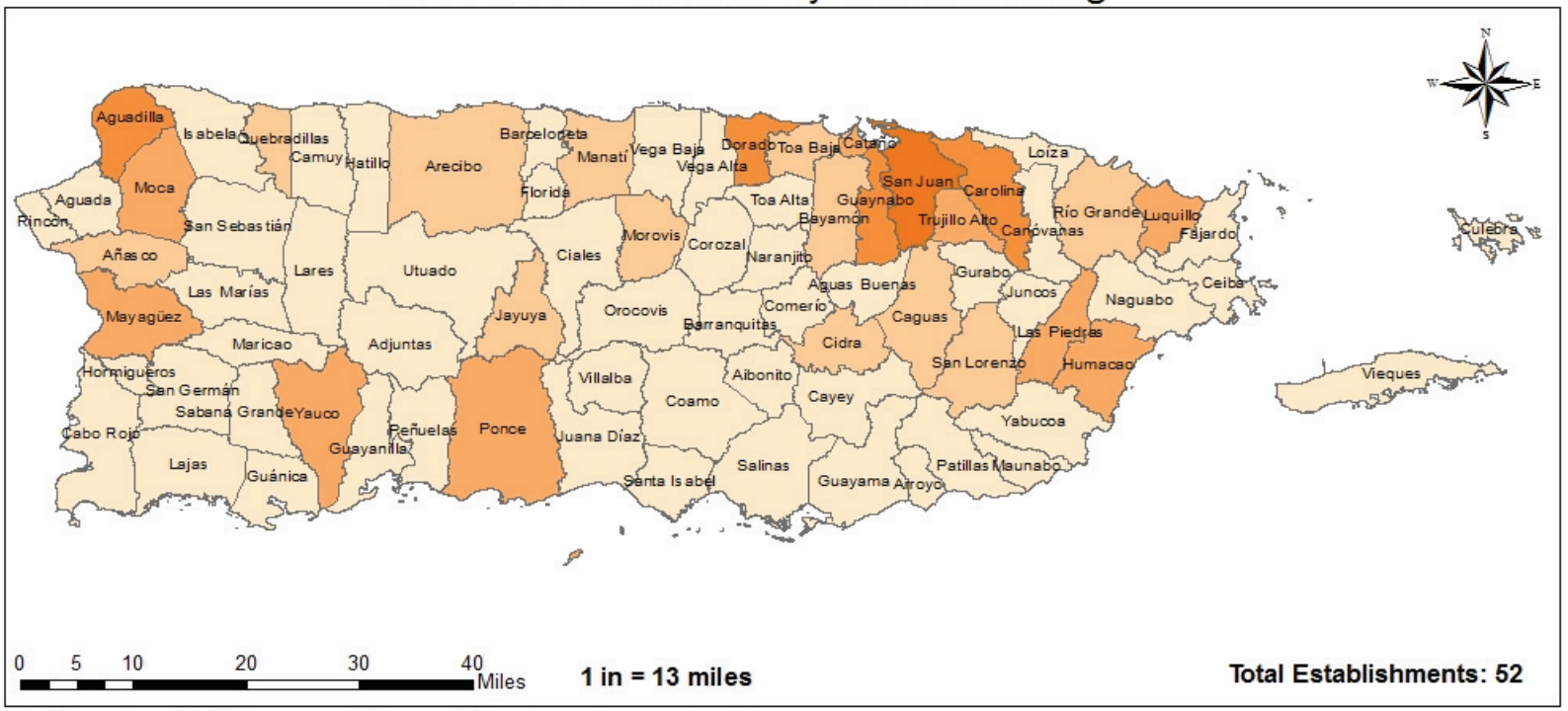


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0 - 1	40
2 - 4	27
5 - 8	5
9 - 14	3
15 - 22	3

Map – 16B

Number of Establishments in Puerto Rico, 2011
NAICS 333 - Machinery Manufacturing

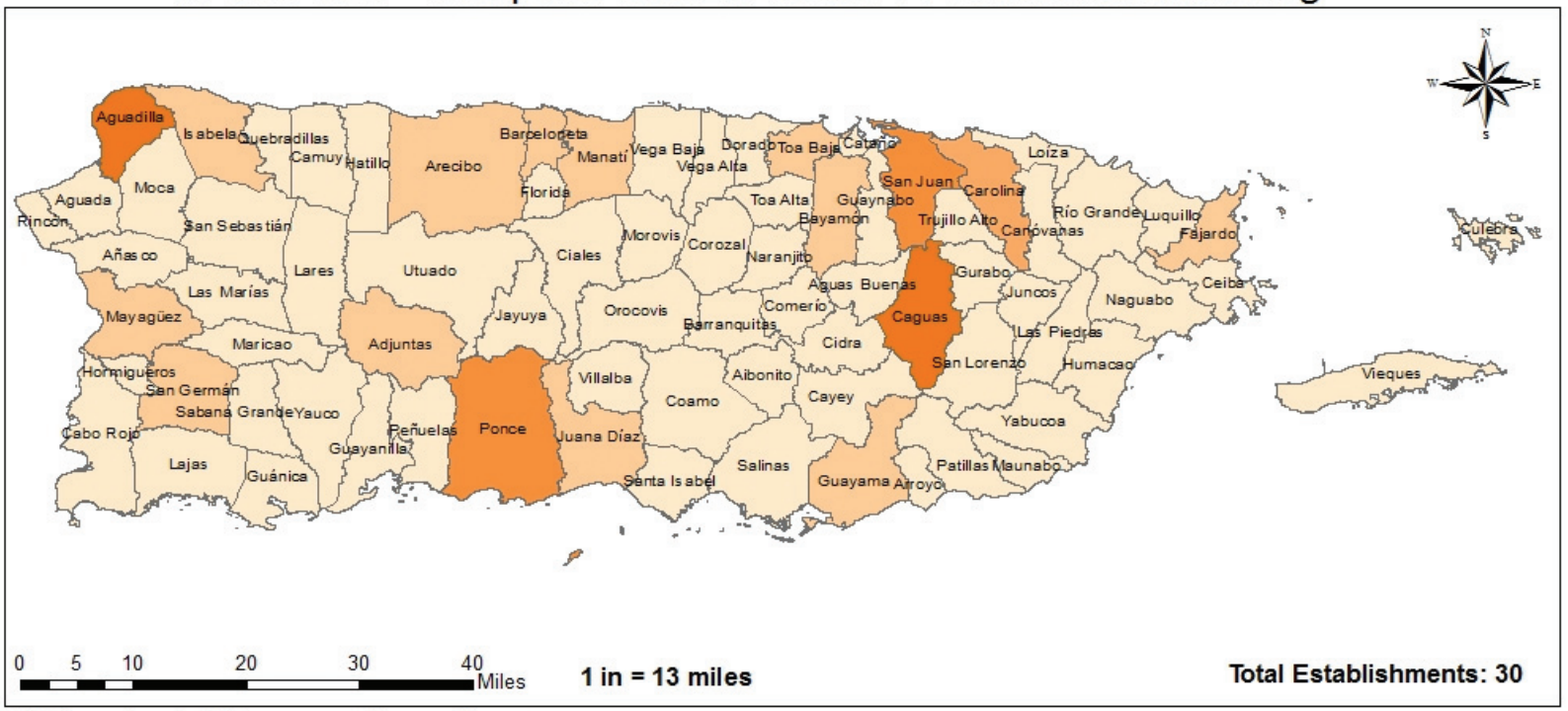


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	52
1	12
2	9
3 - 4	4
5 - 7	1

Map – 17B

Number of Establishments in Puerto Rico, 2011
NAICS 334 - Computer and Electronic Product Manufacturing

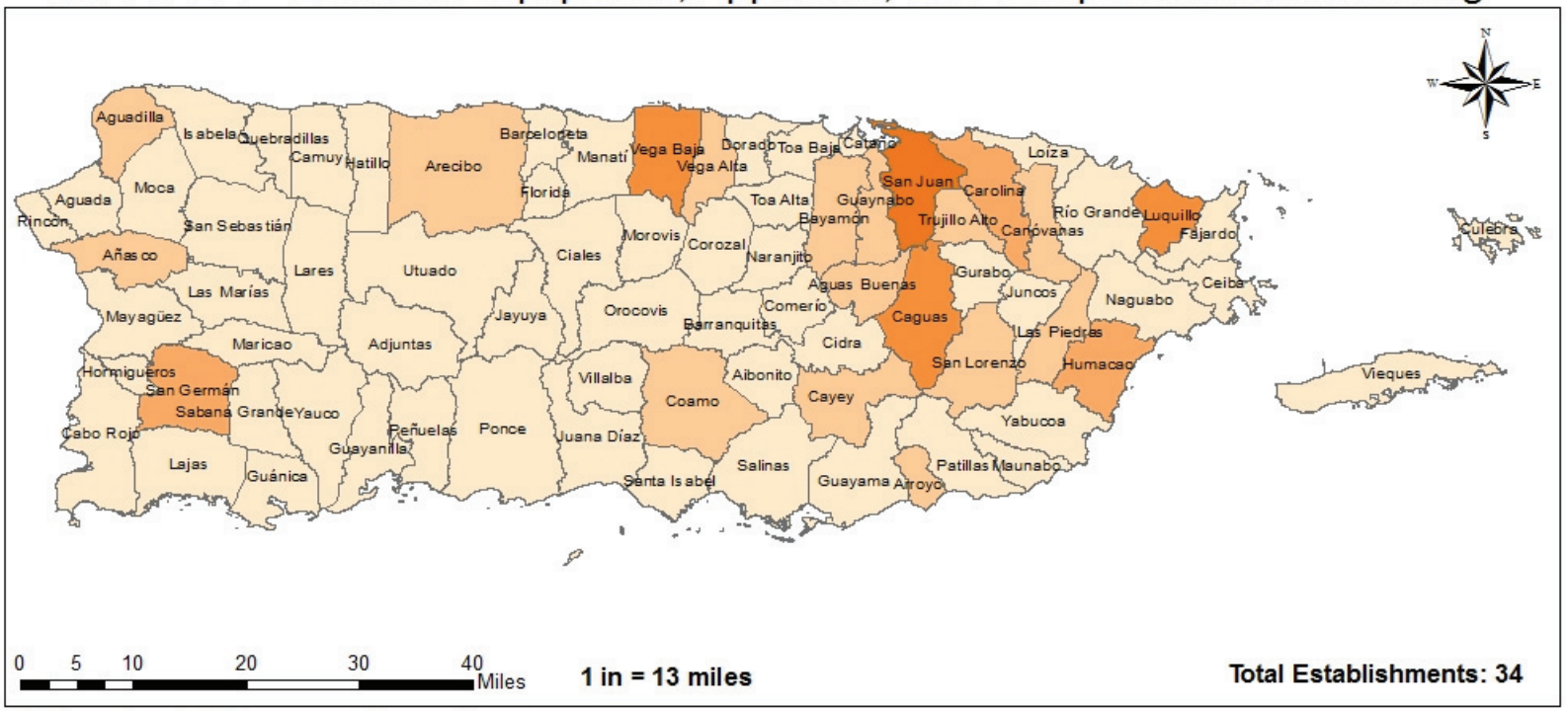


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	61
1	12
2	1
3	2
4 - 5	2

Map – 18B

Number of Establishments in Puerto Rico, 2011
NAICS 335 - Electrical Equipment, Appliance, and Component Manufacturing

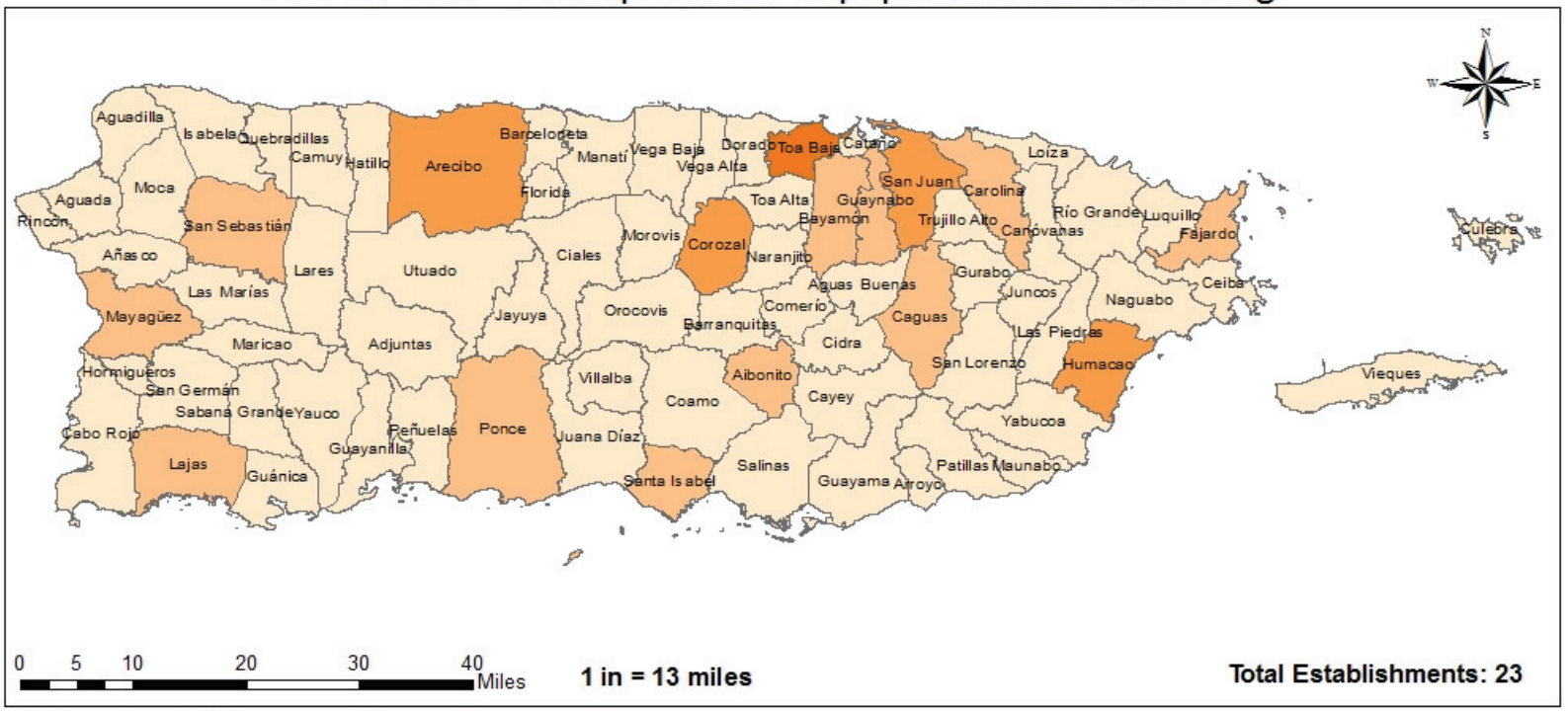


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	57
1	14
2	3
3	3
4 - 5	1

Map – 19B

Number of Establishments in Puerto Rico, 2011
NAICS 336 - Transportation Equipment Manufacturing

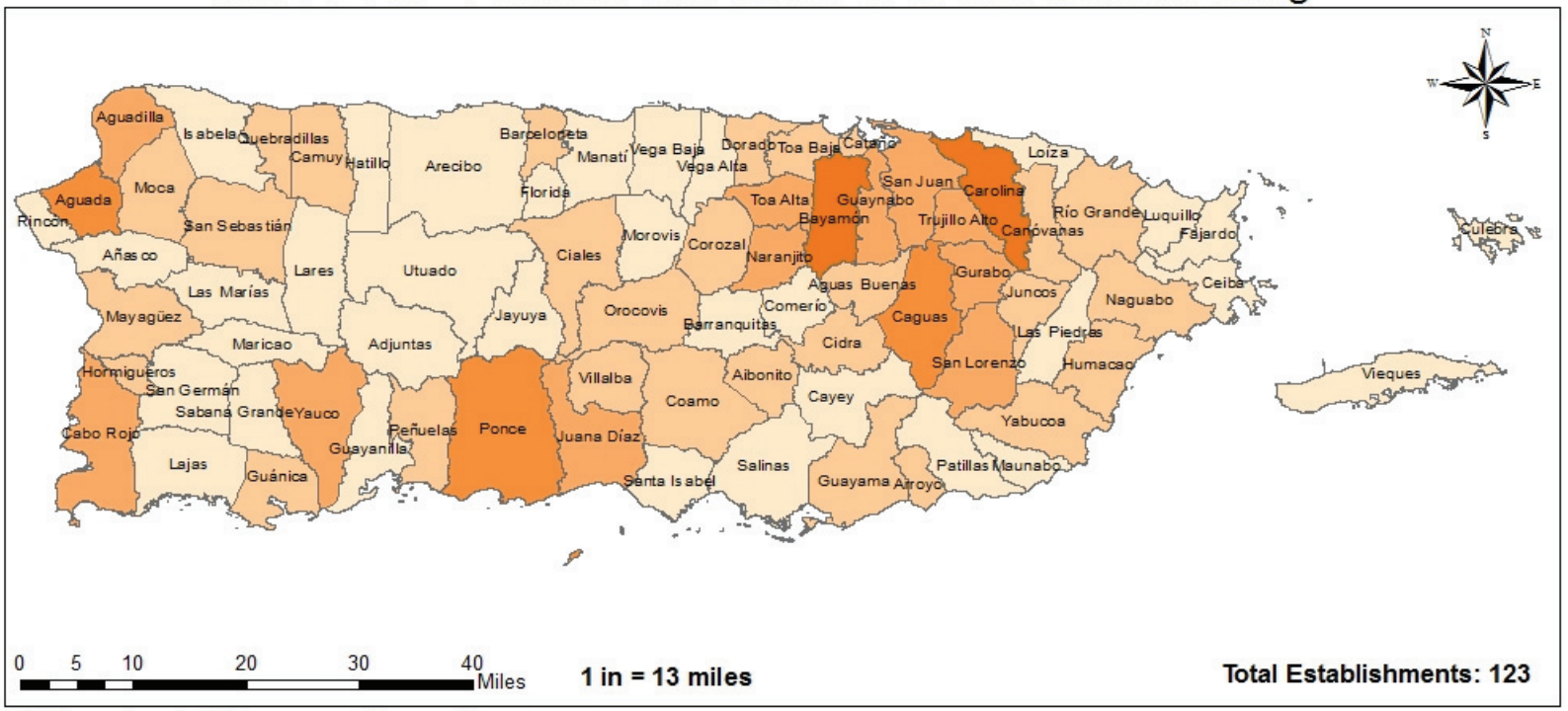


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	62
1	11
2	4
3	1

Map – 20B

Number of Establishments in Puerto Rico, 2011
NAICS 337 - Furniture and Related Product Manufacturing

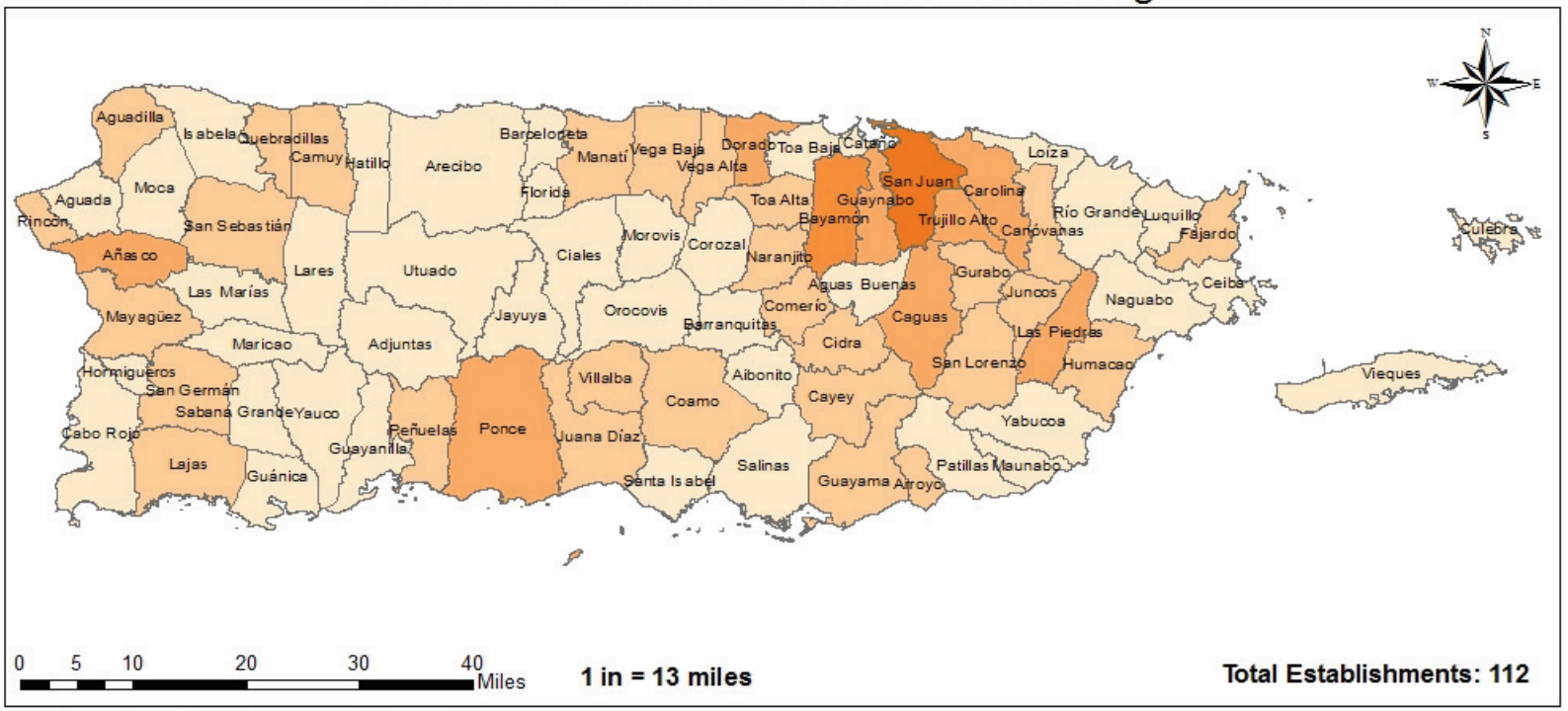


U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	35
1 - 2	27
3 - 5	11
6 - 8	3
9 - 11	2

Map – 21B

Number of Establishments in Puerto Rico, 2011
NAICS 339 - Miscellaneous Manufacturing



U.S. Department of Commerce, Census Bureau
County Business Patterns
Puerto Rico Planning Board
Economic and Social Planning Program

Establishments	Frequency
0	40
1 - 2	28
3 - 8	8
9 - 14	1
15 - 23	1

Map – 22B

Table E1-A:

Table E1-A presents the Annual Payroll per Employee for Puerto Rico, the United States of America, and selected states (Connecticut, Florida, Hawaii, Massachusetts, Mississippi, New York, and South Carolina) for the year 2011. Annual Payroll per Employee was calculated by dividing the Total Annual Payroll with the Total Number of Employees for each sector and sub-sector. Results were calculated by the Puerto Rico Planning Board with data obtained from the U.S. Census - County Business Patterns.

Table E1-B:

Table E1-B presents the Annual Payroll per Employee in Puerto Rico as a proportion of the Annual Payroll per Employee for the United States of America and selected states (Connecticut, Florida, Hawaii, Massachusetts, Mississippi, New York, and South Carolina) for the year 2011. The proportion was calculated by dividing the Annual Payroll per Employee for Puerto Rico by the Annual Payroll per Employee for the observed regions. The table compares the proportion of Annual Payroll per Employee in Puerto Rico between all the observed regions. Results were calculated by the Puerto Rico Planning Board with data obtained from the U.S. Census - County Business Patterns.

Figure E1:

Figure E1 presents selected variables (Total Number of Employees, Total Annual Payroll, and Total Number of Establishments) as a proportion of the total of all sectors for that variable, in the year 2011. The proportion was calculated by dividing the selected variable for the sector by the selected variable for the total of all sectors of the observed region (Puerto Rico, United States of America, Connecticut, Florida, Hawaii, Massachusetts, Mississippi, New York and South Carolina). Results were calculated by the Puerto Rico Planning Board with data obtained from the U.S. Census - County Business Patterns.

Table E2-A:

Table E2-A presents the Total Number of Employees as a proportion of the Total Number of Employees for all sectors of the observed region (Puerto Rico, United States of America, Connecticut, Florida, Hawaii, Massachusetts, Mississippi, New York, and South Carolina) in the year 2011. The proportion was calculated by dividing the Total Number of Employees of the sector and its sub-sectors by the Total Number of Employees for all sectors of the observed region. Results were calculated by the Puerto Rico Planning Board with data obtained from the U.S. Census - County Business Patterns.

Table E2-B:

Table E2-B presents the Total Annual Payroll as a proportion of the Total Annual Payroll for all sectors of the observed region (Puerto Rico, United States of America, Connecticut, Florida, Hawaii, Massachusetts, Mississippi, New York, and South Carolina) in the year 2011. The proportion was calculated by dividing the Total Annual Payroll of the sector and its sub-sectors by the Total Annual Payroll for all sectors of the observed region. Results were calculated by the Puerto Rico Planning Board with data obtained from the U.S. Census - County Business Patterns.

Table E2-C:

Table E2-C presents the Total Number of Establishments as a proportion of the Total Number of Establishments for all sectors of the observed region (Puerto Rico, United States of America, Connecticut, Florida, Hawaii, Massachusetts, Mississippi, New York, and South Carolina) in the year 2011. The proportion was calculated by dividing the Total

Number of Establishments of the sector and its sub-sectors by the Total Number of Establishments for all sectors of the observed region. Results were calculated by the Puerto Rico Planning Board with data obtained from the U.S. Census - County Business Patterns.

Slides E8 – E35

The Figures in Slide E8 - E35 present the Location Quotient (LQ) of Puerto Rico with selected states (Connecticut, Florida, Hawaii, Massachusetts, Mississippi, New York, and South Carolina) for the year 2011. LQ is a way of quantifying how concentrated an industry is in a region compared to another region. Location Quotient (LQ) is calculated as a percentage share of the total of the observed variable for the sector or sub-sector in Puerto Rico, divided by the percentage share of the total of the same observed variable for the same sector or sub-sector of another region. LQ was calculated for the variables: Numbers of Employees, Total Annual Payroll, Number of Establishments, and Annual Payroll per Employee. Annual Payroll per Employee in Puerto Rico is also presented as a proportion of the Annual Payroll per Employee for the sector and its sub-sectors for the selected states. The proportion was calculated by dividing the Annual Payroll per Employee for Puerto Rico by the Annual Payroll per Employee for the observed state. Results were calculated by the Puerto Rico Planning Board with data obtained from the U.S. Census - County Business Patterns.

Table E3:

Table E3 presents selected Location Quotient (LQ) combinations for Puerto Rico and the selected states (Connecticut, Florida, Hawaii, Massachusetts, Mississippi, New York, and South Carolina). LQ is a way of quantifying how concentrated an industry is in a region compared to another region. Location Quotient (LQ) is calculated as a percentage share of the total of the observed variable for the sector or sub-sector in Puerto Rico, divided by the percentage share of the total of the same observed variable for the same sector or sub-sector of another region. The combinations detailed in the Table Legend are:

A. LQ of Numbers of Employees, Total Annual Payroll, Number of Establishments, and Payroll per Employee: 1 or higher
B. LQ of Numbers of Employees, Total Annual Payroll, Number of Establishments, and Payroll per Employee: 1 or lower
C. LQ of Numbers of Employees and Payroll per Employee: 1 or lower

The sector and sub-sectors that meet the criteria for any of the combinations are highlighted for each state. Results were calculated by the Puerto Rico Planning Board with data obtained from the U.S. Census - County Business Patterns.

Table E4-A:

Table E4-A presents the Location Quotient (LQ) of Annual Payroll per Employee of Puerto Rico and selected states (Connecticut, Florida, Hawaii, Massachusetts, Mississippi, New York, and South Carolina) for the sector and its sub-sectors that are lower than 1. LQ is a way of quantifying how concentrated an industry is in a region compared to another region. Location Quotient (LQ) is calculated as a percentage share of the total of the observed variable for the sector or sub-sector in Puerto Rico, divided by the percentage share of the total of the same observed variable for the same sector or sub-sector of another region. Results were calculated by the Puerto Rico Planning Board with data obtained from the U.S. Census - County Business Patterns.

Table E4-B:

Table E4-B presents the Location Quotient (LQ) of Annual Payroll per Employee of Puerto Rico and selected states (Connecticut, Florida, Hawaii, Massachusetts, Mississippi, New York, and South Carolina) for the sector and its sub-sectors that are 1.5 or higher. LQ is a way of quantifying how concentrated an industry is in a region compared to another region. Location Quotient (LQ) is calculated as a percentage share of the total of the observed variable for the sector or sub-sector in Puerto Rico, divided by the percentage share of the total of the same observed variable for the same sector or sub-sector of another region. Results were calculated by the Puerto Rico Planning Board with data obtained from the U.S. Census - County Business Patterns.

Appendix E
Locational Quotients (LQ's) for some U.S. States

Table E1-A: Annual Payroll per Employee
NAICS 31 - Manufacturing Sector and Sub-Sectors
Puerto Rico, United States, and Selected States, 2011

Industrial Sector	Puerto Rico	United States	Connecticut	Florida	Hawaii	Massachusetts	Mississippi	New York	South Carolina
31 - Manufacturing	$ 35,482	$ 52,330	$ 63,911	$ 48,791	$ 37,275	$ 65,524	$ 41,561	$ 51,341	$ 47,494
311 - Food manufacturing	$ 24,698	$ 38,107	$ 38,301	$ 40,390	$ 28,491	$ 40,863	$ 26,606	$ 37,568	$ 29,857
312 - Beverage and tobacco product manufacturing	$ 31,212	$ 50,662	$ 48,936	$ 51,216	$ 37,534	$ 57,924	$ 35,501	$ 46,707	N/D
313 - Textile mills	$ 13,238	$ 38,028	$ 48,335	$ 31,404	N/D	$ 48,708	N/D	$ 48,561	$ 36,552
314 - Textile product mills	$ 17,310	$ 32,087	$ 39,391	$ 29,887	$ 26,492	$ 32,872	$ 29,682	$ 36,953	$ 28,073
315 - Apparel manufacturing	$ 17,128	$ 26,046	N/D	$ 24,689	$ 23,788	$ 30,851	$ 21,984	$ 26,574	$ 24,814
316 - Leather and allied product manufacturing	$ 14,636	$ 33,425	N/D	$ 32,812	N/D	$ 33,041	N/D	$ 31,116	N/D
321 - Wood product manufacturing	$ 21,656	$ 35,196	$ 43,239	$ 31,985	$ 27,390	$ 41,144	$ 34,726	$ 33,518	$ 38,079
322 - Paper manufacturing	$ 25,094	$ 54,874	$ 59,760	$ 57,139	N/D	$ 53,810	$ 57,874	$ 51,289	$ 59,825
323 - Printing and related support activities	$ 28,316	$ 41,415	$ 45,793	$ 36,589	$ 34,064	$ 44,647	$ 30,085	$ 42,580	$ 37,973
324 - Petroleum and coal products manufacturing	$ 34,524	$ 89,317	$ 75,697	$ 47,869	N/D	$ 63,582	N/D	$ 66,272	$ 46,078
325 - Chemical manufacturing	$ 56,601	$ 71,446	$ 66,681	$ 56,024	N/D	$ 85,377	$ 59,104	$ 61,471	$ 59,355
326 - Plastics and rubber products manufacturing	$ 29,320	$ 43,660	$ 50,927	$ 40,134	$ 37,650	$ 53,174	$ 38,254	$ 44,595	$ 48,710
327 - Nonmetallic mineral product manufacturing	$ 25,990	$ 46,819	$ 59,706	$ 39,820	N/D	$ 53,333	$ 41,332	$ 50,969	$ 44,926
331 - Primary metal manufacturing	$ 18,824	$ 58,839	$ 64,081	$ 48,567	N/D	$ 51,209	$ 52,243	$ 60,088	$ 65,922
332 - Fabricated metal product manufacturing	$ 21,845	$ 48,343	$ 57,358	$ 42,097	$ 49,681	$ 56,700	$ 44,132	$ 48,301	$ 44,313
333 - Machinery manufacturing	$ 32,331	$ 57,487	$ 72,017	$ 56,524	N/D	$ 75,374	$ 41,948	$ 59,893	$ 45,337
334 - Computer and electronic product manufacturing	$ 39,212	$ 75,363	$ 72,760	$ 69,148	N/D	$ 93,575	$ 40,381	$ 73,232	$ 56,206
335 - Electrical equipment, appliance, and component manufacturing	$ 29,869	$ 52,052	$ 59,035	$ 44,082	N/D	$ 62,875	$ 44,620	$ 52,536	$ 50,552
336 - Transportation equipment manufacturing	$ 32,166	$ 62,185	N/D	$ 51,559	N/D	$ 81,156	$ 57,508	$ 60,172	$ 59,225
337 - Furniture and related product manufacturing	$ 17,624	$ 36,711	$ 44,673	$ 32,685	$ 39,282	$ 46,942	$ 28,019	$ 40,060	$ 33,468
339 - Miscellaneous manufacturing	$ 34,165	$ 51,037	$ 54,853	$ 51,499	$ 29,479	$ 59,049	$ 36,709	$ 47,206	$ 39,721

Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

*N/D No Data

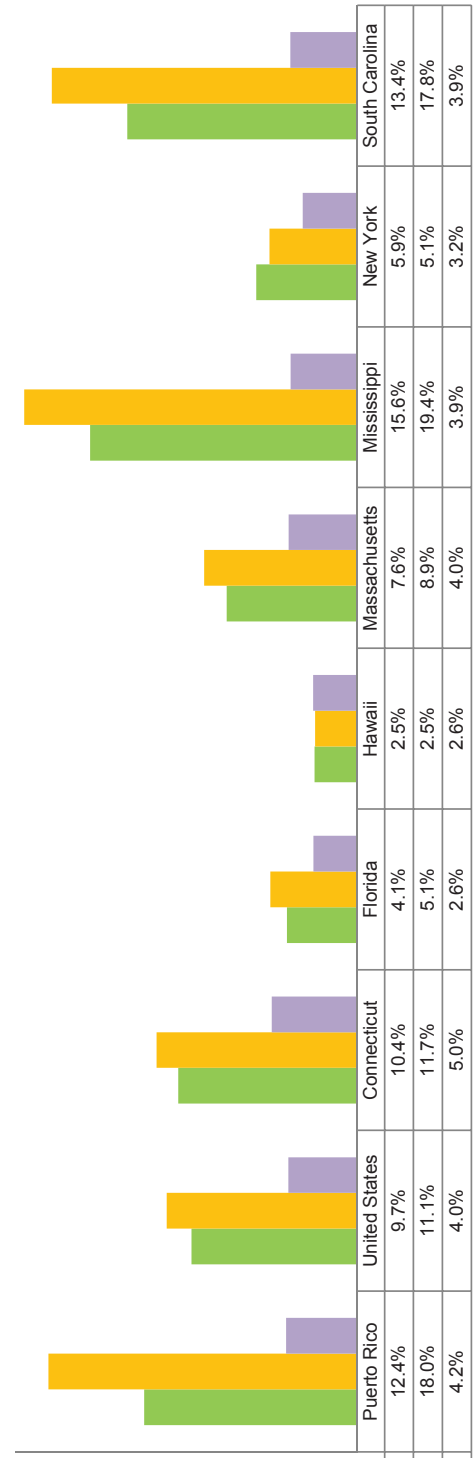
Table E1-B: Puerto Rico Annual Payroll per Employee as a Proportion of the United States and Selected States, 2011
NAICS 31 - Manufacturing Sector and Sub-Sectors

Industrial Sector	United States	Connecticut	Florida	Hawaii	Massachusetts	Mississippi	New York	South Carolina
31 - Manufacturing	68%	56%	73%	95%	54%	85%	69%	75%
311 - Food manufacturing	65%	64%	61%	87%	60%	93%	66%	83%
312 - Beverage and tobacco product manufacturing	62%	64%	61%	83%	54%	88%	67%	N/D
313 - Textile mills	35%	27%	N/D	N/D	27%	N/D	27%	36%
314 - Textile product mills	54%	44%	58%	65%	53%	58%	47%	62%
315 - Apparel manufacturing	66%	N/D	69%	72%	56%	78%	64%	69%
316 - Leather and allied product manufacturing	44%	N/D	45%	N/D	44%	N/D	47%	N/D
321 - Wood product manufacturing	62%	50%	68%	79%	53%	62%	65%	57%
322 - Paper manufacturing	46%	42%	44%	N/D	47%	43%	49%	42%
323 - Printing and related support activities	68%	62%	77%	83%	63%	94%	67%	75%
324 - Petroleum and coal products manufacturing	39%	46%	72%	N/D	54%	N/D	52%	75%
325 - Chemical manufacturing	79%	85%	101%	N/D	66%	96%	92%	95%
326 - Plastics and rubber products manufacturing	67%	58%	73%	78%	55%	77%	66%	60%
327 - Nonmetallic mineral product manufacturing	56%	44%	65%	N/D	49%	63%	51%	58%
331 - Primary metal manufacturing	32%	29%	39%	N/D	37%	36%	31%	29%
332 - Fabricated metal product manufacturing	45%	38%	52%	44%	39%	49%	45%	49%
333 - Machinery manufacturing	56%	45%	57%	N/D	43%	77%	54%	71%
334 - Computer and electronic product manufacturing	52%	54%	57%	N/D	42%	97%	54%	70%
335 - Electrical equipment, appliance, and component manufacturing	57%	51%	68%	N/D	48%	67%	57%	59%
336 - Transportation equipment manufacturing	52%	N/D	62%	N/D	40%	56%	53%	54%
337 - Furniture and related product manufacturing	48%	39%	54%	45%	38%	63%	44%	53%
339 - Miscellaneous manufacturing	67%	62%	66%	116%	58%	93%	72%	86%

Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

*N/D No Data

Figure E1: Selected Variables as a Proportion of the Total for all Sectors
NAICS 31- Manufacturing
Puerto Rico, United States, and Selected States, 2011



	Puerto Rico	United States	Connecticut	Florida	Hawaii	Massachusetts	Mississippi	New York	South Carolina
Employee	12.4%	9.7%	10.4%	4.1%	2.5%	7.6%	15.6%	5.9%	13.4%
Payroll	18.0%	11.1%	11.7%	5.1%	2.5%	8.9%	19.4%	5.1%	17.8%
Establishments	4.2%	4.0%	5.0%	2.6%	2.6%	4.0%	3.9%	3.2%	3.9%

Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Table E2-A: Employees as a Proportion of the Total for all Sectors
NAICS 31 - Manufacturing Sector and Sub-Sectors
Puerto Rico, and Selected States, 2011

Industrial Sector	Puerto Rico	Connecticut	Florida	Hawaii	Massachusetts	Mississippi	New York	South Carolina
31 - Manufacturing	12.43%	10.44%	4.10%	2.50%	7.62%	15.59%	5.90%	13.43%
311 - Food manufacturing	1.55%	0.50%	0.41%	1.12%	0.71%	2.56%	0.67%	1.20%
312 - Beverage and tobacco product manufacturing	0.45%	0.04%	0.10%	0.16%	0.08%	0.04%	0.07%	N/D
313 - Textile mills	0.00%	0.05%	0.01%	N/D	0.10%	N/D	0.03%	0.99%
314 - Textile product mills	0.20%	0.06%	0.05%	0.03%	0.07%	0.22%	0.05%	0.25%
315 - Apparel manufacturing	0.91%	N/D	0.05%	0.09%	0.07%	0.13%	0.19%	0.06%
316 - Leather and allied product manufacturing	0.19%	N/D	0.01%	N/D	0.05%	N/D	0.02%	N/D
321 - Wood product manufacturing	0.10%	0.06%	0.12%	0.04%	0.08%	0.99%	0.09%	0.47%
322 - Paper manufacturing	0.18%	0.23%	0.12%	N/D	0.30%	0.44%	0.21%	0.79%
323 - Printing and related support activities	0.32%	0.44%	0.24%	0.20%	0.38%	0.27%	0.33%	0.27%
324 - Petroleum and coal products manufacturing	0.10%	0.01%	0.02%	N/D	0.02%	N/D	0.02%	0.02%
325 - Chemical manufacturing	3.40%	0.51%	0.27%	N/D	0.54%	0.64%	0.51%	1.21%
326 - Plastics and rubber products manufacturing	0.30%	0.42%	0.16%	0.04%	0.43%	0.77%	0.32%	1.19%
327 - Nonmetallic mineral product manufacturing	0.34%	0.19%	0.19%	N/D	0.19%	0.31%	0.19%	0.39%
331 - Primary metal manufacturing	0.06%	0.22%	0.05%	N/D	0.10%	0.33%	0.14%	0.34%
332 - Fabricated metal product manufacturing	0.60%	1.90%	0.41%	0.10%	0.96%	1.12%	0.68%	1.49%
333 - Machinery manufacturing	0.16%	0.85%	0.33%	N/D	0.60%	1.04%	0.54%	1.38%
334 - Computer and electronic product manufacturing	0.43%	1.12%	0.57%	N/D	1.59%	0.22%	0.65%	0.36%
335 - Electrical equipment, appliance, and component manufacturing	0.66%	0.53%	0.13%	N/D	0.30%	0.78%	0.19%	0.55%
336 - Transportation equipment manufacturing	0.15%	N/D	0.36%	N/D	0.21%	3.02%	0.30%	1.93%
337 - Furniture and related product manufacturing	0.17%	0.15%	0.12%	0.06%	0.12%	1.97%	0.20%	0.16%
339 - Miscellaneous manufacturing	2.14%	0.57%	0.37%	0.17%	0.72%	0.33%	0.49%	0.35%

Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

*N/D No Data

Table E2-B: Total Annual Payroll as a Proportion of the Total for all Sectors
NAICS 31 - Manufacturing Sector and Sub-Sectors
Puerto Rico, and Selected States, 2011

Industrial Sector	Puerto Rico	Connecticut	Florida	Hawaii	Massachusetts	Mississippi	New York	South Carolina
31 - Manufacturing	18.02%	11.72%	5.08%	2.46%	8.94%	19.44%	5.13%	17.83%
311 - Food manufacturing	1.57%	0.34%	0.42%	0.84%	0.52%	2.04%	0.42%	1.00%
312 - Beverage and tobacco product manufacturing	0.58%	0.04%	0.14%	0.16%	0.09%	0.05%	0.06%	N/D
313 - Textile mills	0.00%	0.04%	0.01%	N/D	0.09%	N/D	0.03%	1.01%
314 - Textile product mills	0.14%	0.04%	0.04%	0.02%	0.04%	0.19%	0.03%	0.19%
315 - Apparel manufacturing	0.64%	N/D	0.03%	0.06%	0.04%	0.09%	0.08%	0.04%
316 - Leather and allied product manufacturing	0.11%	N/D	0.01%	N/D	0.03%	N/D	0.01%	0.00%
321 - Wood product manufacturing	0.09%	0.05%	0.10%	0.03%	0.06%	1.03%	0.05%	0.50%
322 - Paper manufacturing	0.18%	0.24%	0.17%	N/D	0.29%	0.76%	0.18%	1.31%
323 - Printing and related support activities	0.37%	0.35%	0.22%	0.18%	0.30%	0.25%	0.24%	0.29%
324 - Petroleum and coal products manufacturing	0.14%	0.02%	0.03%	N/D	0.03%	N/D	0.02%	0.03%
325 - Chemical manufacturing	7.87%	0.59%	0.38%	N/D	0.82%	1.13%	0.54%	2.01%
326 - Plastics and rubber products manufacturing	0.35%	0.37%	0.16%	0.04%	0.41%	0.88%	0.24%	1.62%
327 - Nonmetallic mineral product manufacturing	0.37%	0.20%	0.19%	0.25%	0.18%	0.38%	0.16%	0.49%
331 - Primary metal manufacturing	0.04%	0.25%	0.06%	N/D	0.09%	0.52%	0.15%	0.63%
332 - Fabricated metal product manufacturing	0.54%	1.92%	0.44%	0.14%	0.98%	1.48%	0.56%	1.84%
333 - Machinery manufacturing	0.21%	1.07%	0.47%	0.01%	0.82%	1.31%	0.55%	1.74%
334 - Computer and electronic product manufacturing	0.69%	1.44%	1.00%	0.01%	2.67%	0.27%	0.81%	0.56%
335 - Electrical equipment, appliance, and component manufacturing	0.80%	0.55%	0.15%	N/D	0.34%	1.05%	0.17%	0.77%
336 - Transportation equipment manufacturing	0.20%	N/D	0.47%	N/D	0.31%	5.21%	0.31%	3.19%
337 - Furniture and related product manufacturing	0.12%	0.12%	0.10%	0.06%	0.10%	1.66%	0.13%	0.15%
339 - Miscellaneous manufacturing	2.99%	0.55%	0.49%	0.13%	0.76%	0.36%	0.39%	0.39%

Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

*N/D No Data

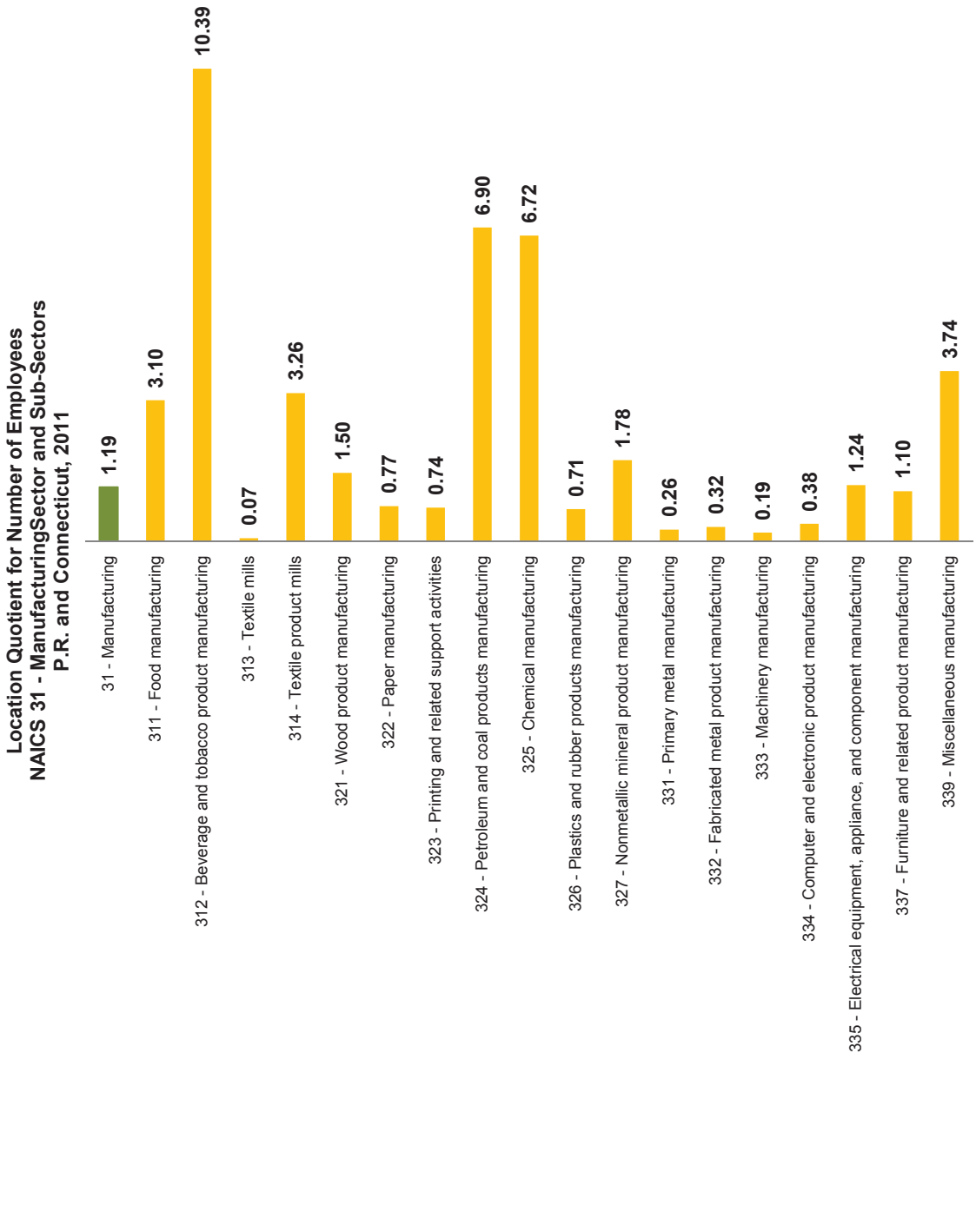
Table E2-C: Establishments as a Proportion of the Total for all Sectors
NAICS 31 - Manufacturing Sector and Sub-Sectors
Puerto Rico, and Selected States, 2011

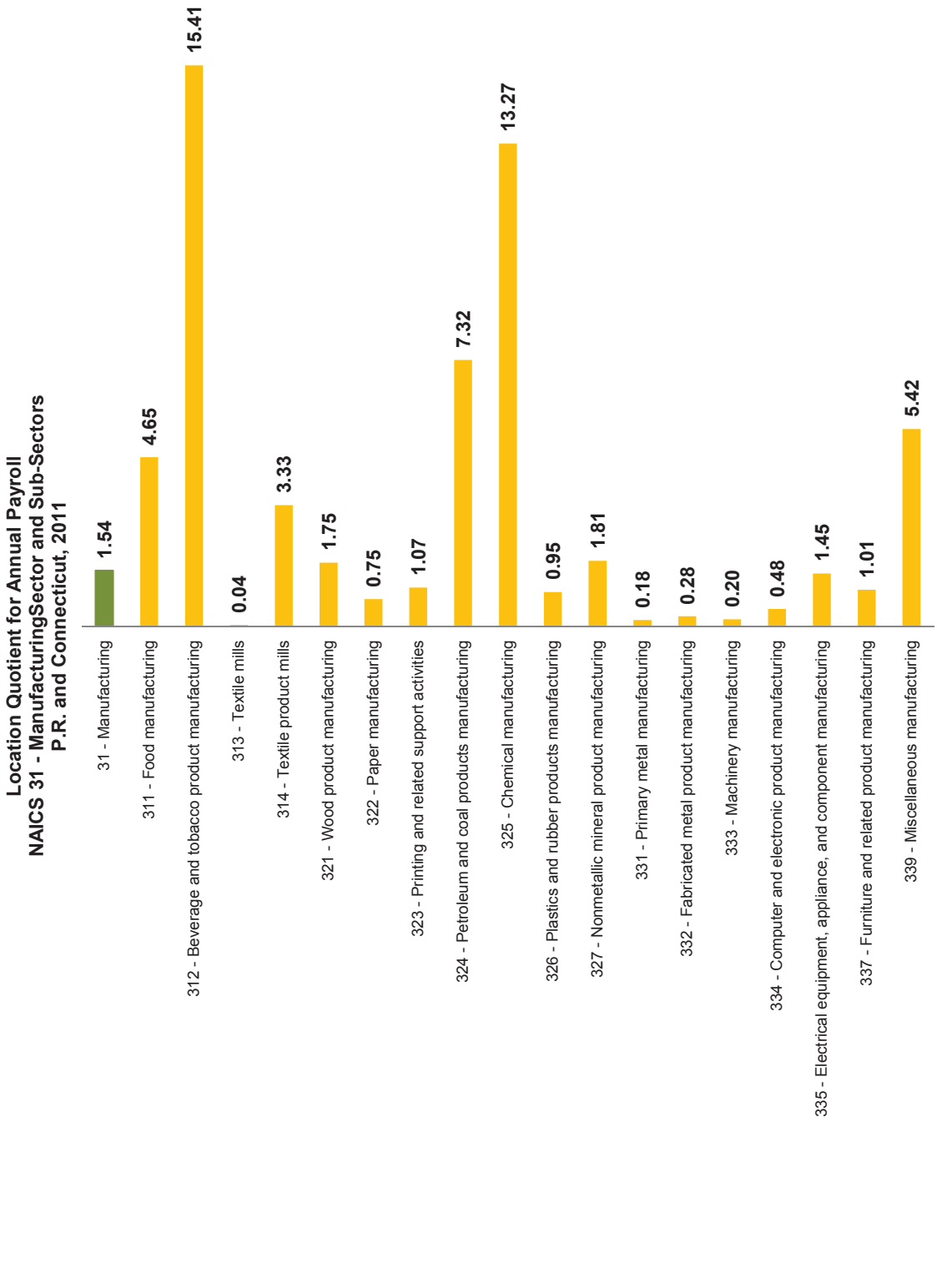
Industrial Sector	Puerto Rico	Connecticut	Florida	Hawaii	Massachusetts	Mississippi	New York	South Carolina
31 - Manufacturing	4.15%	4.98%	2.57%	2.58%	4.01%	3.89%	3.19%	3.90%
311 - Food manufacturing	0.93%	0.32%	0.19%	0.79%	0.36%	0.30%	0.38%	0.21%
312 - Beverage and tobacco product manufacturing	0.14%	0.05%	0.03%	0.10%	0.04%	0.03%	0.05%	0.03%
313 - Textile mills	0.02%	0.04%	0.02%	0.00%	0.05%	0.03%	0.04%	0.17%
314 - Textile product mills	0.09%	0.10%	0.09%	0.07%	0.07%	0.08%	0.06%	0.14%
315 - Apparel manufacturing	0.18%	0.02%	0.05%	0.17%	0.05%	0.04%	0.23%	0.04%
316 - Leather and allied product manufacturing	0.02%	0.01%	0.01%	0.00%	0.02%	0.01%	0.02%	0.01%
321 - Wood product manufacturing	0.11%	0.12%	0.08%	0.07%	0.10%	0.42%	0.10%	0.23%
322 - Paper manufacturing	0.08%	0.07%	0.03%	0.01%	0.08%	0.09%	0.05%	0.09%
323 - Printing and related support activities	0.35%	0.42%	0.32%	0.32%	0.40%	0.27%	0.35%	0.32%
324 - Petroleum and coal products manufacturing	0.07%	0.04%	0.01%	0.01%	0.03%	0.05%	0.03%	0.03%
325 - Chemical manufacturing	0.30%	0.18%	0.11%	0.07%	0.19%	0.19%	0.11%	0.24%
326 - Plastics and rubber products manufacturing	0.13%	0.19%	0.10%	0.05%	0.17%	0.21%	0.10%	0.20%
327 - Nonmetallic mineral product manufacturing	0.32%	0.16%	0.16%	0.14%	0.14%	0.30%	0.12%	0.27%
331 - Primary metal manufacturing	0.05%	0.07%	0.03%	0.00%	0.05%	0.07%	0.04%	0.08%
332 - Fabricated metal product manufacturing	0.51%	1.33%	0.35%	0.14%	0.76%	0.61%	0.46%	0.73%
333 - Machinery manufacturing	0.12%	0.51%	0.16%	0.02%	0.32%	0.24%	0.18%	0.29%
334 - Computer and electronic product manufacturing	0.07%	0.32%	0.12%	0.02%	0.39%	0.05%	0.14%	0.07%
335 - Electrical equipment, appliance, and component manufacturing	0.08%	0.17%	0.05%	0.00%	0.12%	0.08%	0.06%	0.09%
336 - Transportation equipment manufacturing	0.05%	0.21%	0.13%	0.06%	0.08%	0.16%	0.07%	0.20%
337 - Furniture and related product manufacturing	0.28%	0.25%	0.20%	0.15%	0.18%	0.40%	0.20%	0.19%
339 - Miscellaneous manufacturing	0.25%	0.38%	0.33%	0.38%	0.40%	0.26%	0.41%	0.28%

Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

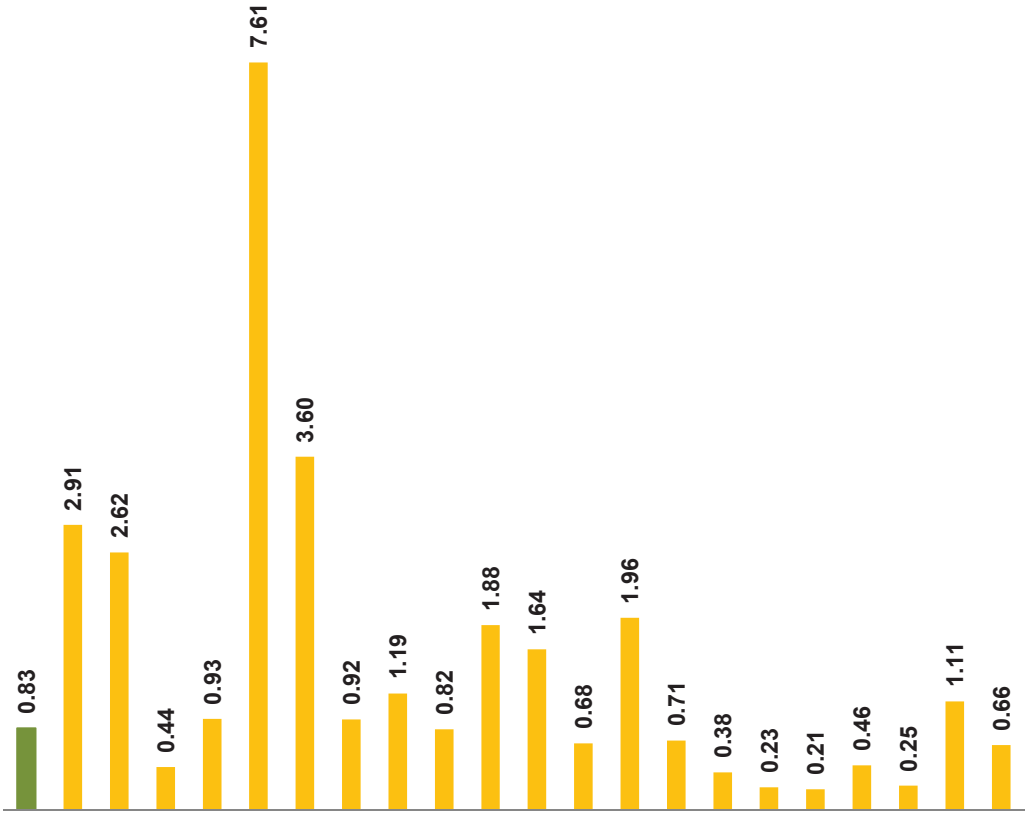
*N/D No Data

CONNECTICUT


Location Quotient for Number of Employees
NAICS 31 - ManufacturingSector and Sub-Sectors
P.R. and Connecticut, 2011
31 - Manufacturing
1.19
311 - Food manufacturing
3.10
312 - Beverage and tobacco product manufacturing
10.39
313 - Textile mills
0.07
314 - Textile product mills
3.26
321 - Wood product manufacturing
1.50
322 - Paper manufacturing
0.77
323 - Printing and related support activities
0.74
324 - Petroleum and coal products manufacturing
6.90
325 - Chemical manufacturing
6.72
326 - Plastics and rubber products manufacturing
0.71
327 - Nonmetallic mineral product manufacturing
1.78
331 - Primary metal manufacturing
0.26
332 - Fabricated metal product manufacturing
0.32
333 - Machinery manufacturing
0.19
334 - Computer and electronic product manufacturing
0.38
335 - Electrical equipment, appliance, and component manufacturing
1.24
337 - Furniture and related product manufacturing
1.10
339 - Miscellaneous manufacturing
3.74
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

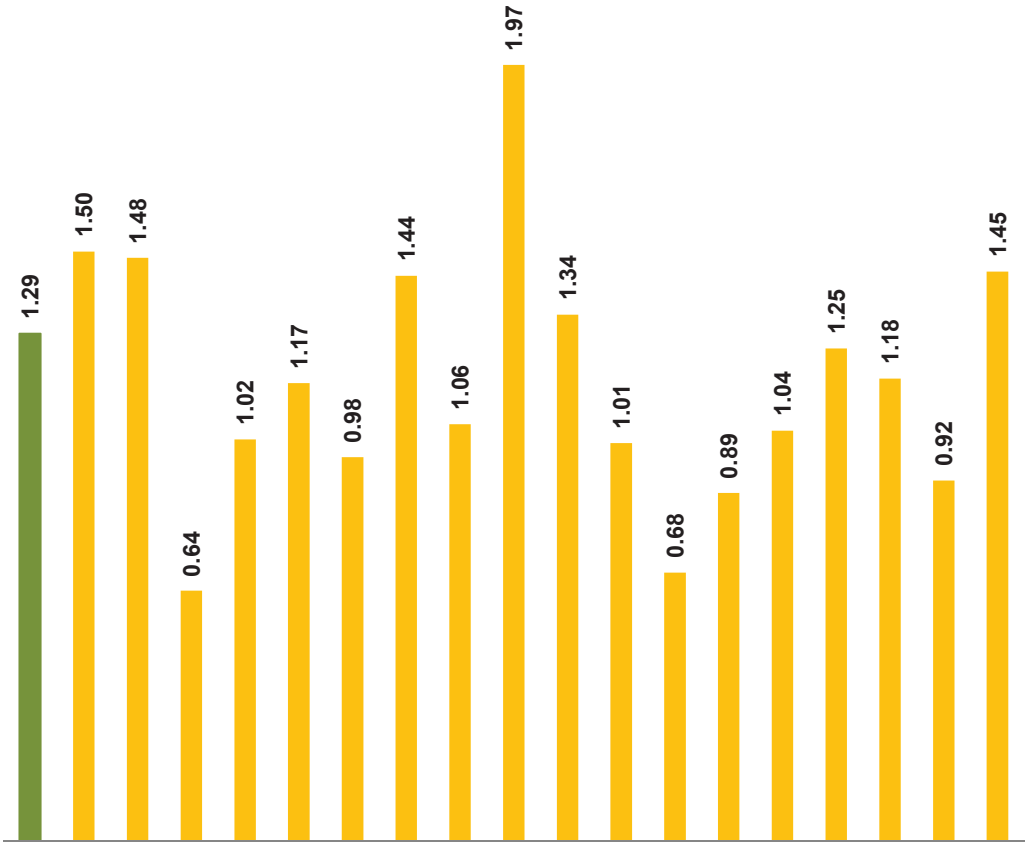

Location Quotient for Annual Payroll
NAICS 31 - ManufacturingSector and Sub-Sectors
P.R. and Connecticut, 2011
31 - Manufacturing 1.54
311 - Food manufacturing 4.65
312 - Beverage and tobacco product manufacturing 15.41
313 - Textile mills 0.04
314 - Textile product mills 3.33
321 - Wood product manufacturing 1.75
322 - Paper manufacturing 0.75
323 - Printing and related support activities 1.07
324 - Petroleum and coal products manufacturing 7.32
325 - Chemical manufacturing 13.27
326 - Plastics and rubber products manufacturing 0.95
327 - Nonmetallic mineral product manufacturing 1.81
331 - Primary metal manufacturing 0.18
332 - Fabricated metal product manufacturing 0.28
333 - Machinery manufacturing 0.20
334 - Computer and electronic product manufacturing 0.48
335 - Electrical equipment, appliance, and component manufacturing 1.45
337 - Furniture and related product manufacturing 1.01
339 - Miscellaneous manufacturing 5.42
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Location Quotient for Number of Establishments
NAICS 31 - ManufacturingSector and Sub-Sectors
P.R. and Connecticut, 2011



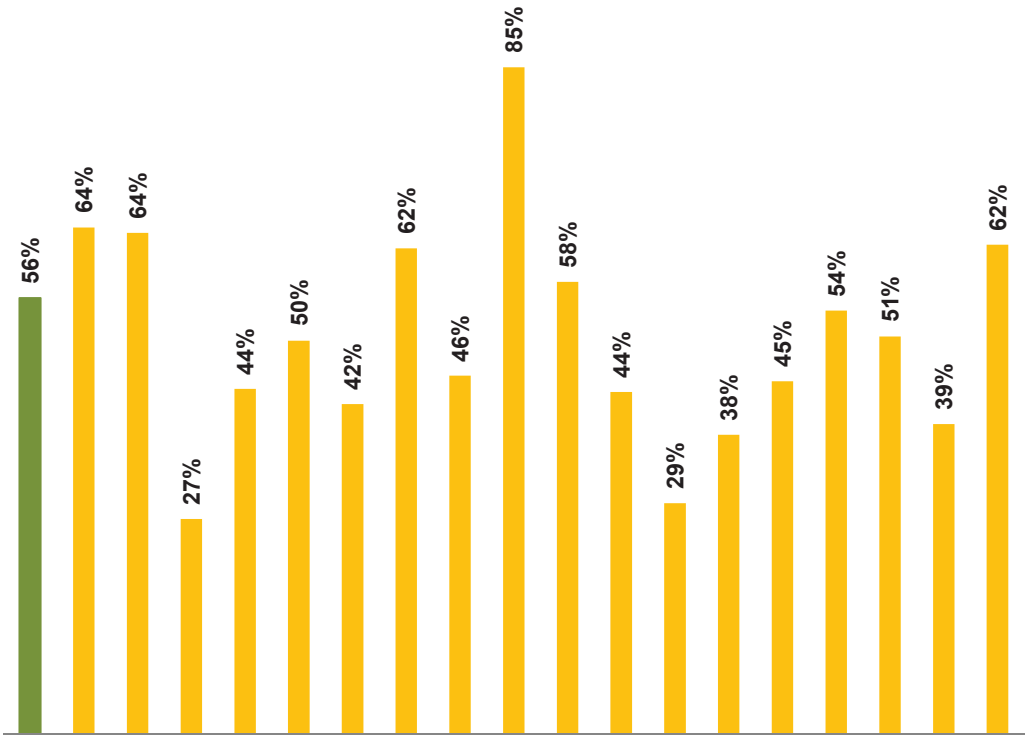
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Location Quotient for Annual Payroll per Employee
NAICS 31 - ManufacturingSector and Sub-Sectors
P.R. and Connecticut, 2011



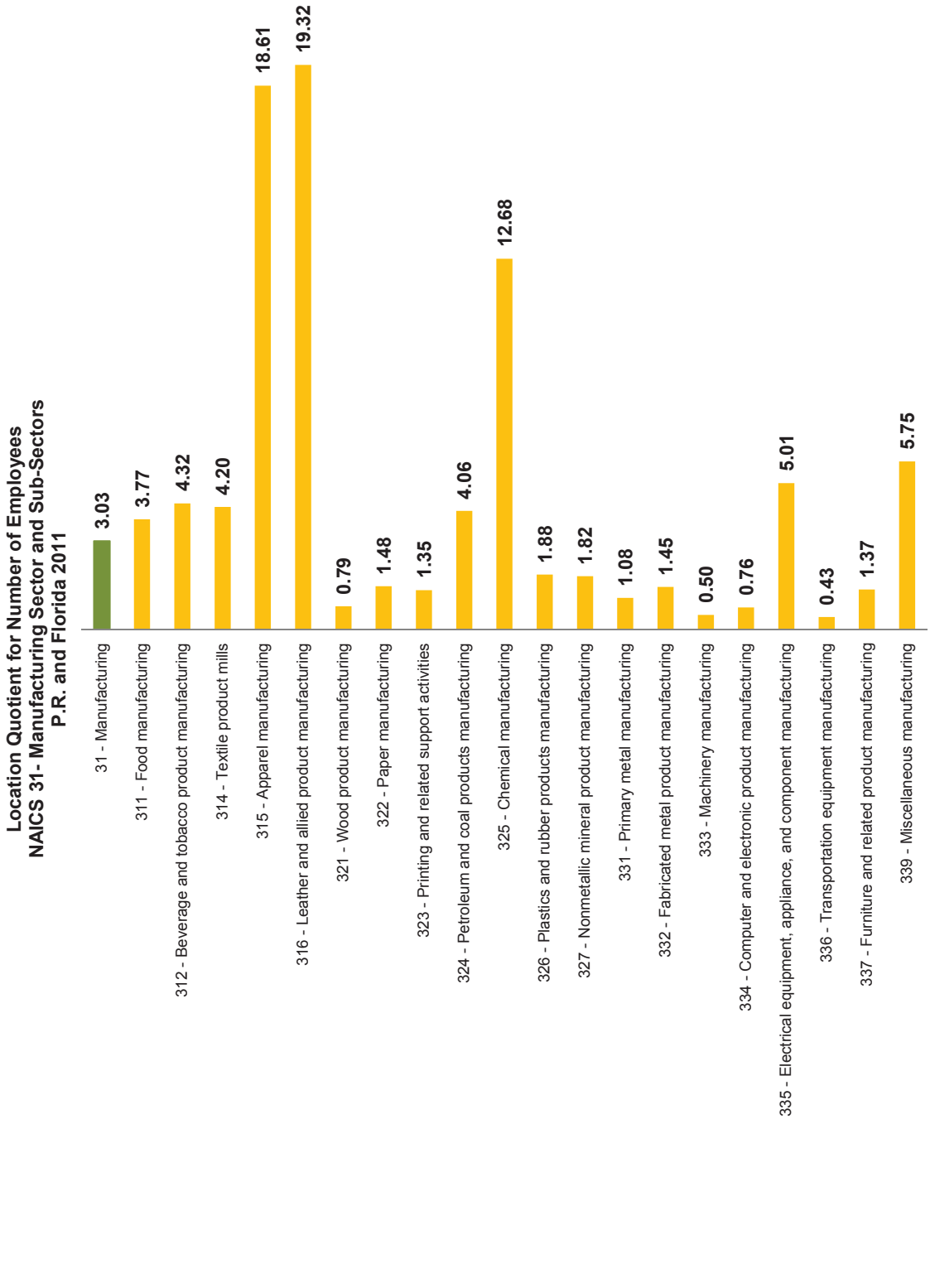
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

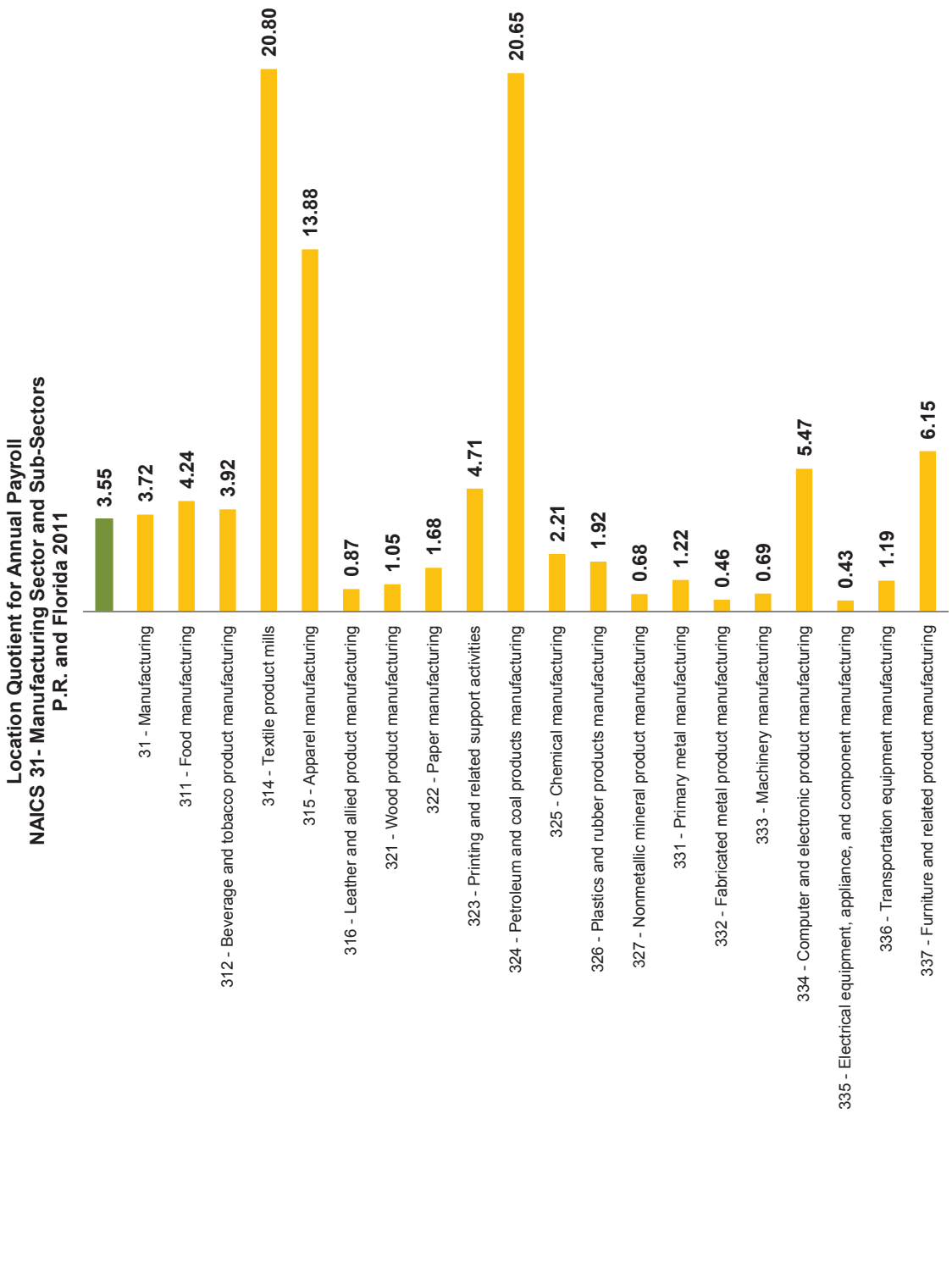
P.R. Annual Payroll per Employee as a Percentage of Annual Payroll per Employee in Connecticut
NAICS 31 – Manufacturing Sector and Sub-Sectors
P.R. and Connecticut, 2011

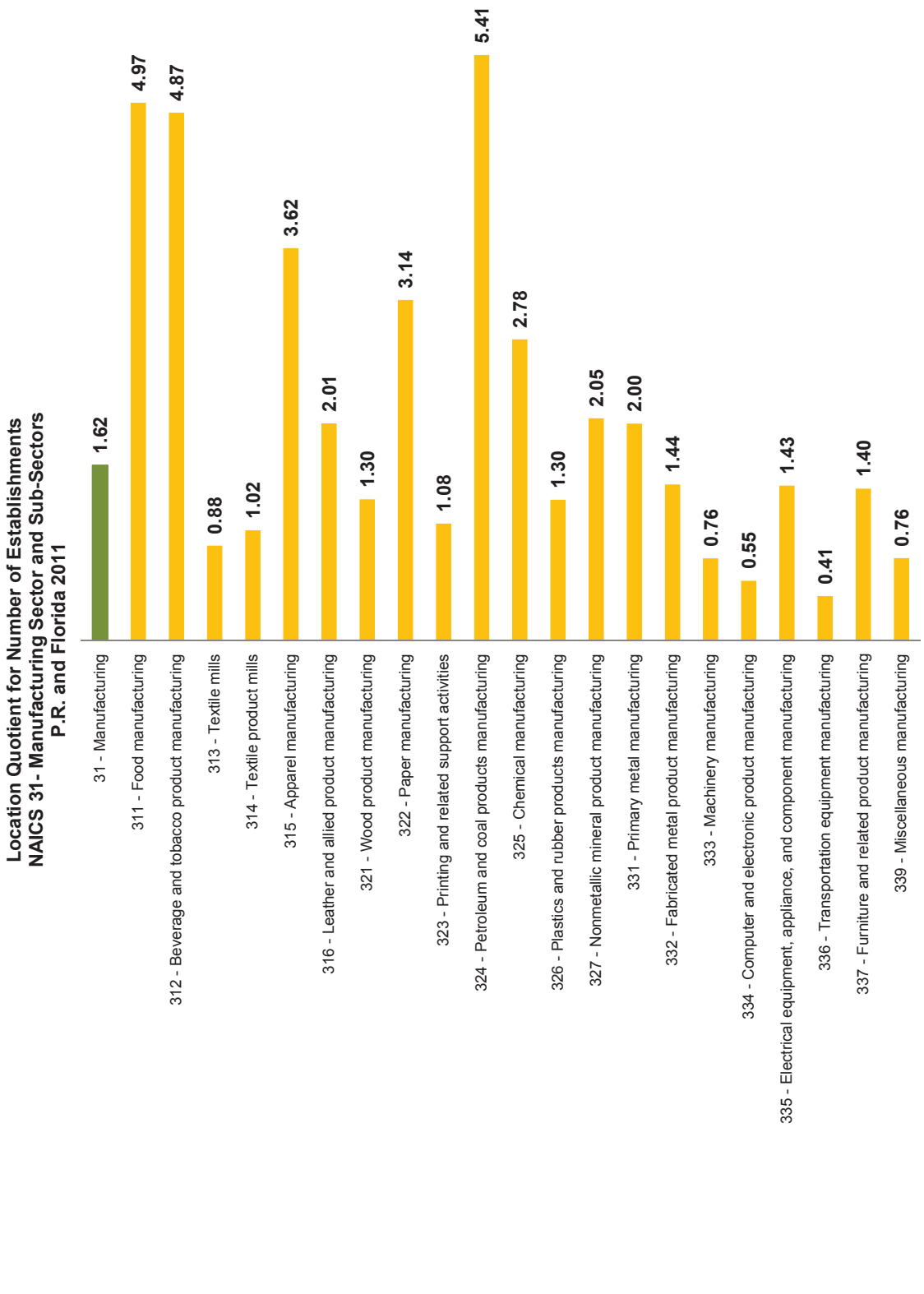


Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

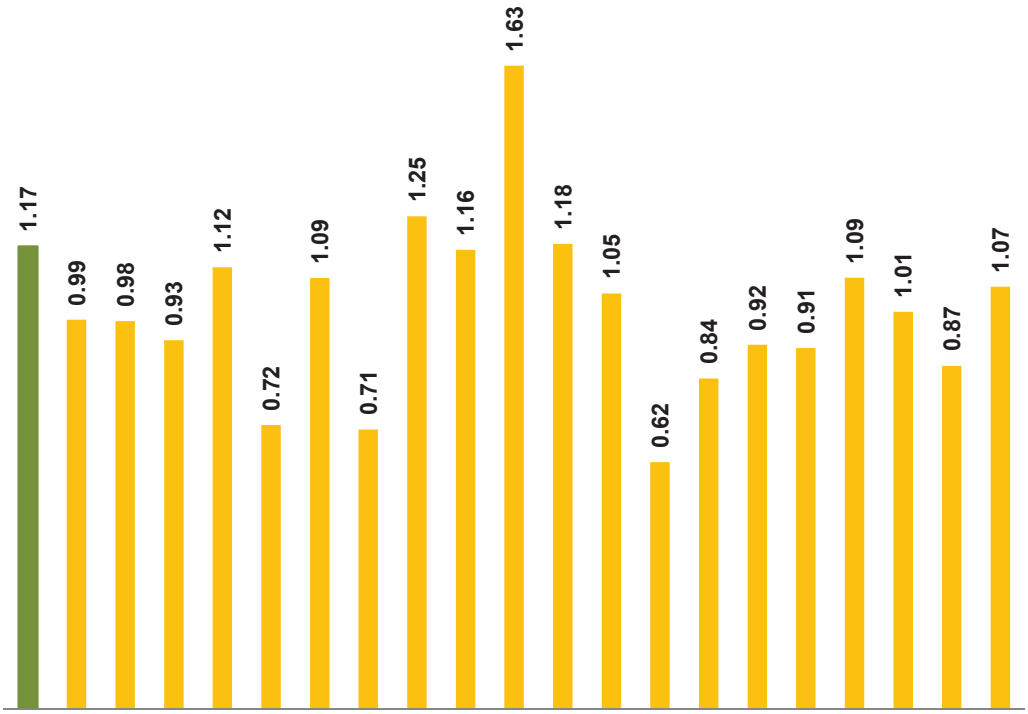
FLORIDA


Location Quotient for Number of Employees
NAICS 31- Manufacturing Sector and Sub-Sectors
P.R. and Florida 2011
31 - Manufacturing
3.03
311 - Food manufacturing
3.77
312 - Beverage and tobacco product manufacturing
4.32
314 - Textile product mills
4.20
315 - Apparel manufacturing
18.61
316 - Leather and allied product manufacturing
19.32
321 - Wood product manufacturing
0.79
322 - Paper manufacturing
1.48
323 - Printing and related support activities
1.35
324 - Petroleum and coal products manufacturing
4.06
325 - Chemical manufacturing
12.68
326 - Plastics and rubber products manufacturing
1.88
327 - Nonmetallic mineral product manufacturing
1.82
331 - Primary metal manufacturing
1.08
332 - Fabricated metal product manufacturing
1.45
333 - Machinery manufacturing
0.50
334 - Computer and electronic product manufacturing
0.76
335 - Electrical equipment, appliance, and component manufacturing
5.01
336 - Transportation equipment manufacturing
0.43
337 - Furniture and related product manufacturing
1.37
339 - Miscellaneous manufacturing
5.75
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns


Location Quotient for Annual Payroll
NAICS 31- Manufacturing Sector and Sub-Sectors
P.R. and Florida 2011
3.55
3.72
4.24
3.92
20.80
13.88
0.87
1.05
1.68
4.71
20.65
2.21
1.92
0.68
1.22
0.46
0.69
5.47
0.43
1.19
6.15
31 - Manufacturing
311 - Food manufacturing
312 - Beverage and tobacco product manufacturing
314 - Textile product mills
315 - Apparel manufacturing
316 - Leather and allied product manufacturing
321 - Wood product manufacturing
322 - Paper manufacturing
323 - Printing and related support activities
324 - Petroleum and coal products manufacturing
325 - Chemical manufacturing
326 - Plastics and rubber products manufacturing
327 - Nonmetallic mineral product manufacturing
331 - Primary metal manufacturing
332 - Fabricated metal product manufacturing
333 - Machinery manufacturing
334 - Computer and electronic product manufacturing
335 - Electrical equipment, appliance, and component manufacturing
336 - Transportation equipment manufacturing
337 - Furniture and related product manufacturing
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

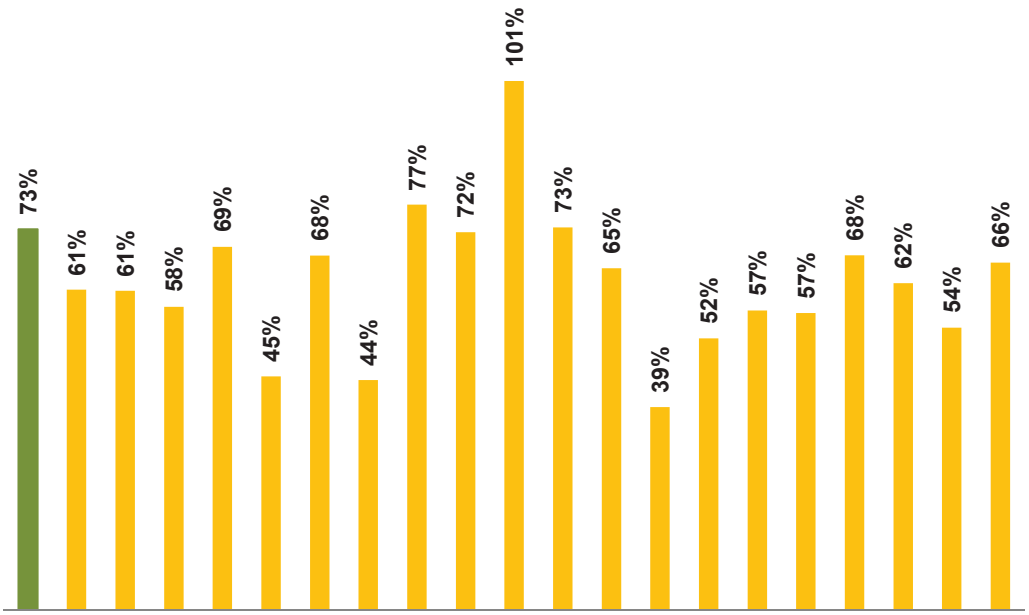

Location Quotient for Number of Establishments
NAICS 31- Manufacturing Sector and Sub-Sectors
P.R. and Florida 2011
31 - Manufacturing
1.62
311 - Food manufacturing
4.97
312 - Beverage and tobacco product manufacturing
4.87
313 - Textile mills
0.88
314 - Textile product mills
1.02
315 - Apparel manufacturing
3.62
316 - Leather and allied product manufacturing
2.01
321 - Wood product manufacturing
1.30
322 - Paper manufacturing
3.14
323 - Printing and related support activities
1.08
324 - Petroleum and coal products manufacturing
5.41
325 - Chemical manufacturing
2.78
326 - Plastics and rubber products manufacturing
1.30
327 - Nonmetallic mineral product manufacturing
2.05
331 - Primary metal manufacturing
2.00
332 - Fabricated metal product manufacturing
1.44
333 - Machinery manufacturing
0.76
334 - Computer and electronic product manufacturing
0.55
335 - Electrical equipment, appliance, and component manufacturing
1.43
336 - Transportation equipment manufacturing
0.41
337 - Furniture and related product manufacturing
1.40
339 - Miscellaneous manufacturing
0.76
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Location Quotient for Annual Payroll per Employee
NAICS 31- Manufacturing Sector and Sub-Sectors
P.R. and Florida 2011



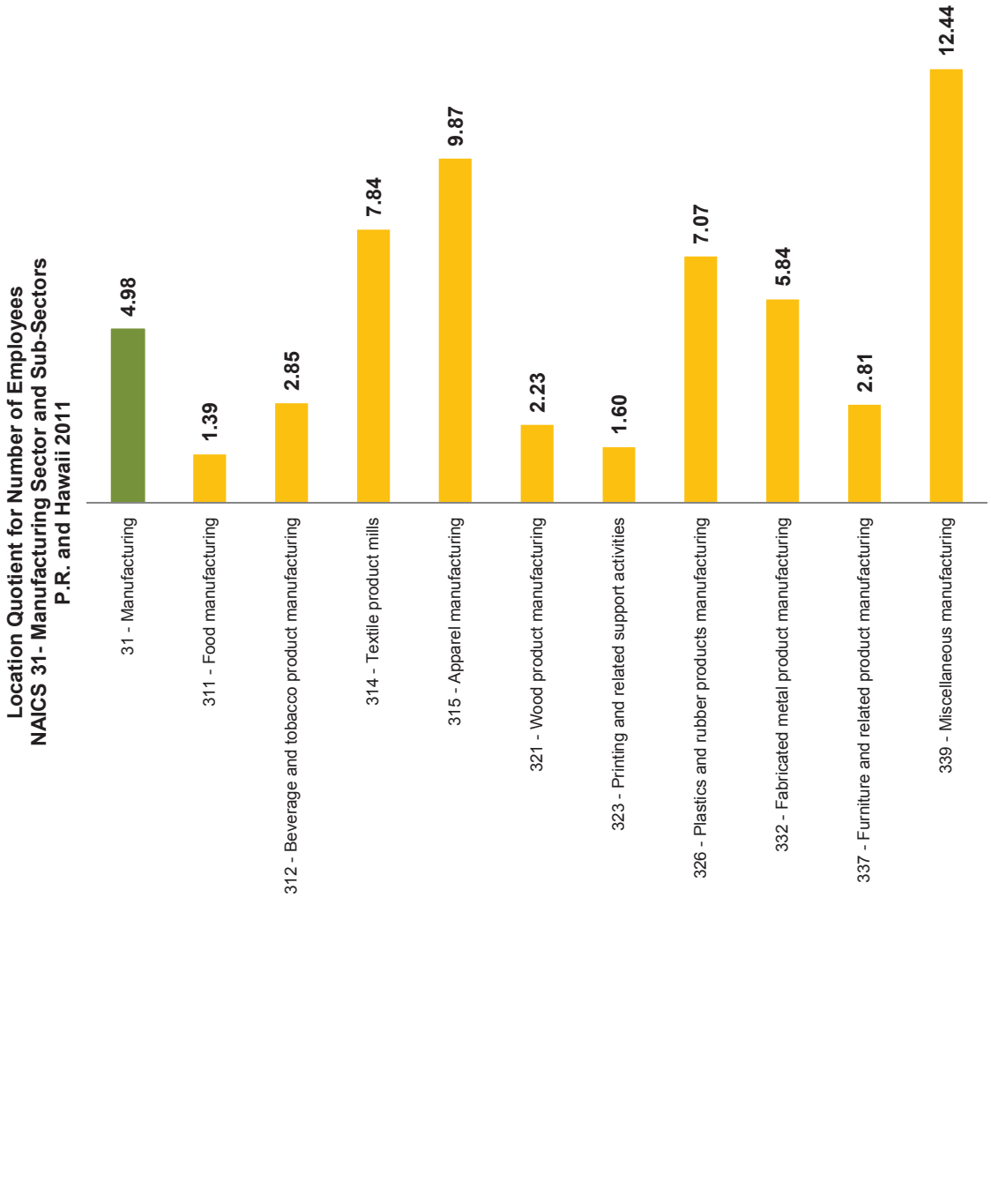
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

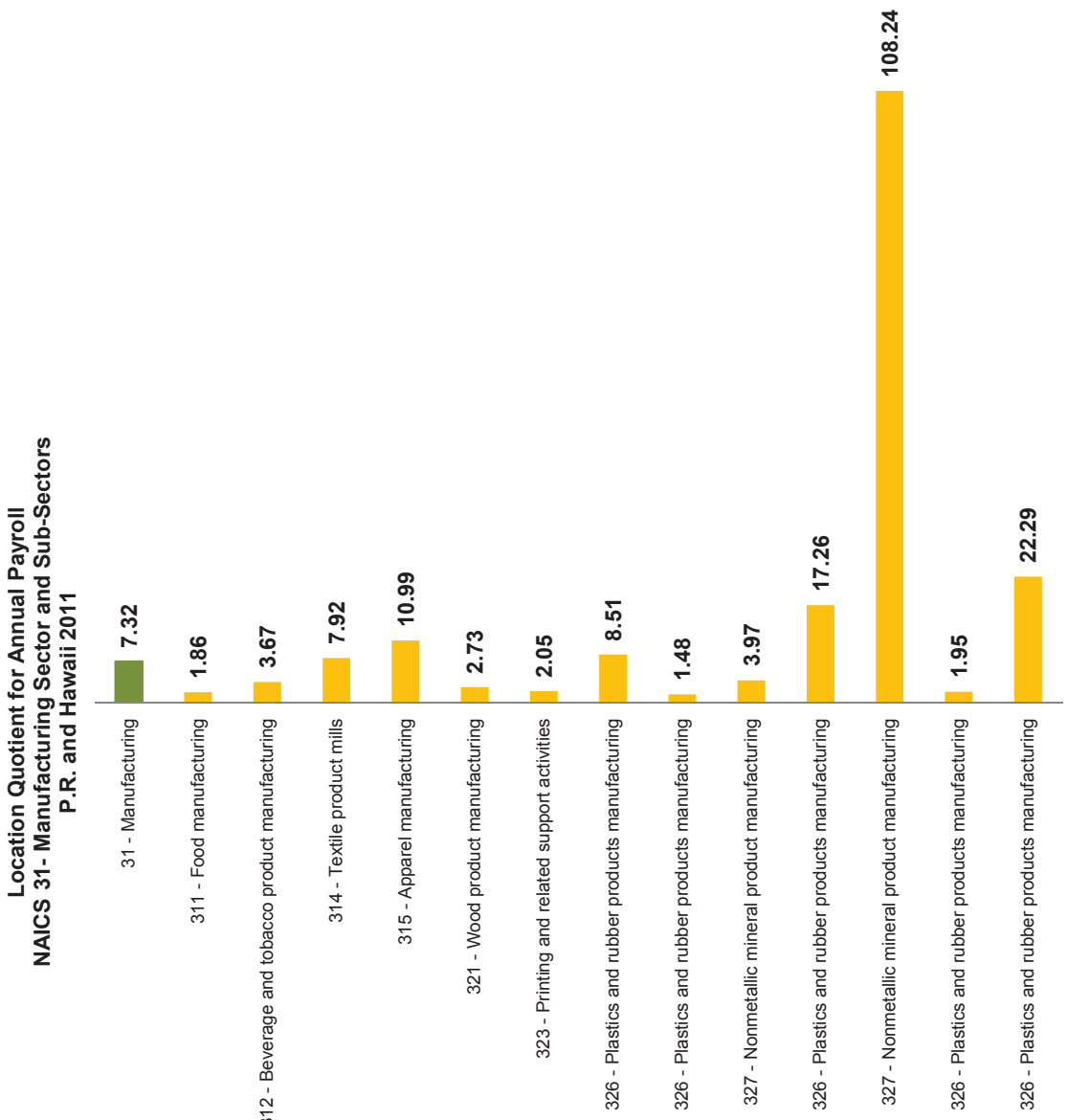
P.R. Annual Payroll per Employee as a Percentage of Annual Payroll per Employee in Florida
NAICS 31- Manufacturing Sector and Sub-Sectors
P.R. and Florida 2011



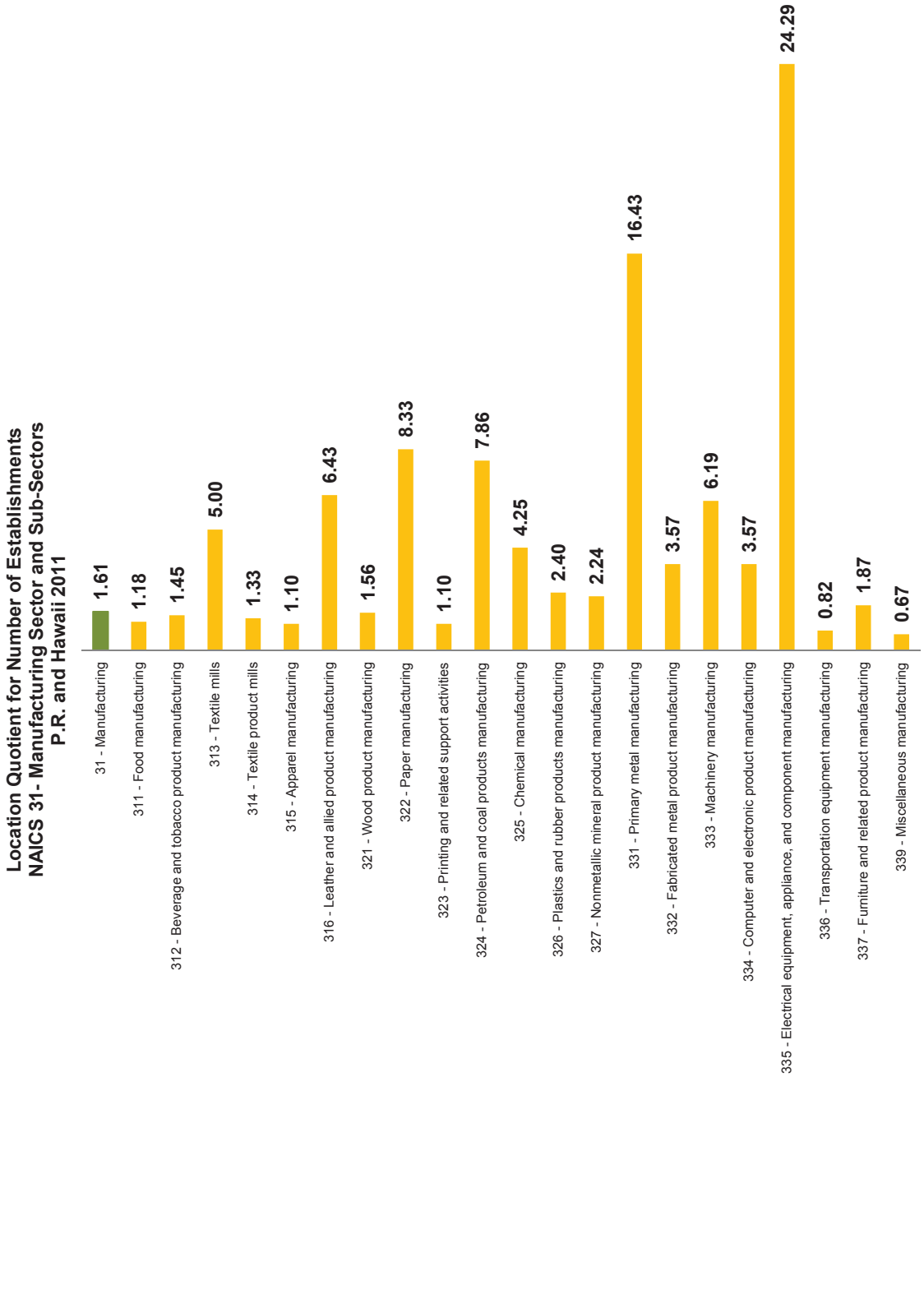
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

HAWAII

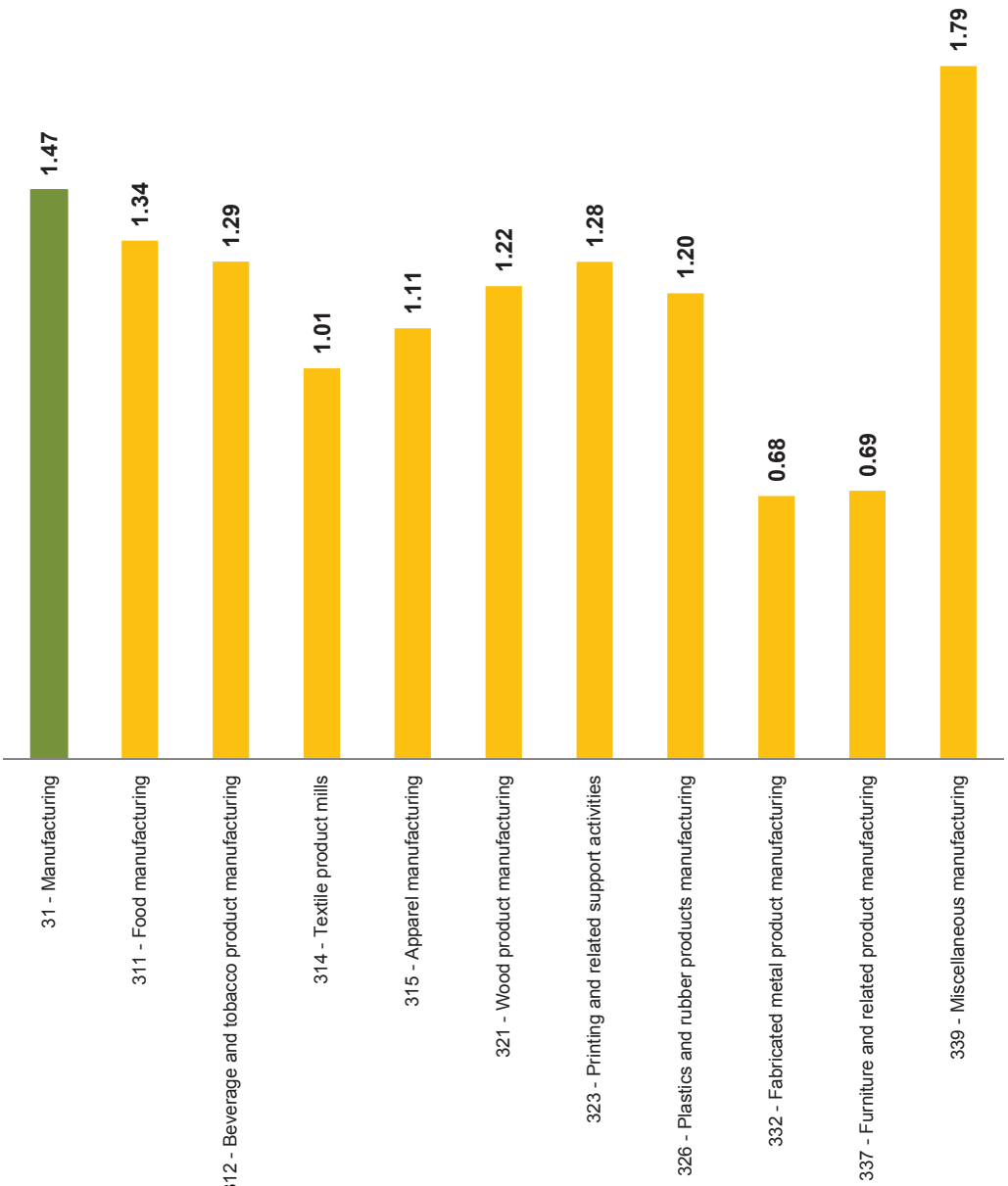

Location Quotient for Number of Employees
NAICS 31- Manufacturing Sector and Sub-Sectors
P.R. and Hawaii 2011
4.98
1.39
2.85
7.84
9.87
2.23
1.60
7.07
5.84
2.81
12.44
31 - Manufacturing
311 - Food manufacturing
312 - Beverage and tobacco product manufacturing
314 - Textile product mills
315 - Apparel manufacturing
321 - Wood product manufacturing
323 - Printing and related support activities
326 - Plastics and rubber products manufacturing
332 - Fabricated metal product manufacturing
337 - Furniture and related product manufacturing
339 - Miscellaneous manufacturing
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns



Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

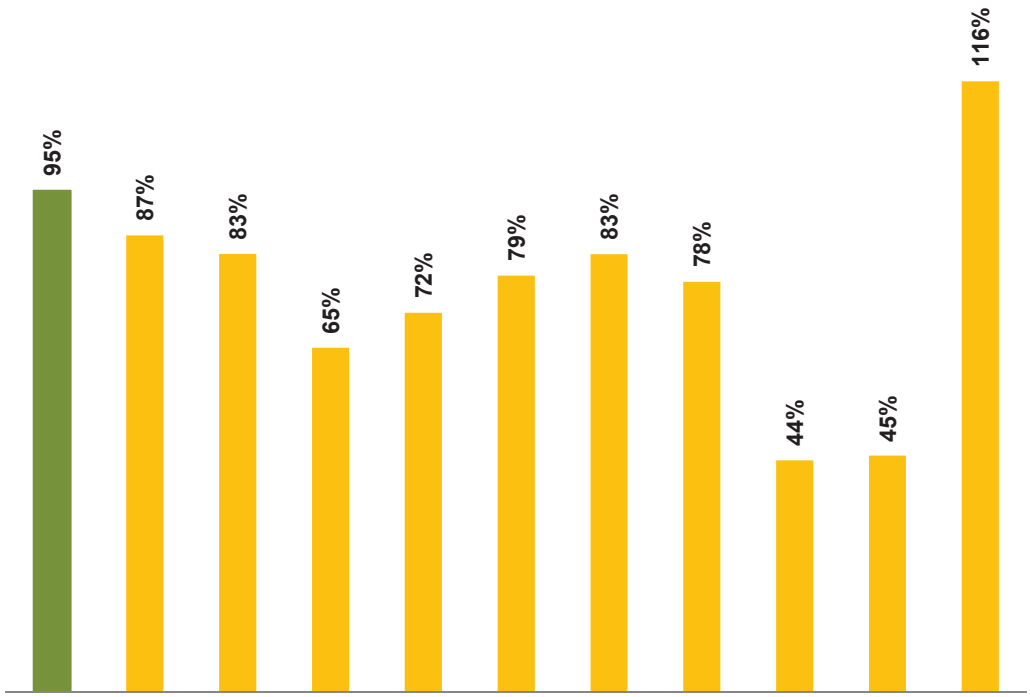

Location Quotient for Number of Establishments
NAICS 31- Manufacturing Sector and Sub-Sectors
P.R. and Hawaii 2011
31 - Manufacturing
1.61
311 - Food manufacturing
1.18
312 - Beverage and tobacco product manufacturing
1.45
313 - Textile mills
5.00
314 - Textile product mills
1.33
315 - Apparel manufacturing
1.10
316 - Leather and allied product manufacturing
6.43
321 - Wood product manufacturing
1.56
322 - Paper manufacturing
8.33
323 - Printing and related support activities
1.10
324 - Petroleum and coal products manufacturing
7.86
325 - Chemical manufacturing
4.25
326 - Plastics and rubber products manufacturing
2.40
327 - Nonmetallic mineral product manufacturing
2.24
331 - Primary metal manufacturing
16.43
332 - Fabricated metal product manufacturing
3.57
333 - Machinery manufacturing
6.19
334 - Computer and electronic product manufacturing
3.57
335 - Electrical equipment, appliance, and component manufacturing
24.29
336 - Transportation equipment manufacturing
0.82
337 - Furniture and related product manufacturing
1.87
339 - Miscellaneous manufacturing
0.67
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Location Quotient for Annual Payroll per Employee
NAICS 31- Manufacturing Sector and Sub-Sectors
P.R. and Hawaii 2011



Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

P.R. Annual Payroll per Employee as a Percentage of Annual Payroll per Employee in Hawaii
NAICS 31- Manufacturing Sector and Sub-Sectors
P.R. and Hawaii 2011



Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

MASSACHUSETTS

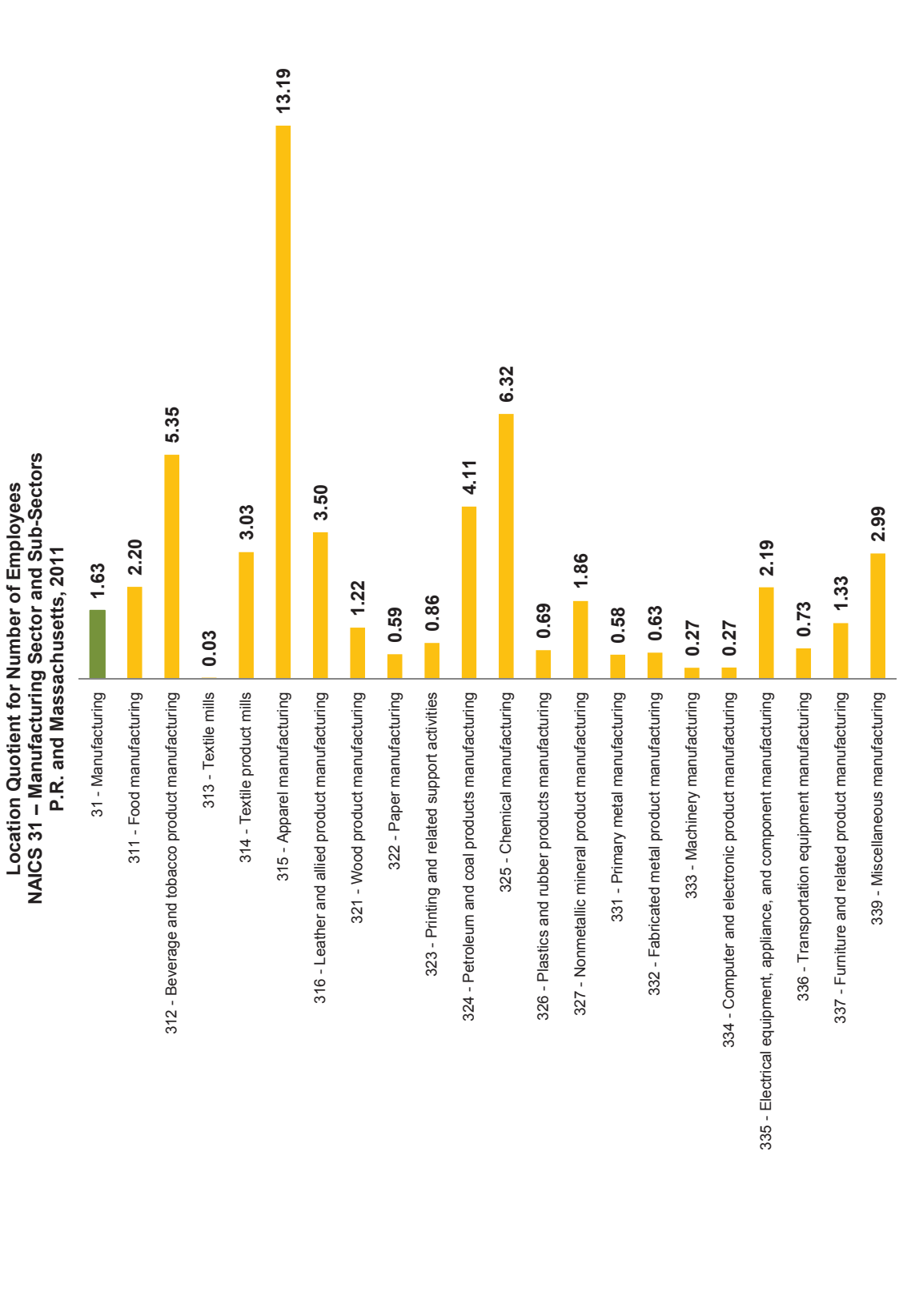

Location Quotient for Number of Employees
NAICS 31 – Manufacturing Sector and Sub-Sectors
P.R. and Massachusetts, 2011
31 - Manufacturing 1.63
311 - Food manufacturing 2.20
312 - Beverage and tobacco product manufacturing 5.35
313 - Textile mills 0.03
314 - Textile product mills 3.03
315 - Apparel manufacturing 13.19
316 - Leather and allied product manufacturing 3.50
321 - Wood product manufacturing 1.22
322 - Paper manufacturing 0.59
323 - Printing and related support activities 0.86
324 - Petroleum and coal products manufacturing 4.11
325 - Chemical manufacturing 6.32
326 - Plastics and rubber products manufacturing 0.69
327 - Nonmetallic mineral product manufacturing 1.86
331 - Primary metal manufacturing 0.58
332 - Fabricated metal product manufacturing 0.63
333 - Machinery manufacturing 0.27
334 - Computer and electronic product manufacturing 0.27
335 - Electrical equipment, appliance, and component manufacturing 2.19
336 - Transportation equipment manufacturing 0.73
337 - Furniture and related product manufacturing 1.33
339 - Miscellaneous manufacturing 2.99
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Figure - EM1

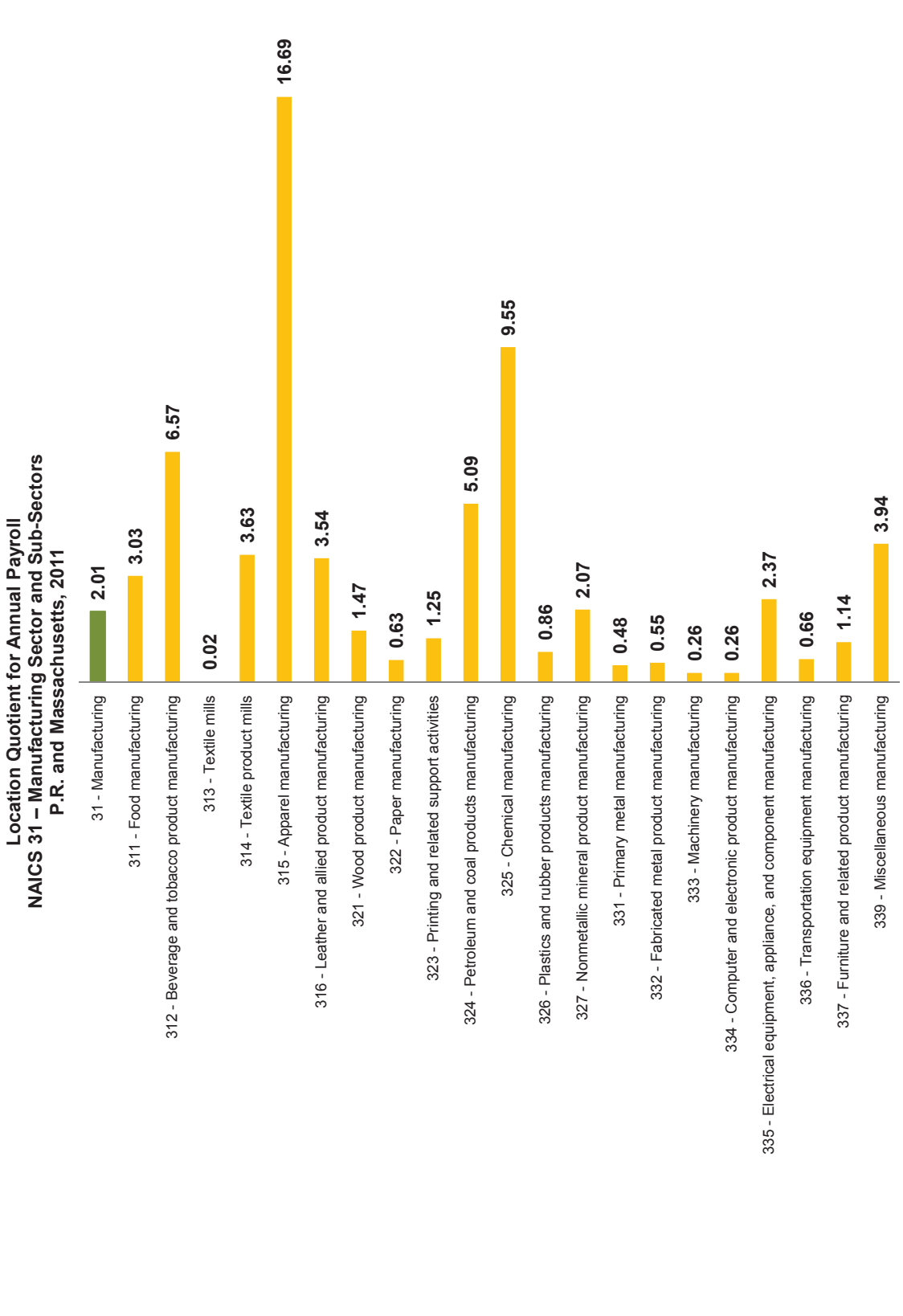
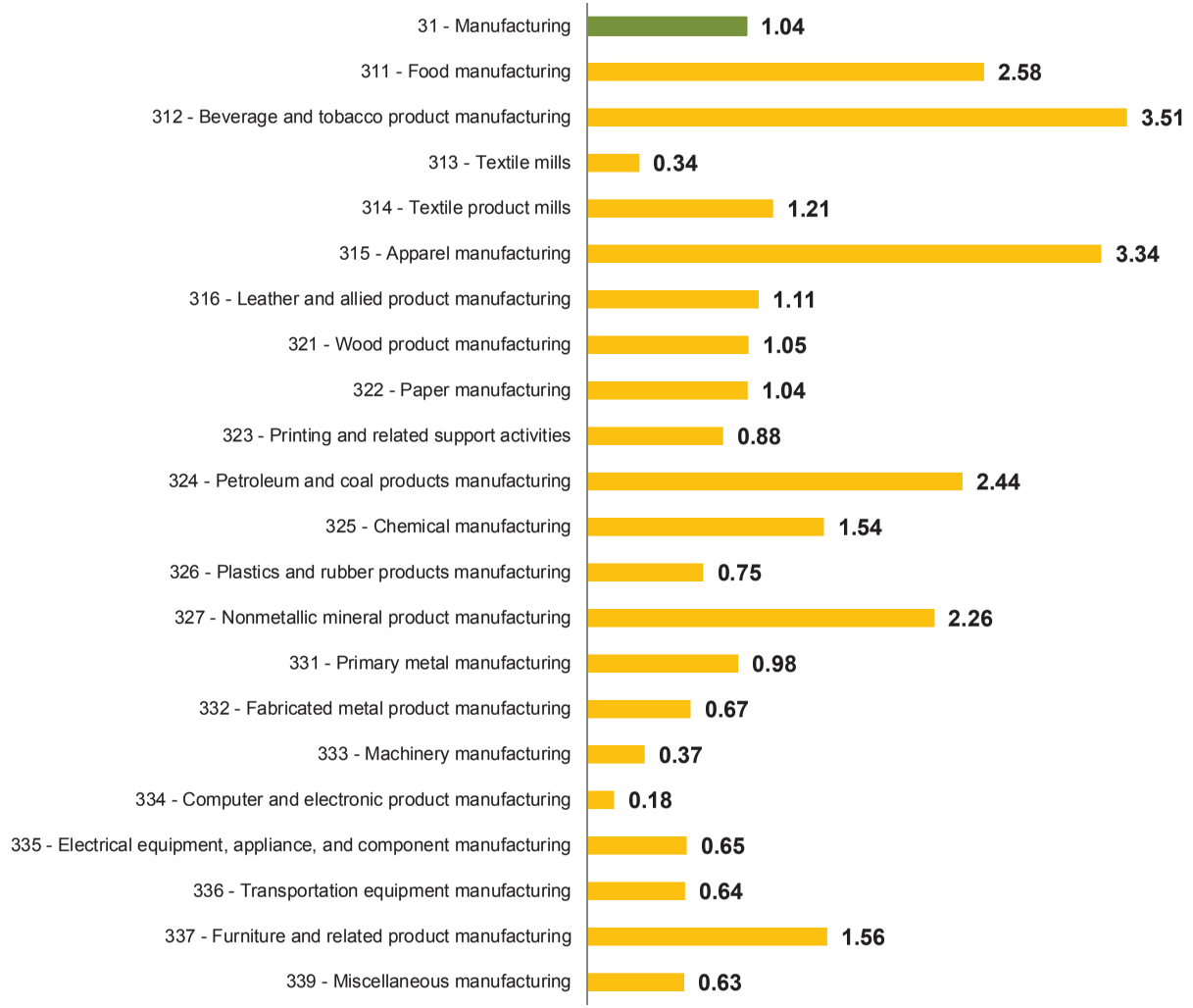

Location Quotient for Annual Payroll
NAICS 31 – Manufacturing Sector and Sub-Sectors
P.R. and Massachusetts, 2011
31 - Manufacturing 2.01
311 - Food manufacturing 3.03
312 - Beverage and tobacco product manufacturing 6.57
313 - Textile mills 0.02
314 - Textile product mills 3.63
315 - Apparel manufacturing 16.69
316 - Leather and allied product manufacturing 3.54
321 - Wood product manufacturing 1.47
322 - Paper manufacturing 0.63
323 - Printing and related support activities 1.25
324 - Petroleum and coal products manufacturing 5.09
325 - Chemical manufacturing 9.55
326 - Plastics and rubber products manufacturing 0.86
327 - Nonmetallic mineral product manufacturing 2.07
331 - Primary metal manufacturing 0.48
332 - Fabricated metal product manufacturing 0.55
333 - Machinery manufacturing 0.26
334 - Computer and electronic product manufacturing 0.26
335 - Electrical equipment, appliance, and component manufacturing 2.37
336 - Transportation equipment manufacturing 0.66
337 - Furniture and related product manufacturing 1.14
339 - Miscellaneous manufacturing 3.94
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Figure - EM2

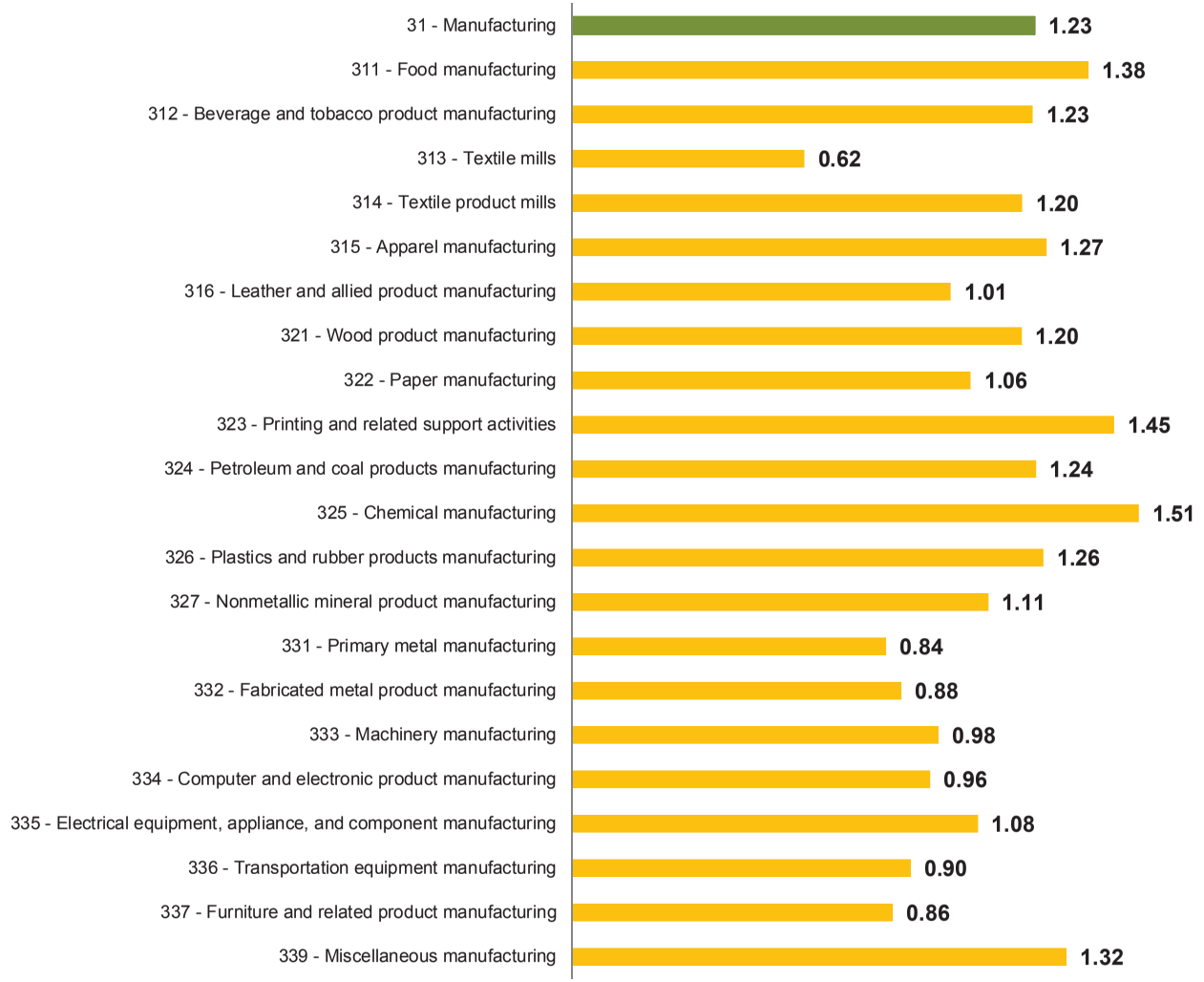
Location Quotient for Number of Establishments
NAICS 31 – Manufacturing Sector and Sub-Sectors
P.R. and Massachusetts, 2011



Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Figure - EM3

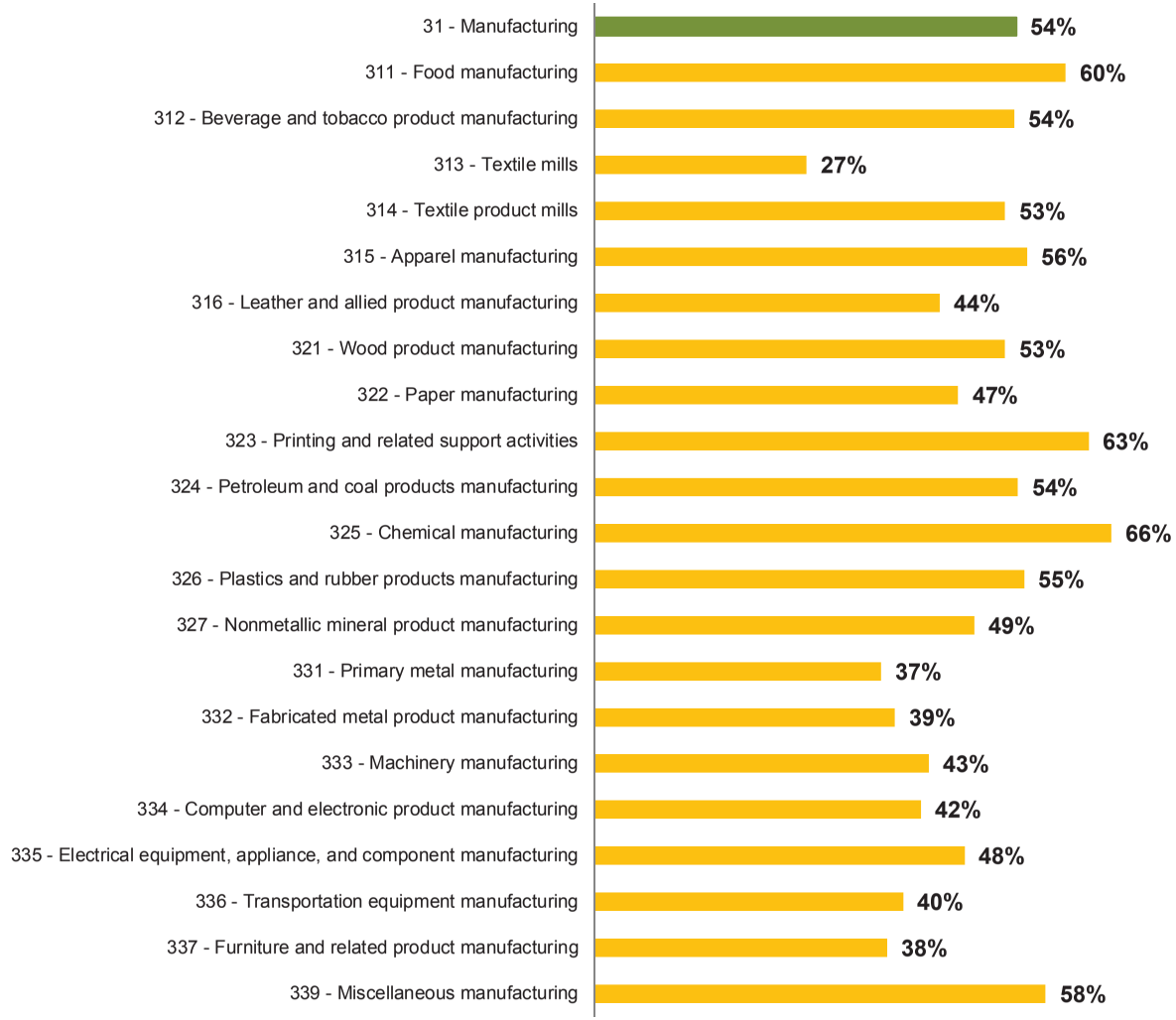
Location Quotient for Annual Payroll per Employee
NAICS 31 – Manufacturing Sector and Sub-Sectors
P.R. and Massachusetts, 2011



Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Figure - EM4

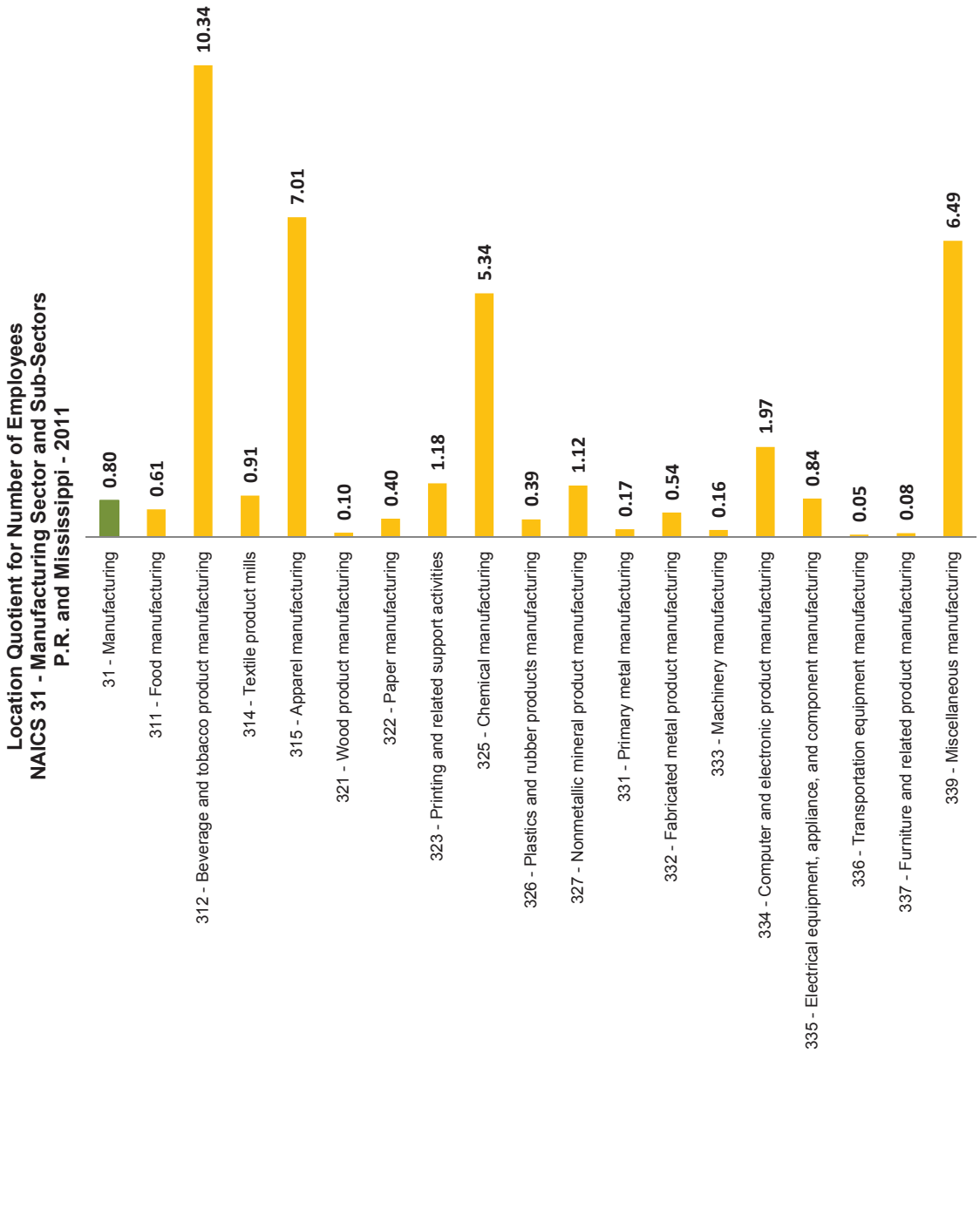
P.R. Annual Payroll per Employee as a Percentage of Annual Payroll per Employee in Massachusetts
NAICS 31 – Manufacturing Sector and Sub-Sectors
P.R. and Massachusetts, 2011

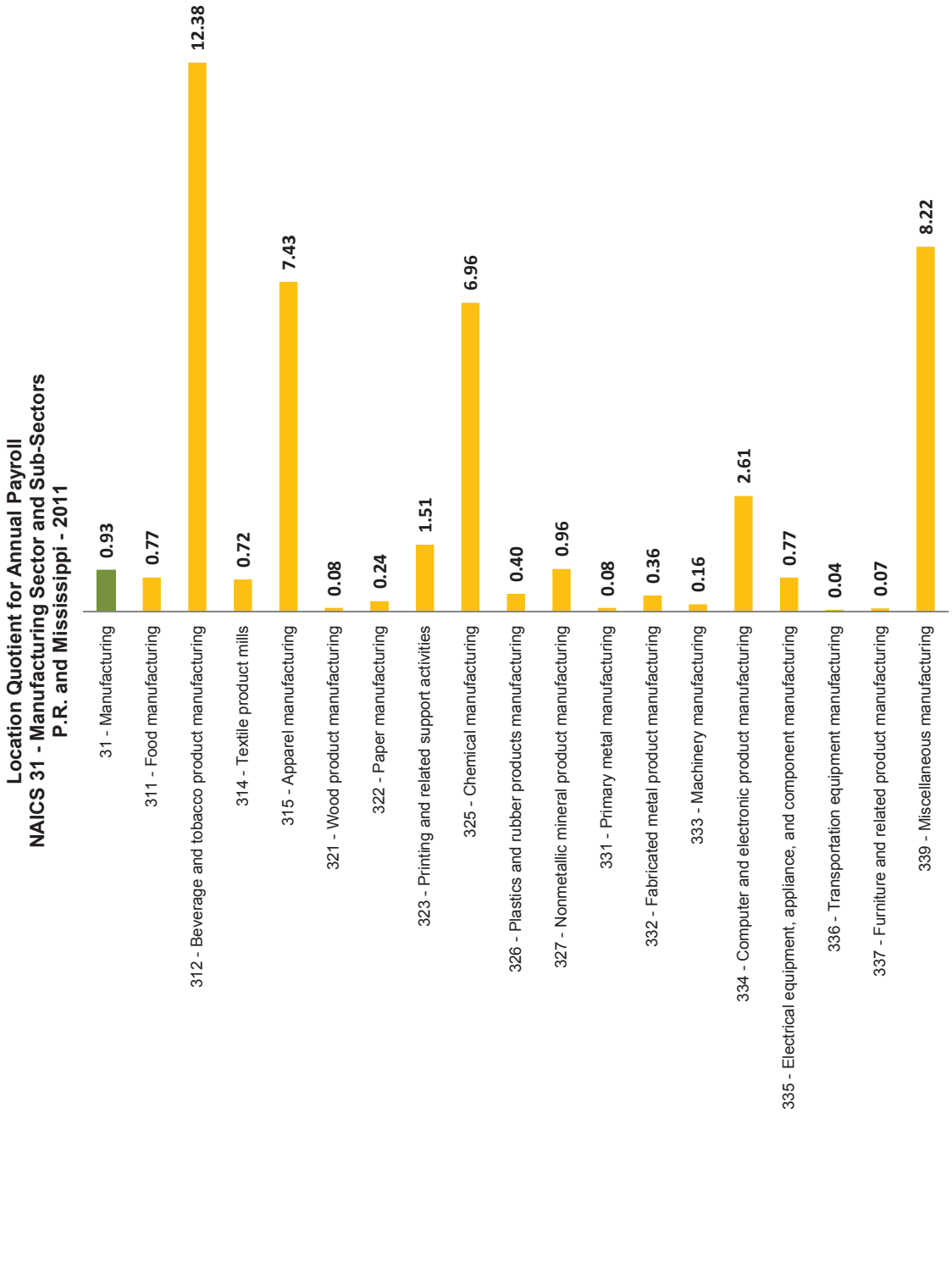


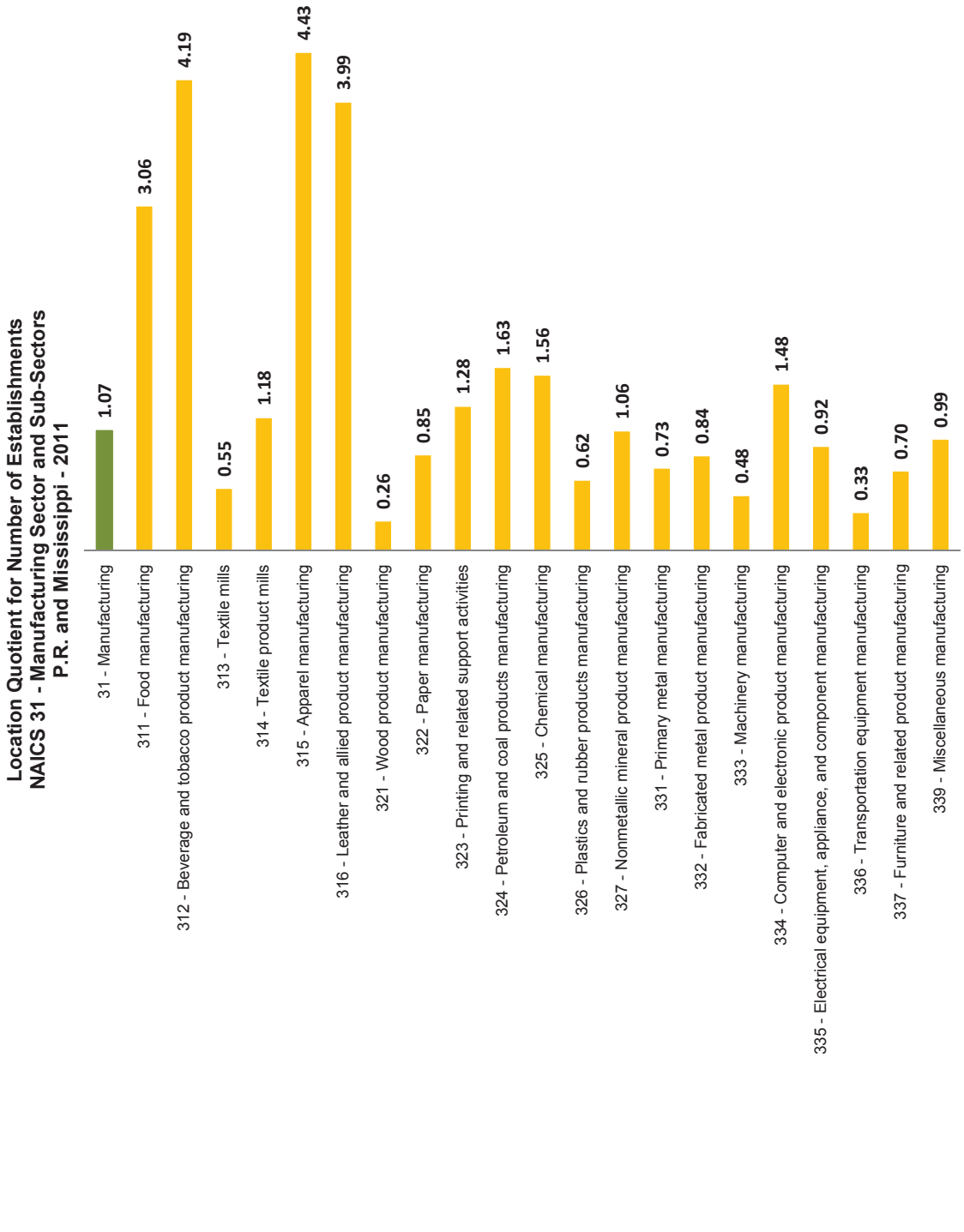
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Figure - EM5

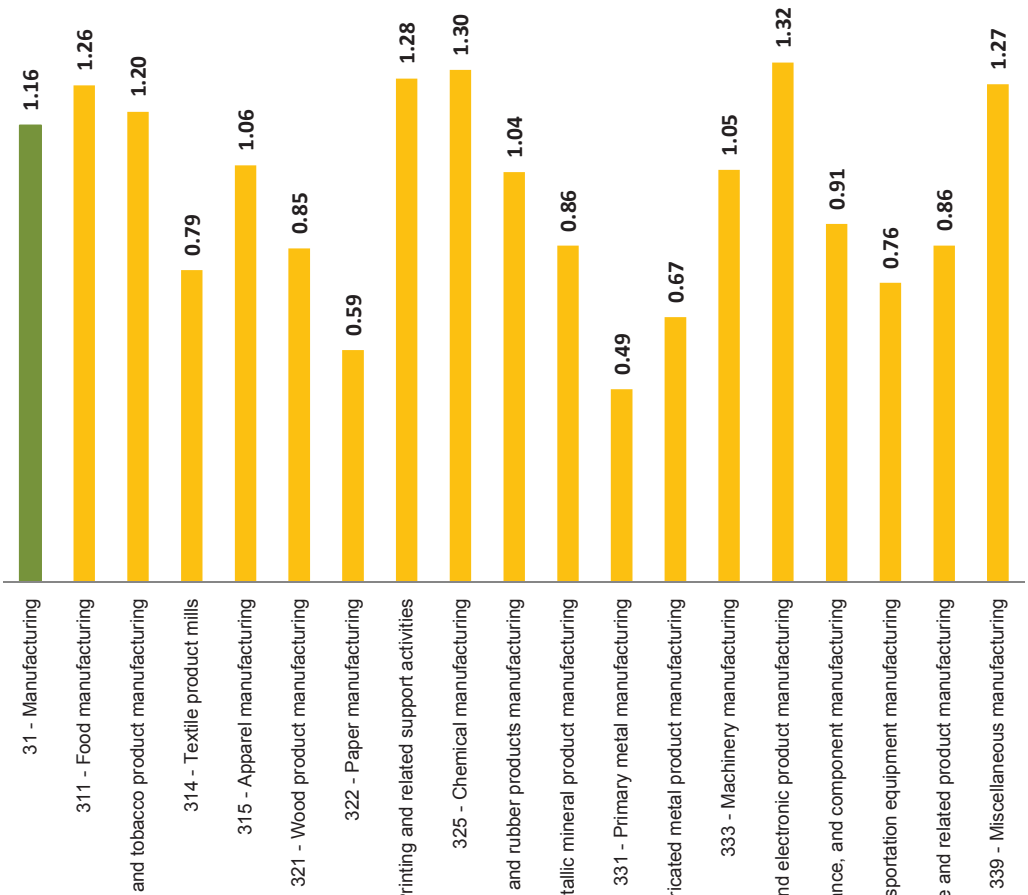
MISSISSIPPI


Location Quotient for Number of Employees
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and Mississippi - 2011
31 - Manufacturing
0.80
311 - Food manufacturing
0.61
312 - Beverage and tobacco product manufacturing
10.34
314 - Textile product mills
0.91
315 - Apparel manufacturing
7.01
321 - Wood product manufacturing
0.10
322 - Paper manufacturing
0.40
323 - Printing and related support activities
1.18
325 - Chemical manufacturing
5.34
326 - Plastics and rubber products manufacturing
0.39
327 - Nonmetallic mineral product manufacturing
1.12
331 - Primary metal manufacturing
0.17
332 - Fabricated metal product manufacturing
0.54
333 - Machinery manufacturing
0.16
334 - Computer and electronic product manufacturing
1.97
335 - Electrical equipment, appliance, and component manufacturing
0.84
336 - Transportation equipment manufacturing
0.05
337 - Furniture and related product manufacturing
0.08
339 - Miscellaneous manufacturing
6.49
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns


Location Quotient for Annual Payroll
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and Mississippi - 2011
31 - Manufacturing
0.93
311 - Food manufacturing
0.77
312 - Beverage and tobacco product manufacturing
12.38
314 - Textile product mills
0.72
315 - Apparel manufacturing
7.43
321 - Wood product manufacturing
0.08
322 - Paper manufacturing
0.24
323 - Printing and related support activities
1.51
325 - Chemical manufacturing
6.96
326 - Plastics and rubber products manufacturing
0.40
327 - Nonmetallic mineral product manufacturing
0.96
331 - Primary metal manufacturing
0.08
332 - Fabricated metal product manufacturing
0.36
333 - Machinery manufacturing
0.16
334 - Computer and electronic product manufacturing
2.61
335 - Electrical equipment, appliance, and component manufacturing
0.77
336 - Transportation equipment manufacturing
0.04
337 - Furniture and related product manufacturing
0.07
339 - Miscellaneous manufacturing
8.22
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

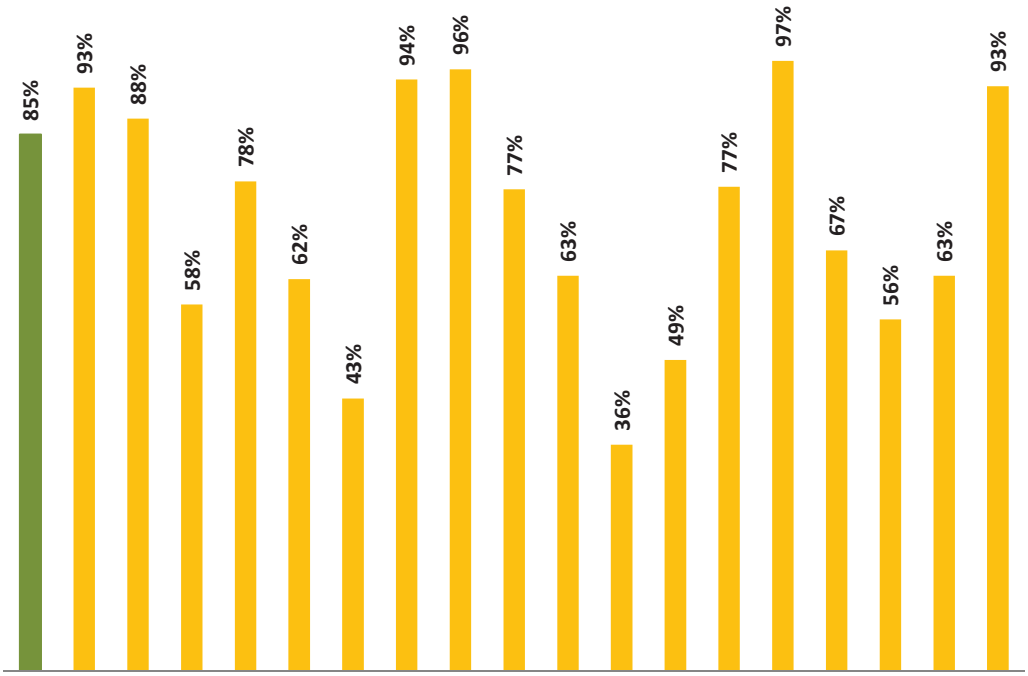

Location Quotient for Number of Establishments
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and Mississippi - 2011
31 - Manufacturing 1.07
311 - Food manufacturing 3.06
312 - Beverage and tobacco product manufacturing 4.19
313 - Textile mills 0.55
314 - Textile product mills 1.18
315 - Apparel manufacturing 4.43
316 - Leather and allied product manufacturing 3.99
321 - Wood product manufacturing 0.26
322 - Paper manufacturing 0.85
323 - Printing and related support activities 1.28
324 - Petroleum and coal products manufacturing 1.63
325 - Chemical manufacturing 1.56
326 - Plastics and rubber products manufacturing 0.62
327 - Nonmetallic mineral product manufacturing 1.06
331 - Primary metal manufacturing 0.73
332 - Fabricated metal product manufacturing 0.84
333 - Machinery manufacturing 0.48
334 - Computer and electronic product manufacturing 1.48
335 - Electrical equipment, appliance, and component manufacturing 0.92
336 - Transportation equipment manufacturing 0.33
337 - Furniture and related product manufacturing 0.70
339 - Miscellaneous manufacturing 0.99
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Location Quotient for Annual Payroll per Employee
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and Mississippi - 2011



Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

P.R. Annual Payroll per Employee as a Percentage of Annual Payroll per Employee in Mississippi
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and Mississippi - 2011



Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

NEW YORK

Location Quotient for Number of Employees
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and New York, 2011
31 - Manufacturing
2.11
311 - Food manufacturing
2.33
312 - Beverage and tobacco product manufacturing
6.23
313 - Textile mills
0.09
314 - Textile product mills
3.77
315 - Apparel manufacturing
4.92
316 - Leather and allied product manufacturing
7.69
321 - Wood product manufacturing
1.03
322 - Paper manufacturing
0.86
323 - Printing and related support activities
0.99
324 - Petroleum and coal products manufacturing
5.48
325 - Chemical manufacturing
6.60
326 - Plastics and rubber products manufacturing
0.92
327 - Nonmetallic mineral product manufacturing
1.84
331 - Primary metal manufacturing
0.39
332 - Fabricated metal product manufacturing
0.89
333 - Machinery manufacturing
0.30
334 - Computer and electronic product manufacturing
0.66
335 - Electrical equipment, appliance, and component manufacturing
3.50
336 - Transportation equipment manufacturing
0.51
337 - Furniture and related product manufacturing
0.85
339 - Miscellaneous manufacturing
4.36
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Figure - ENY1

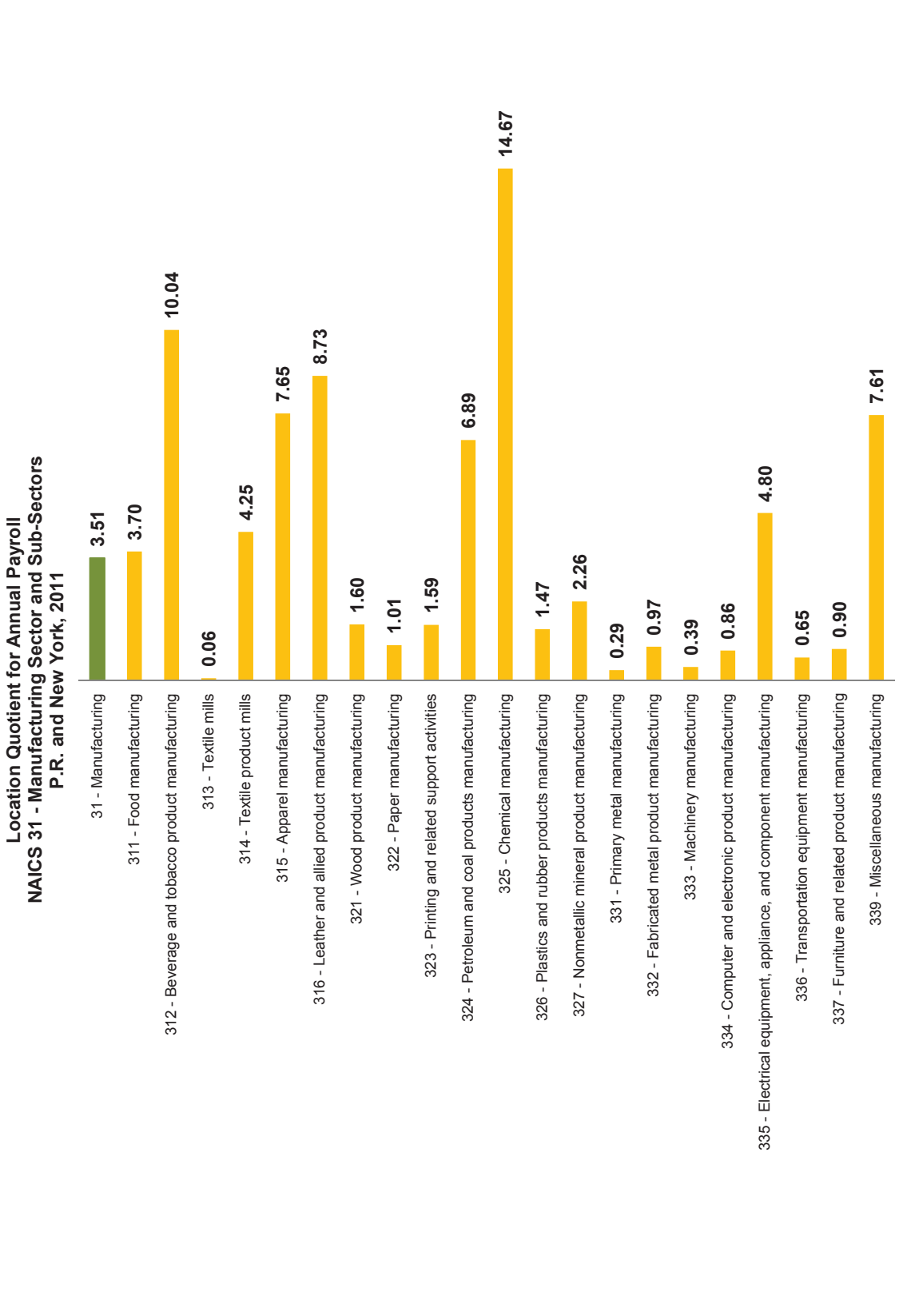

Location Quotient for Annual Payroll
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and New York, 2011
31 - Manufacturing
3.51
311 - Food manufacturing
3.70
312 - Beverage and tobacco product manufacturing
10.04
313 - Textile mills
0.06
314 - Textile product mills
4.25
315 - Apparel manufacturing
7.65
316 - Leather and allied product manufacturing
8.73
321 - Wood product manufacturing
1.60
322 - Paper manufacturing
1.01
323 - Printing and related support activities
1.59
324 - Petroleum and coal products manufacturing
6.89
325 - Chemical manufacturing
14.67
326 - Plastics and rubber products manufacturing
1.47
327 - Nonmetallic mineral product manufacturing
2.26
331 - Primary metal manufacturing
0.29
332 - Fabricated metal product manufacturing
0.97
333 - Machinery manufacturing
0.39
334 - Computer and electronic product manufacturing
0.86
335 - Electrical equipment, appliance, and component manufacturing
4.80
336 - Transportation equipment manufacturing
0.65
337 - Furniture and related product manufacturing
0.90
339 - Miscellaneous manufacturing
7.61
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Figure - NY2

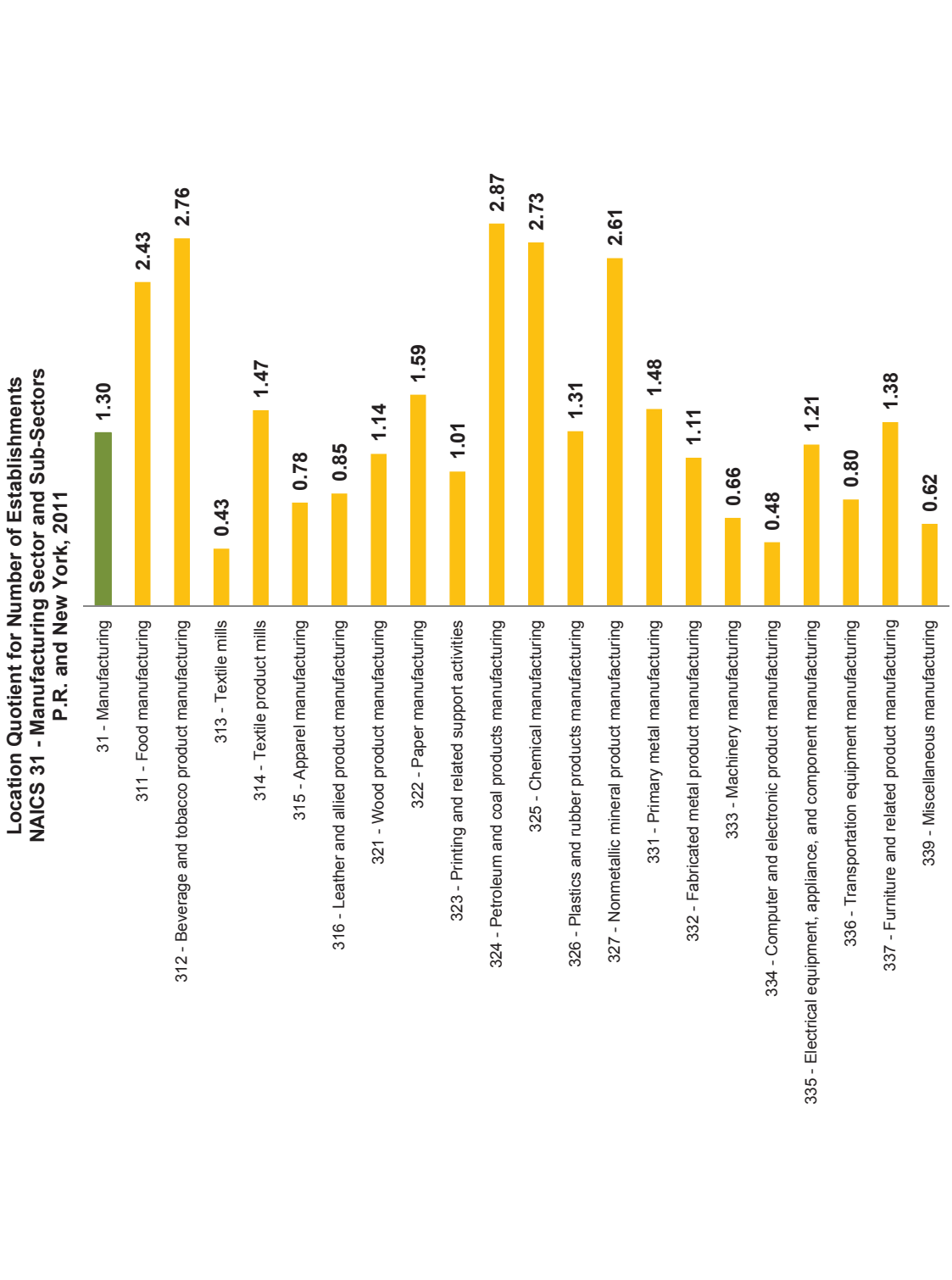
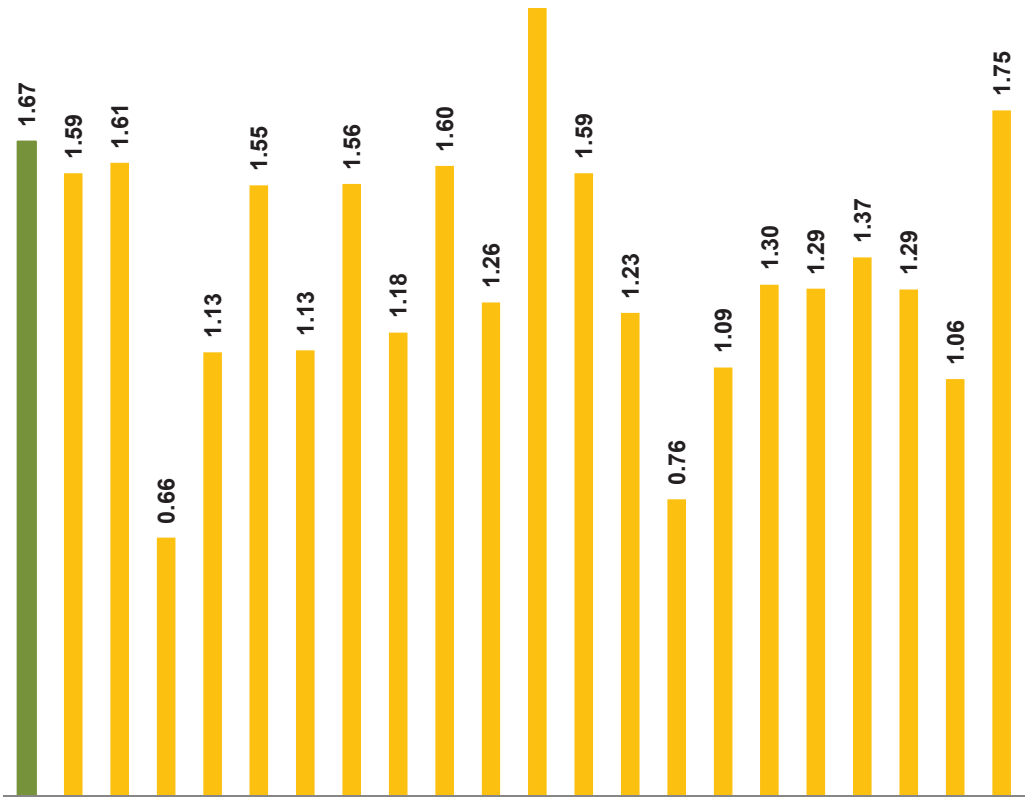

Location Quotient for Number of Establishments
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and New York, 2011
31 - Manufacturing 1.30
311 - Food manufacturing 2.43
312 - Beverage and tobacco product manufacturing 2.76
313 - Textile mills 0.43
314 - Textile product mills 1.47
315 - Apparel manufacturing 0.78
316 - Leather and allied product manufacturing 0.85
321 - Wood product manufacturing 1.14
322 - Paper manufacturing 1.59
323 - Printing and related support activities 1.01
324 - Petroleum and coal products manufacturing 2.87
325 - Chemical manufacturing 2.73
326 - Plastics and rubber products manufacturing 1.31
327 - Nonmetallic mineral product manufacturing 2.61
331 - Primary metal manufacturing 1.48
332 - Fabricated metal product manufacturing 1.11
333 - Machinery manufacturing 0.66
334 - Computer and electronic product manufacturing 0.48
335 - Electrical equipment, appliance, and component manufacturing 1.21
336 - Transportation equipment manufacturing 0.80
337 - Furniture and related product manufacturing 1.38
339 - Miscellaneous manufacturing 0.62
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

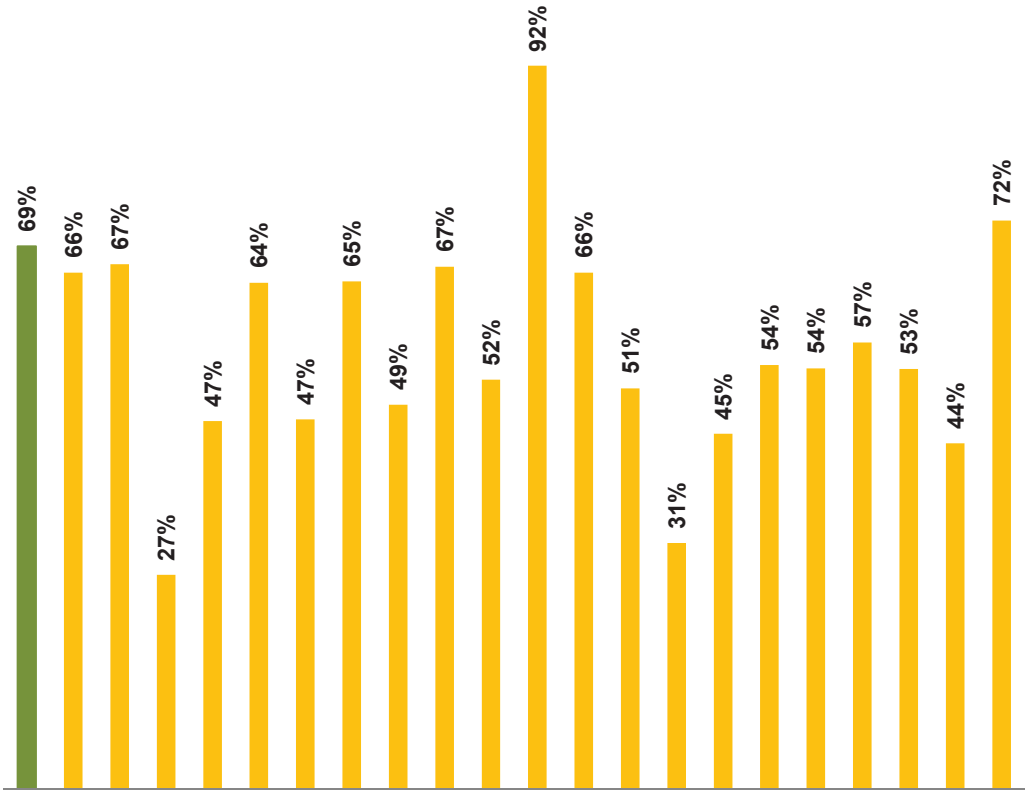
Figure - NY3

Location Quotient for Annual Payroll per Employee
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and New York, 2011



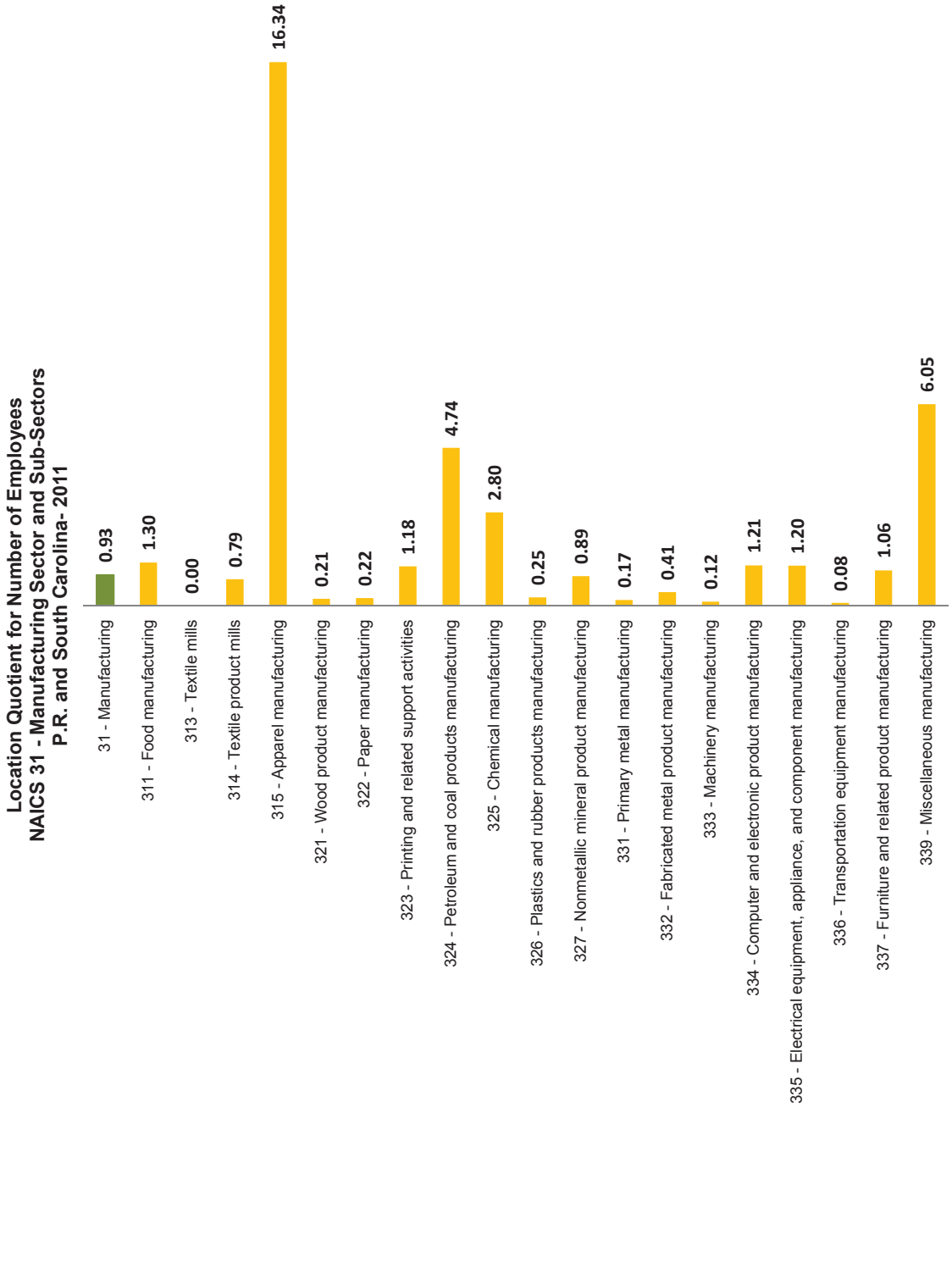
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

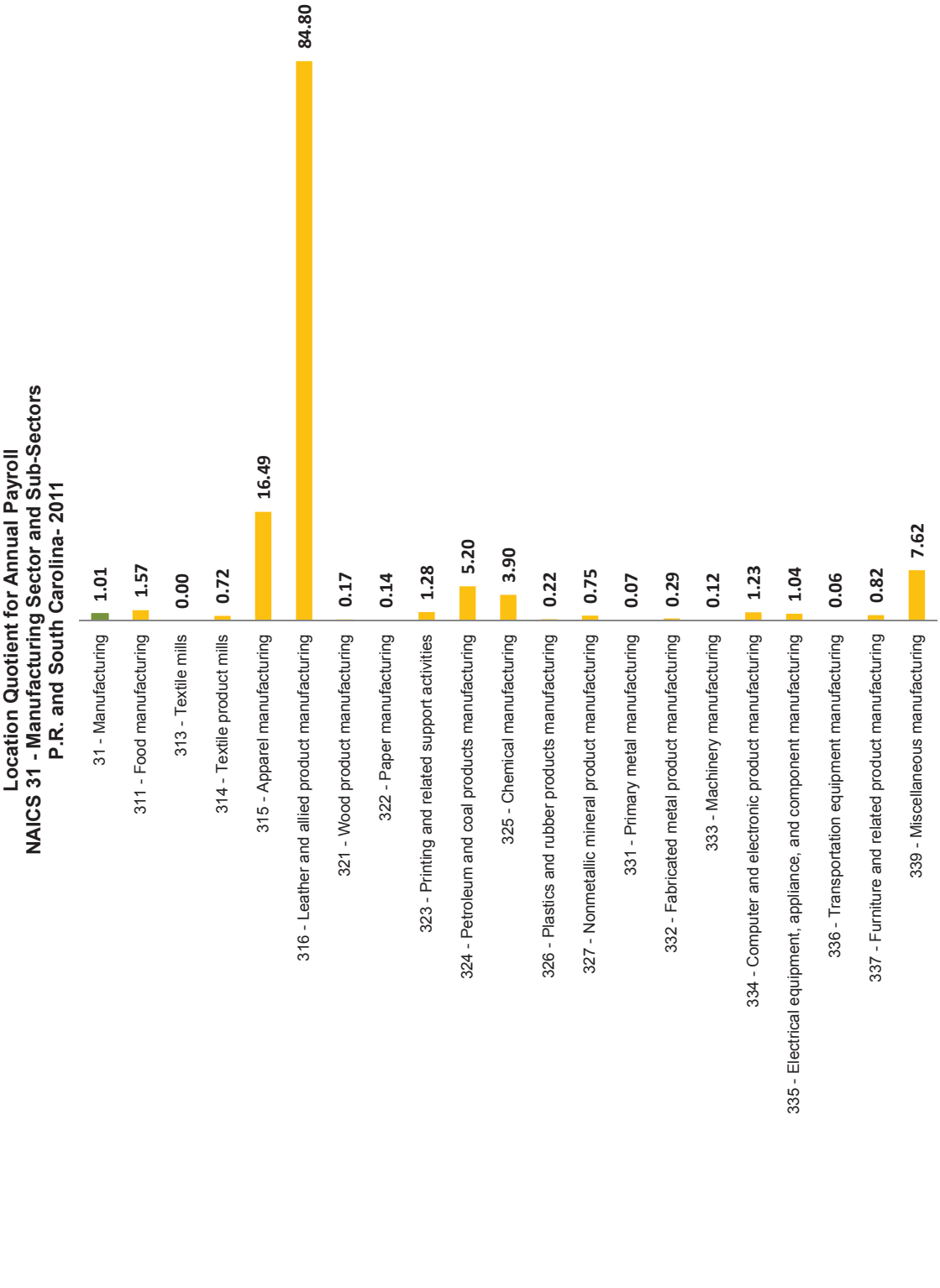
P.R. Annual Payroll per Employee as a Percentage of Annual Payroll per Employee in New York
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and New York, 2011

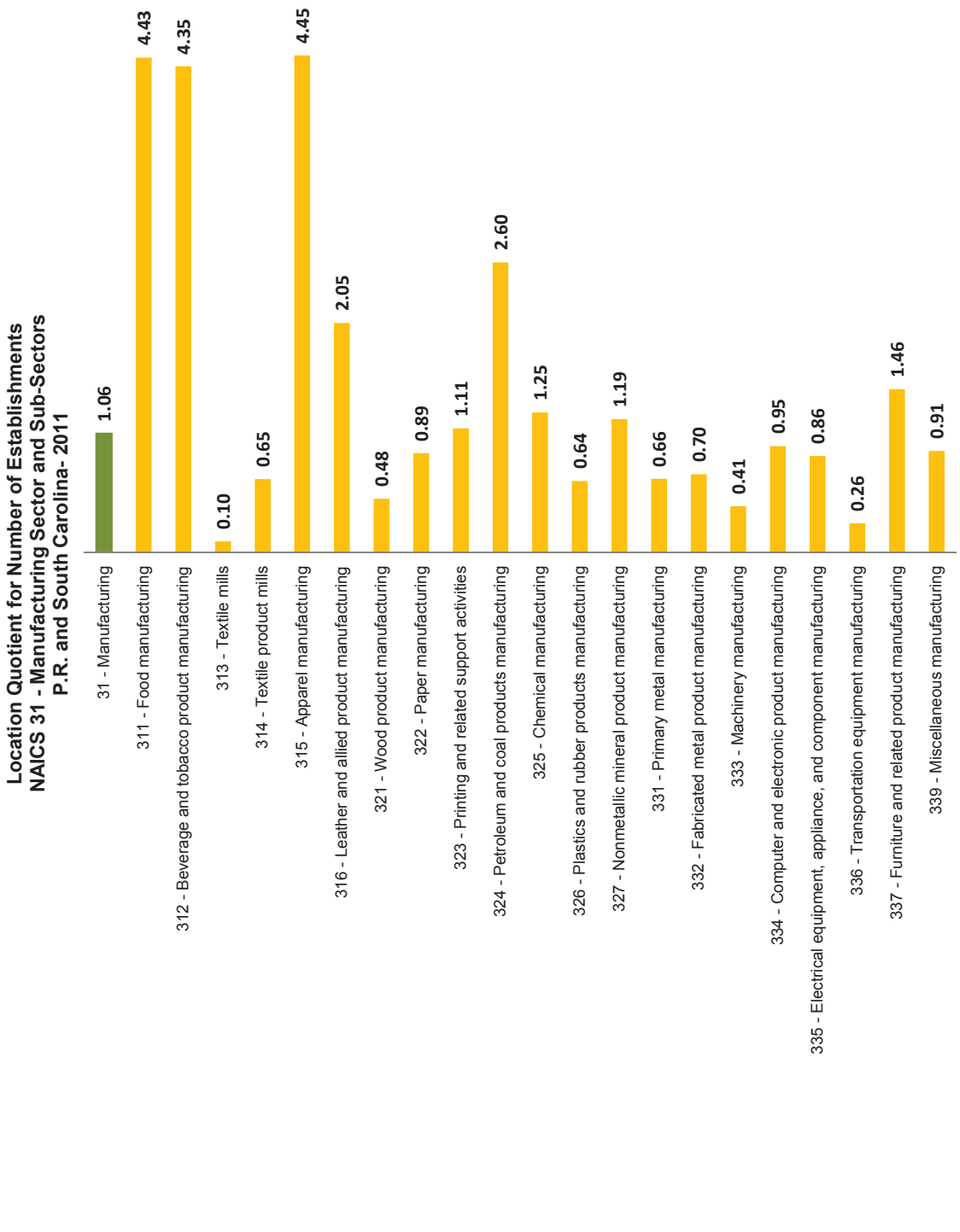


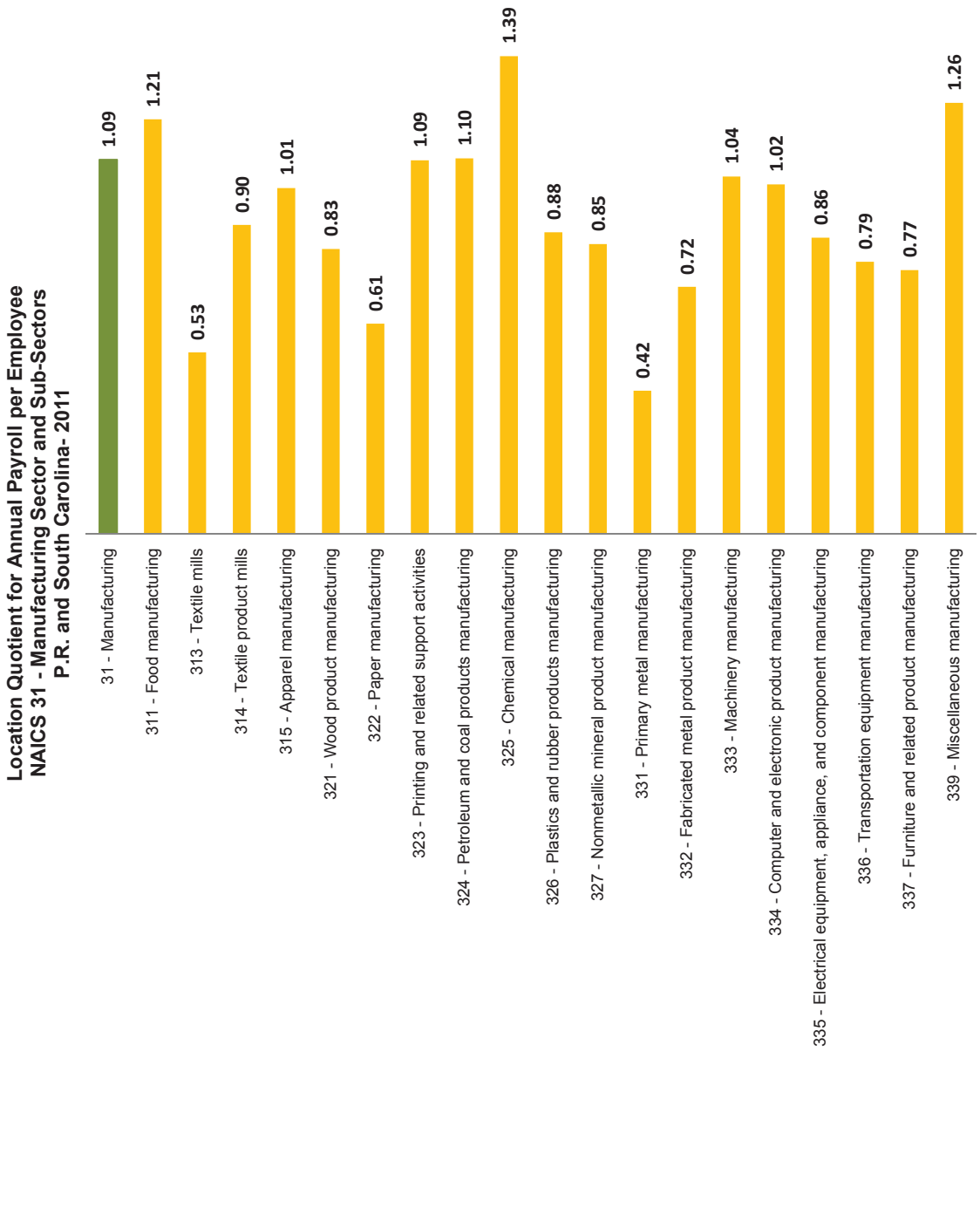
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

SOUTH CAROLINA

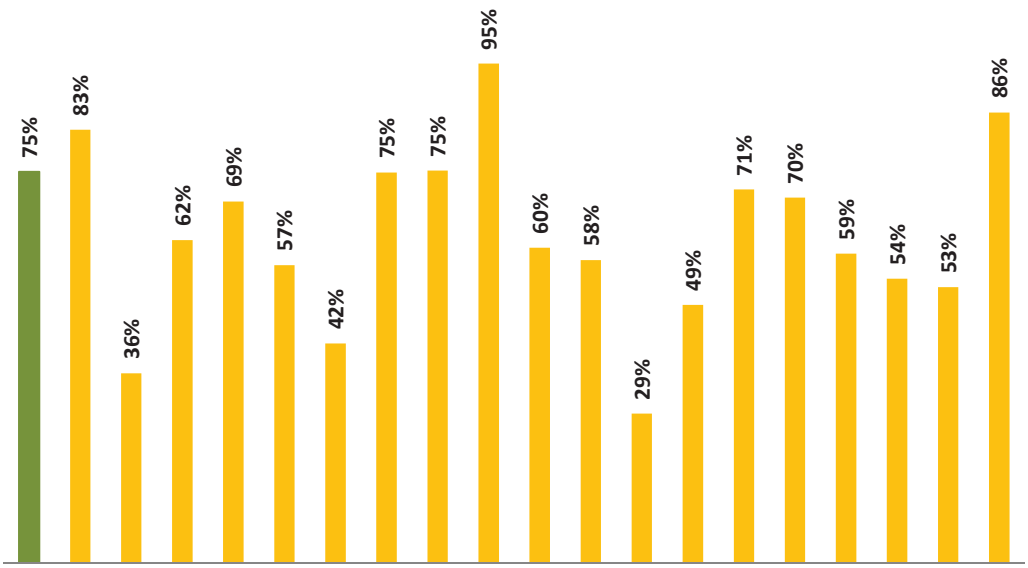

Location Quotient for Number of Employees
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and South Carolina- 2011
31 - Manufacturing
0.93
311 - Food manufacturing
1.30
313 - Textile mills
0.00
314 - Textile product mills
0.79
315 - Apparel manufacturing
16.34
321 - Wood product manufacturing
0.21
322 - Paper manufacturing
0.22
323 - Printing and related support activities
1.18
324 - Petroleum and coal products manufacturing
4.74
325 - Chemical manufacturing
2.80
326 - Plastics and rubber products manufacturing
0.25
327 - Nonmetallic mineral product manufacturing
0.89
331 - Primary metal manufacturing
0.17
332 - Fabricated metal product manufacturing
0.41
333 - Machinery manufacturing
0.12
334 - Computer and electronic product manufacturing
1.21
335 - Electrical equipment, appliance, and component manufacturing
1.20
336 - Transportation equipment manufacturing
0.08
337 - Furniture and related product manufacturing
1.06
339 - Miscellaneous manufacturing
6.05
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns


Location Quotient for Annual Payroll
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and South Carolina- 2011
31 - Manufacturing
1.01
311 - Food manufacturing
1.57
313 - Textile mills
0.00
314 - Textile product mills
0.72
315 - Apparel manufacturing
16.49
316 - Leather and allied product manufacturing
84.80
321 - Wood product manufacturing
0.17
322 - Paper manufacturing
0.14
323 - Printing and related support activities
1.28
324 - Petroleum and coal products manufacturing
5.20
325 - Chemical manufacturing
3.90
326 - Plastics and rubber products manufacturing
0.22
327 - Nonmetallic mineral product manufacturing
0.75
331 - Primary metal manufacturing
0.07
332 - Fabricated metal product manufacturing
0.29
333 - Machinery manufacturing
0.12
334 - Computer and electronic product manufacturing
1.23
335 - Electrical equipment, appliance, and component manufacturing
1.04
336 - Transportation equipment manufacturing
0.06
337 - Furniture and related product manufacturing
0.82
339 - Miscellaneous manufacturing
7.62
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns


Location Quotient for Number of Establishments
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and South Carolina- 2011
31 - Manufacturing
1.06
311 - Food manufacturing
4.43
312 - Beverage and tobacco product manufacturing
4.35
313 - Textile mills
0.10
314 - Textile product mills
0.65
315 - Apparel manufacturing
4.45
316 - Leather and allied product manufacturing
2.05
321 - Wood product manufacturing
0.48
322 - Paper manufacturing
0.89
323 - Printing and related support activities
1.11
324 - Petroleum and coal products manufacturing
2.60
325 - Chemical manufacturing
1.25
326 - Plastics and rubber products manufacturing
0.64
327 - Nonmetallic mineral product manufacturing
1.19
331 - Primary metal manufacturing
0.66
332 - Fabricated metal product manufacturing
0.70
333 - Machinery manufacturing
0.41
334 - Computer and electronic product manufacturing
0.95
335 - Electrical equipment, appliance, and component manufacturing
0.86
336 - Transportation equipment manufacturing
0.26
337 - Furniture and related product manufacturing
1.46
339 - Miscellaneous manufacturing
0.91
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns


Location Quotient for Annual Payroll per Employee
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and South Carolina- 2011
31 - Manufacturing 1.09
311 - Food manufacturing 1.21
313 - Textile mills 0.53
314 - Textile product mills 0.90
315 - Apparel manufacturing 1.01
321 - Wood product manufacturing 0.83
322 - Paper manufacturing 0.61
323 - Printing and related support activities 1.09
324 - Petroleum and coal products manufacturing 1.10
325 - Chemical manufacturing 1.39
326 - Plastics and rubber products manufacturing 0.88
327 - Nonmetallic mineral product manufacturing 0.85
331 - Primary metal manufacturing 0.42
332 - Fabricated metal product manufacturing 0.72
333 - Machinery manufacturing 1.04
334 - Computer and electronic product manufacturing 1.02
335 - Electrical equipment, appliance, and component manufacturing 0.86
336 - Transportation equipment manufacturing 0.79
337 - Furniture and related product manufacturing 0.77
339 - Miscellaneous manufacturing 1.26
Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

P.R. Annual Payroll per Employee as a Percentage of Annual Payroll per Employee in South Carolina
NAICS 31 - Manufacturing Sector and Sub-Sectors
P.R. and South Carolina- 2011



Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

Table E3: Selected Location Quotient Combinations
NAICS 31 - 33 - Manufacturing Sector and Sub-Sectors
Puerto Rico and Selected States, 2011

Industrial Sector	Connecticut			Florida			Hawaii			Massachusetts			Mississippi			New York			South Carolina		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
31 - Manufacturing				■			■			■						■					
311 - Food manufacturing	■						■			■						■			■		
312 - Beverage and tobacco product manufacturing	■						■			■			■			■					
313 - Textile mills		■	■								■	■					■	■		■	■
314 - Textile product mills							■			■					■	■				■	■
315 - Apparel manufacturing				■			■			■			■						■		
316 - Leather and allied product manufacturing										■											
321 - Wood product manufacturing							■			■				■	■	■				■	■
322 - Paper manufacturing			■											■	■					■	■
323 - Printing and related support activities				■			■						■						■		
324 - Petroleum and coal products manufacturing	■			■						■						■			■		
325 - Chemical manufacturing	■			■						■			■			■			■		
326 - Plastics and rubber products manufacturing				■			■													■	■
327 - Nonmetallic mineral product manufacturing	■			■						■						■					■
331 - Primary metal manufacturing		■	■								■	■		■	■			■		■	■
332 - Fabricated metal product manufacturing		■	■								■	■		■	■					■	■
333 - Machinery manufacturing					■	■					■	■									
334 - Computer and electronic product manufacturing					■	■					■	■	■								
335 - Electrical equipment, appliance, and component manufacturing				■										■	■	■					
336 - Transportation equipment manufacturing											■	■		■	■					■	■
337 - Furniture and related product manufacturing														■	■						
339 - Miscellaneous manufacturing																					

Legend:

A. LQ of Numbers of Employees, Total Annual Payroll, Number of Establishments, and Payroll per Employee: 1 or higher

B. LQ of Numbers of Employees, Total Annual Payroll, Number of Establishments, and Payroll per Employee: 1 or lower

C. LQ of Numbers of Employees and Payroll per Employee: 1 or lower

Table E4-A: Annual Payroll per Employee Location Quotient of 1 or Lower
NAICS 31-33 - Manufacturing Sector and Sub-Sectors
Puerto Rico and Selected States, 2011

Industrial Sector	Connecticut	Florida	Hawaii	Massachusetts	Mississippi	New York	South Carolina
311 - Food manufacturing	N/D	0.99	N/D	N/D	N/D	N/D	N/D
312 - Beverage and tobacco product manufacturing	N/D	0.98	N/D	N/D	N/D	N/D	N/D
313 - Textile mills	0.64	N/D	N/D	0.62	N/D	0.66	N/D
314 - Textile product mills	N/D	0.93	N/D	N/D	0.79	N/D	N/D
316 - Leather and allied product manufacturing	N/D	0.72	N/D	N/D	N/D	N/D	N/D
321 - Wood product manufacturing	N/D	N/D	N/D	N/D	0.85	N/D	N/D
322 - Paper manufacturing	0.98	0.71	N/D	N/D	0.59	N/D	N/D
327 - Nonmetallic mineral product manufacturing	N/D	N/D	N/D	N/D	0.86	N/D	N/D
331 - Primary metal manufacturing	0.68	0.62	N/D	0.84	0.49	0.76	N/D
332 - Fabricated metal product manufacturing	0.89	0.84	0.68	0.88	0.67	N/D	N/D
333 - Machinery manufacturing	N/D	0.92	N/D	0.98	N/D	N/D	N/D
334 - Computer and electronic product manufacturing	N/D	0.91	N/D	0.96	N/D	N/D	N/D
335 - Electrical equipment, appliance, and component manufacturing	N/D	N/D	N/D	N/D	0.91	N/D	N/D
336 - Transportation equipment manufacturing	N/D	N/D	N/D	0.90	0.76	N/D	N/D
337 - Furniture and related product manufacturing	0.92	0.87	0.69	0.86	0.86	N/D	N/D

Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

*N/D No Data

Table E4-B: Annual Payroll per Employee Location Quotient of 1.5 or Higher
NAICS 31-33 - Manufacturing Sector and Sub-Sectors
Puerto Rico and Selected States, 2011

Industrial Sector	Connecticut	Florida	Hawaii	Massachusetts	Mississippi	New York	South Carolina
31 - Manufacturing	N/D	N/D	N/D	N/D	N/D	1.67	N/D
311 - Food manufacturing	1.50	N/D	N/D	N/D	N/D	1.59	N/D
312 - Beverage and tobacco product manufacturing	N/D	N/D	N/D	N/D	N/D	1.61	N/D
315 - Apparel manufacturing	N/D	N/D	N/D	N/D	N/D	1.55	N/D
321 - Wood product manufacturing	N/D	N/D	N/D	N/D	N/D	1.56	N/D
323 - Printing and related support activities	N/D	N/D	N/D	N/D	N/D	1.6	N/D
325 - Chemical manufacturing	1.97	1.63	N/D	1.51	N/D	2.22	N/D
326 - Plastics and rubber products manufacturing	N/D	N/D	N/D	N/D	N/D	1.59	N/D
339 - Miscellaneous manufacturing	N/D	N/D	1.79	N/D	N/D	1.75	N/D

Calculated by PR Planning Board with data from the U.S. Census Bureau, County Business Patterns

*N/D No Data

Section 2

Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis of the Manufacturing Sector in Puerto Rico

I. Introduction

This section reports the SWOT analysis of the manufacturing sector in Puerto Rico. This analysis presents the strengths, weaknesses, opportunities and threats in the development of this sector in the island. It makes it possible to recognize the positive and negative factors affecting this sector's growth path and establishing an equilibrium between its internal capacities and external possibilities. This analysis depend upon the statistical analyses reported in section 2. But it also depends on the review of Puerto Rico and other countries' development plans and other relevant literature. Finally, it took into account the views of several Puerto Rico's economists that are very knowledgeable about this economic sector[12].

The section contain five Swot analyses. One is of the whole sector and the rest are individual analyses for the following key sub-sectors: pharmaceutical, medical device, food and apparel industries. The first two, are High-Tech industries while the last two have mainly labor intensive production processes. Thus, the analyses are representative of industries with this two types of productions process. It represents export-oriented industries and industries whose production is directed to local market.

II. The SWOT Analyses

The results of the statistical analyses discussed in the previous section were used as one of the inputs in the development of the SWOT analysis, as mentioned above. For example, it was reported in that section, that there is a gap between the U.S. and Puerto Rico's labor compensation in this economic sector (manufacturing wages in the island are around 33% lower than in United States). Thus, this is a competitive advantage of the island's manufacturing industry or a Strength.

In was found, also, that the pharmaceutical industry in Puerto Rico has a greater share of the total manufacturing employment in comparison to the U.S.A. In 2012, the pharmaceutical employment was nearly 9 times more concentrated in the island than in the USA. This industry has a location quotient (LQ) of almost 9. Another high-technology distinguishing industry is the medical devices' industry with a LQ of 5.28. The Strong specialization of these industries represent a Strength of this economic sector

The results of the artificial intelligence model (ANN) imply that energy and labor costs, and structural dummy variables are important in explaining the dynamics of the manufacturing sector's employment. These variables have negative effects on manufacturing employment growth, consequently high levels of them represent Weaknesses of this economic sector.

This mathematical model (ANN) also reveals that the flows of the United States' foreign direct investment to Latin America and other countries in the region, are crucial in explaining the downward trend in manufacturing employment. These can be taken as proxies for the United States' trade agreements, as NAFTA and CAFTA, and other changes in global competitiveness. This is a Threat.

[12] *I am grateful to William Lockwood Benet and José G. Garcia López for their useful comments and information provided.*

On the other hand, the relative high level of the aggregate demand (imports and consumption) in the country can be taken as an Opportunity for future growth in this sector. Tables 2.1A to 2.5 contains the complete SWOT analysis for the whole manufacturing sector and the key sub-sectors analyzed in section 1.

Table 2.1 A

Swot Analysis: Manufacturing Sector

INTERNAL ANALYSIS	
Strengths	**Weakness**
Puerto Rico has lower wages rates than the United States.	High and volatile energy cost
High labor productivity	Labor compensation is high compared to some developing countries
An extended industrial production experience High-quality Production standards (several industries) Developed industrial infrastructure	Puerto Rico's economic activity's structural problems
Strong specialization of the island in the manufacturing of medicines, medical devices, and food. (High LQs)	Relative small local market
A large proportion of manufacturing industries are small and medium (PYMES), which typically show greater resilience to economic shocks than larger corporations, (In 2011, 38% of the MNF firms had less than 5 employees and 72% < 50)	Limited access of local producers to capital markets (venture capital) Small and medium firms have limited access to funding sources
Relative good physical infrastructure of the island	Weak linkages to R&D resources (private and academic)
Industry rivals working together under various organizations	Incomplete Business Clusters (lack of universities and others research institutions participation)
Geographic location with access to the Caribbean and Central America markets	Some local firms have competition with U.S.A. firms. (Although the U.S.A. has higher labor costs, it also has higher labor productivity)
	High costs associated with crime avoidance
	Under-developed entrepreneurial spirit

Table 2.1B

Swot Analysis: Manufacturing Sector

EXTERNAL ANALYSIS	
Opportunities	**Threats**
Relative high aggregate demand	Emergence of low-cost production countries in the region (NAFTA, CAFTA).
Low interest rates (increased probability of projects viability)	Puerto Rico's economic activity is expected to be weak in the near future
Expected growth in U.S. economy according to the slope the yield curve	Tax system complexity for local producers
Possibilities to provide lower energy costs from renewable sources	High import levels of intermediate and final products
Expansion potential for local food sub-sector. (Substitution of imports.)	Global economic crisis
High demands of local goods in the United States from Puerto Rican diaspora, (opportunity to increase exports)	Absence of strategies to increase industrial linkages (principally between local producers)
Manufacturing expertise transferable from principal industries (principally non-locals) to other industries Possibilities to transfer technology from foreign firms to local producers (spillovers)	Risks to government deficits problems (fiscal policies to raise revenues)
Human resources and infrastructure required for developing local firms innovation activities	External dependency in energy
	Deficiencies in public educational system
	Adverse demographic trends Skilled labor migration (Brain Drain)
	High risk of deterioration of physical infrastructure as results of government budget deficits.
	Weak financial system

Table 2.2 Swot Analysis: Chemical (pharmaceutical) sub-sector	
INTERNAL ANALYSIS	
Strengths	**Weakness**
An extended industrial experience	Puerto Rico's Economic activity's structural problems
Puerto Rico has lower wages rates than the United States High labor productivity Higher education institutions programs that provide the human resources needed	High and volatile energy cost
Production at global quality-standards Strong specialization of the island	Inadequate R&D activities in the island .
Rival players within industries working together in manufacturing organizations	Incomplete Business Cluster . Weak linkages between firms, academic and other research institutions
EXTERNAL ANALYSIS	
Opportunities	**Threats**
Expected growth in U.S. economy	Slow economic growth in the U.S. A.
Potential growth in investment from low interest rates	Lack of stability and simplicity in tax policies of the island
Markets in the surrounding countries	Global economic crisis
Good foundation and infrastructure required for their own innovation process	Patents' expirations
Opportunity to R&D in Puerto Rico Growing demand for products	Lower production costs in others countries.

Table 2.3 Swot Analysis: Medical Device sub-Sector	
INTERNAL ANALYSIS	
Strengths	**Weakness**
An extended industrial experience. Production at international standards	High and volatile energy cost
High labor productivity	Relative small local markets
Puerto Rico has lower wages rates than the United States	Puerto Rico's economic activity structural problems
Higher education institutions programs that provide the human resources needed	
EXTERNAL ANALYSIS	
Opportunities	**Threats**
Expected growth in US economy	Emergence of low-cost production countries in the region (NAFTA, CAFTA)
Growing demand for products	Risks to government-finances' stability policies Skilled labor migration (Brain Drain)
As nations continue to growth, start to become less competitive on labor costs	Global economics crisis
Opportunity to R&D in Puerto Rico	Absence of strategies to increase industrial linkages

Table 2.4 Swot Analysis: **Food** **sub-Sector**	
INTERNAL ANALYSIS	
Strengths	**Weakness**
High labor productivity	High and volatile energy cost
An extended industrial experience	High import levels of intermediate products
Strong specialization of the island in the manufacturing of food (see LQ,s)	Absence of strategies to increase industrial linkages of this sector to the agricultural and retail and wholesale trade sectors
Relatively high demand for local products	Incomplete implementation of clustering strategies
EXTERNAL ANALYSIS	
Opportunities	**Threats**
Opportunity to import substitutions (high imports)	Tax system complexity for local producers.
Expected growth in U.S. High demands of local goods in the United States from Puerto Rican diaspora, (opportunity to increase exports)	Emergence of low-cost production countries in the region
Possibilities to increase backwards and forwards industrial linkages	High import levels of final products
Potential expansion for local food industries	Weak growth of the island's economy in the near future.
	Slow economic growth in the U.S.A

Table 2.5 SWOT Analysis: Apparel sub-Sector

INTERNAL ANALYSIS	
Strengths	**Weakness**
Puerto Rico has lower wages rates than the United States	High and volatile energy cost.
High labor productivity	Puerto Rico's Economic activity's structural problems (936)
Production at international standards and quality by the island industry	Relatively small local markets
Link with U.S. economy (military apparel and occupational uniforms manufacturing)	Tax system complexity for local producers
EXTERNAL ANALYSIS	
Opportunities	**Threats**
Relative high aggregate demand	Reduction of labor intensive manufacturing sectors in United States.
Low interest rates (increase probability of projects viability)	Emergence of low-cost production countries in the region
Expected growth in U.S. economy	High import levels of intermediate and final products
As nations continue to growth they reduce their labor costs advantage	Global economic crisis
Available techniques to increase competitiveness by raising productivity. Recent technological developments in clothing production equipment focus on machinery technologies.	Low local supply of raw materials

III. Final Remarks

The manufacturing sector in Puerto Rico has been exposed to several adverse shocks that have reduced its production possibilities. This sector has experienced significant challenges that have raised questions about its competitiveness and its ability to growth in a world with different production inputs costs and increased trade liberalization policies. Some of the factors affecting the competitiveness of the manufacturing sector in the island have been associated to limitations in the macro-economic environment and changes in the institutional frameworks in which Puerto Rican manufacturers operate. However the island has the potential to increase this sector's output in the future. According to the SWOT analysis there are opportunities to increase the export levels of some of the manufacturing industries and to increase the production of the local markets thus reducing imports. Specific strategies to develop this economic sector are presented in Section 4.