

The Construction of Encore Boston Harbor: Spending, Employment, and Economic Impacts

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Executive Summary

The UMass Donahue Institute ([UMDI](#)) is a member of the Social and Economic Impacts of Gambling in Massachusetts ([SEIGMA](#)) research team charged with carrying out aspects of the research agenda of the Massachusetts Gaming Commission (MGC). This report seeks to inform stakeholders about the construction of the Encore Boston Harbor casino and its economic impacts in the Commonwealth. Over the course of the casino's construction, UMDI worked with the Massachusetts Gaming Commission and the project's construction managers at Suffolk Construction Company to obtain data on the spending, employment, and wages related to the construction of the casino. These data are summarized here along with an estimate of the total economic impacts to the Commonwealth of Massachusetts resulting from the casino construction.

Wynn Resorts spent nearly \$1.6 billion to build the Encore Boston Harbor casino. This amount differs from the larger amount that is commonly reported in the press. The larger amount represents total investment of which construction is a component. The difference between investment and construction includes design fees; furniture, fixtures, and equipment (FF&E); operating supplies and equipment (OSE); license/application fees; and pre-opening expenses.

Where were the construction dollars spent?

- Almost three-quarters of the construction budget (\$1.1B of \$1.6B) went to firms based in Massachusetts. Nearly 60 percent of Massachusetts' share (\$662M) (or 40 percent of the total) remained in Middlesex and Suffolk Counties.
- Firms based in the City of Everett received \$32 million in contracts.
- The remaining quarter that went out of state (\$446M) was distributed among 36 states. Rhode Island, Connecticut, and New York accounted for over \$200 million of that amount while \$71 million went outside of the country.
- Thirteen percent of the total contract value went to firms that met at least one element of the diversity criteria while another fifth went to local businesses from the region.

Where did construction workers reside and was it a diverse workforce?

- In total, half of in-state workers lived in Middlesex and Suffolk Counties. Residents of Everett did about five percent of all the work.
- Workforce diversity statistics suggest that the Encore Boston Harbor construction workforce largely reflected the composition of the populations from which they were drawn.
- Members of minority groups did one-quarter of the work on the Encore Boston Harbor construction site, which is similar to their share of statewide construction workers. Overall, the construction workers were over 90 percent male and non-veteran, which is also similar to statewide shares.
- The share of the work done by minority construction workers from Everett was less than the city's minority share of working age population. Our findings showed that non-White workers did 46 percent of all the work compared to 63 percent of Everett's working age population being Black, Hispanic, Native American, or Asian. We could not find reliable data on the racial/ethnic mix of only those workers who are in construction occupations.

What were the total statewide economic impacts of constructing Encore Boston Harbor?

- Increases in company revenues and employment drive larger changes in the economy, which are estimated using an economic model.
- Overall, total statewide economic activity (also known as output) increased by \$2.6 billion over the five-year construction period.

- Net new economic activity (i.e., value added or gross state product) totaled almost \$1.6 billion.
- About 2,500 jobs were created or supported by this economic activity. These jobs accrued \$1 billion of income.
- When the estimates of total economic impacts are compared to Encore Boston Harbor's construction expenditures, the results show that every \$1.55 of construction spending created about \$1 of additional economic activity in Massachusetts and every in-state job created another 0.85 jobs elsewhere in the Commonwealth.

Introduction

The UMass Donahue Institute ([UMDI](#)) is a member of the Social and Economic Impacts of Gambling in Massachusetts ([SEIGMA](#)) project team that has been charged with carrying out aspects of the research agenda of the Massachusetts Gaming Commission (MGC). The MGC's research agenda creates the opportunity to measure the actual economic outcomes of the casino facilities as they are built and carry out operations in the state. This report describes the activities undertaken to construct the Commonwealth's second integrated resort casino—Encore Boston Harbor along the Mystic River in Everett, Massachusetts—and measures the economic impacts generated through this process.

In November of 2011, Governor Deval Patrick signed the Expanded Gaming Act, which allows for the creation of up to three commercial resort-style casinos and one slot parlor.¹ To reduce internal competition among casinos and maximize their potential benefits, the Commonwealth was divided into three regions, shown in Figure 1, with each region able to obtain one casino license. The slot parlor license was not geographically limited. To date, two casino licenses in Regions A and B and the slot parlor license have been awarded as shown in Figure 2.

Figure 1: Massachusetts Gaming Regions²



¹ <http://massgaming.com/about/expanded-gaming-act>.

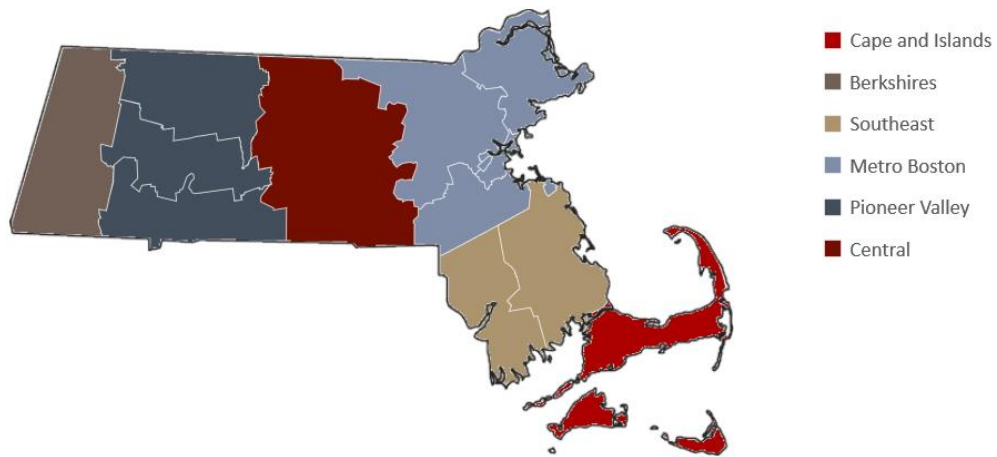
² <http://massgaming.com/about/expanded-gaming-act>.

Figure 2: Locations of Approved Massachusetts Casinos and Slot Parlor



Figure 3 shows the regions selected for the REMI economic impact model used for the SEIGMA analyses. This configuration was chosen because it aligns with the gaming regions and the Commonwealth’s existing economic and commuting linkages.

Figure 3. Regional Configuration of SEIGMA’s REMI Model



MGM Springfield was the first resort-style casino to open in Massachusetts on August 24, 2018. This followed three years after the opening of Plainridge Park Casino on June 24, 2015, which is the singular

slot parlor. Encore Boston Harbor, the final licensed property, held its grand opening on June 23, 2019. The status of the Region C casino license is complicated by the decision of the MGC to not award a license to the only commercial bidder, which hoped to open in Brockton,³ and U.S. District and Appeals Court rulings invalidating the land in trust granted to the Mashpee Wampanoag tribe for a casino in nearby Taunton.⁴ The tribe is continuing to pursue various options to regain its land in trust. Should any of these efforts succeed, a potential Region C casino would still be many years in the future.

Recognizing that the introduction of casinos is likely to create both positive and negative social and economic impacts, Section 71 of the Expanded Gaming Act includes a mandate for the Massachusetts Gaming Commission to establish “an annual research agenda.”⁵ To facilitate this research, the MGC sought bids through a competitive request for research process in 2012. The SEIGMA research team, based at the [UMass Amherst School of Public Health and Health Sciences](#), was successful in its competitive bid and the project officially began in April 2013.⁶ The role of UMDI in the larger research agenda is to collect data on and measure the economic impacts of the introduction of casinos in Massachusetts.

This report seeks to inform stakeholders about the construction of Encore Boston Harbor and its economic contribution to the Commonwealth. Over the course of construction, UMDI worked with the MGC and the project’s construction managers at Suffolk Construction Company to obtain data on the spending, employment, and wages related to the construction of the casino. These data are presented in this report along with an estimate of the total economic impacts to the Commonwealth of Massachusetts resulting from the construction of the casino.

Encore Boston Harbor is located on the Mystic River waterfront on Rt. 99 in Everett, Massachusetts and across the river from the Assembly Row area of Somerville. For much of the past century, various industrial and chemical companies used the 33-acre site leaving it and the surrounding river sections contaminated. As part of the construction project, Encore remediated the site and waterfront. Now completed, the site contains the casino and hotel building, a publicly-accessible harbor walk, and parking.

Construction began with remediation in the fall of 2015 and finished ahead of the casino’s opening on June 23, 2019, roughly one year after MGM Springfield. During this time, a total of \$1.6 billion was spent on construction. This amount differs from the larger amount that is commonly reported in the press. The larger amount represents total investment of which construction is a component. The difference between investment and construction includes design fees; furniture, fixtures, and equipment (FF&E); operating supplies and equipment (OSE); license/application fees; and pre-opening expenses. This total includes money spent on both in-state and out-of-state vendors and labor. The lead contractor, Suffolk Construction Company, oversaw the project and all other contractors.

For continuity, this report generally mirrors the language and structure of our previous construction reports on [Plainridge Park Casino](#) and [MGM Springfield](#).

³ <http://massgaming.com/wp-content/uploads/16-025RegionC.pdf>.

⁴ https://www.gpo.gov/fdsys/pkg/USCOURTS-mad-1_16-cv-10184/pdf/USCOURTS-mad-1_16-cv-10184-0.pdf and <http://media.ca1.uscourts.gov/pdf/opinions/16-2484P-01A.pdf>.

⁵ <http://massgaming.com/about/research-agenda>.

⁶ An overview of the research plan can be found on the MGC’s website: <http://massgaming.com/wp-content/uploads/SEIGMA-Research-Plan.pdf>.

Glossary for Economic Impact Concepts

In this section, we define terms common to economic modeling and analysis that we utilize in the impacts section of this report. They are as follows:

Employment: Employment is a count of jobs, not people, by place of work. It counts all jobs with the same weight regardless of whether the position is full- or part-time or the labor of a self-employed proprietor. Additionally, jobs are counted as job-years, which are equivalent to one job lasting for one year. It is a similar concept to “person-hours.” New jobs often carry over from year to year and therefore the jobs in one year include many of the same jobs as in the previous year. For example, if a new business opens with 10 employees, then the host community of that business will have 10 more jobs than it would have had in every future year that the company maintains its workforce. Over 5 years, the business will have created 50 job-years (10 jobs at the company x 5 years = 50 job-years) though it is possible that it is not the same 10 people who are working there over time. When reviewing changes in employment across multiple years, knowledge of the concept of job-years is vital to proper interpretation.

Output: Output is the total value of production, sales, or business revenues, whether final (i.e., purchased by the end user) or intermediate (i.e., used by another business to produce its own output). It includes the value of inputs to production, wages paid to employees, capital expenses, taxes, and profit. It is useful as an indicator of business activity but, due the inclusion of intermediate purchases, it should not be interpreted as net new economic activity.

Personal Income: Personal income is income and benefits from all sources earned by all persons living in an area. It excludes the income earned by non-resident workers who commute into an area but includes the income of residents who commute out.

Value Added: Value added is the value of all final (i.e., purchased by the end user) goods and services created in an economy. It is net new economic activity and is also known as gross product or net economic impact. It is less than output by the value of all the goods and services that were used in production (i.e., intermediate purchases). Value added provides a useful summary of the economy which is why all nations and U.S. states report their economic growth by using it, calling it either gross domestic product or gross state product as appropriate. Its usefulness derives from the elimination of the double-counting inherent in output, which stems from the inclusion of inputs. Double-counting of inputs can be understood and simplified using an example of making and selling a loaf of bread. A farmer sells wheat to a mill, which then sells flour to a baker, who then sells bread to the final customer. The sale price of the bread includes the cost of all necessary inputs including growing the wheat, milling the flour, and baking the bread. Value added only counts the sale price of the bread to the final consumer, which is the net new value created in the economy. On the other hand, output counts the revenues earned by every business in the supply chain, which means that the value of the wheat and flour are counted more than once. A detailed explanation of value added versus output is available in *Appendix 3: Output versus Value Added*.

Methodology

Overview

The process of assessing economic impacts began with collecting data from Suffolk, the project's general contractor and construction manager. These data were then prepared for and run through an economic impact model to produce an estimate of the impacts of construction on Massachusetts and its regions. UMDI worked in collaboration with Suffolk to ensure that data included all applicable general contractors and subcontractors and their workers. The information included the location, contract amount, and diversity criteria for each contractor and the wages and hours of workers by location and diversity criteria.

For this and future economic analyses, the SEIGMA team has chosen the PI⁺ model from Massachusetts-based Regional Economic Models, Inc. (REMI). PI⁺ generates realistic year-by-year estimates of the total regional effects of specific initiatives. Model simulations using PI⁺ allow users to estimate comprehensive economic and demographic effects created by economic events, such as the development and operation of a casino within a region. REMI allows for dynamic, multi-year modeling as compared to other, more simplistic modeling systems. REMI thus has significant advantages for major complex initiatives that: a) have time-series based impacts that are likely to vary over time; b) require the use and interpretation of multiple economic variables; and c) emphasize economic interactions between regions within the state that add up to a true state-level impact.

The REMI model purchased by SEIGMA is a 6-region, 70-sector model. Each of the six regions in the model is comprised of Massachusetts counties, and the 70 REMI industry sectors roughly correspond to the 3-digit codes of the North American Industry Classification System (NAICS). For the purposes of this study, PI⁺ used information by region on spending, the number of workers, and wages to produce economic impact estimates. These inputs allow for the appropriate allocation of economic activity across the regions of the Commonwealth. The model can then calculate the total economic impacts for the state and show how activity in one region impacts other regions.

More information on the PI⁺ model and the methods used to prepare the data for use in the model can be found at the end of this report in *Appendix 1: The PI+ Model* and *Appendix 2: Detailed Data Methodology*.

Data Collection

Early in construction, the Massachusetts Gaming Commission facilitated meetings between Encore Boston Harbor, the MGC's construction manager, and the SEIGMA research team to coordinate data collection for this study. Contrary to MGM where a group of the company's employees was responsible for the management of the construction project, Encore hired Suffolk to handle project management and hiring contractors. In this regard, this project more closely resembled the construction of Plainridge Park Casino. Because of this arrangement, Suffolk, not Encore, became our main data supplier.

Working with Suffolk, we obtained datasets for both contractors and workers that provided the information needed for our analysis. For each prime contractor, we received information on its project component, subcontractors, contract amount, address, and diversity criteria. The data we received for workers was aggregated by ZIP code and included total wages and hours and the subset of wages and hours for workers meeting at least one of the diversity criteria. We also requested data by quarter but due to the difficulty of pulling that information from Suffolk's database and overarching time constraints, we chose to forego it. As a result, for this study's economic impacts we averaged spending

and employment across the construction period by the number of months of activity in each year. This change in methodology did not alter the total value of construction or employment and therefore did not materially change the reported total economic impacts. However, averaging spending across the months could result in the economic impacts attributed to specific years being too high or too low while the total remains unaffected.

Preparation of Data for Economic Impact Analysis

The detail and specificity of the data provided by Suffolk allowed the modelers to replace some of the default assumptions of the economic model with project-specific information. For example, PI+ includes average wages by industry and region and the typical flows of goods and services among regions. The construction data for Encore Boston Harbor included specific information in each of these areas and therefore allowed the use of actual reported data rather than industry and/or regional averages. The averages built into the model are needed in the absence of precise inputs. As previously noted, detailed methodologies of the PI+ model and the data preparation appear in *Appendix 1: The PI+ Model* and *Appendix 2: Detailed Data Methodology*.

Construction Data

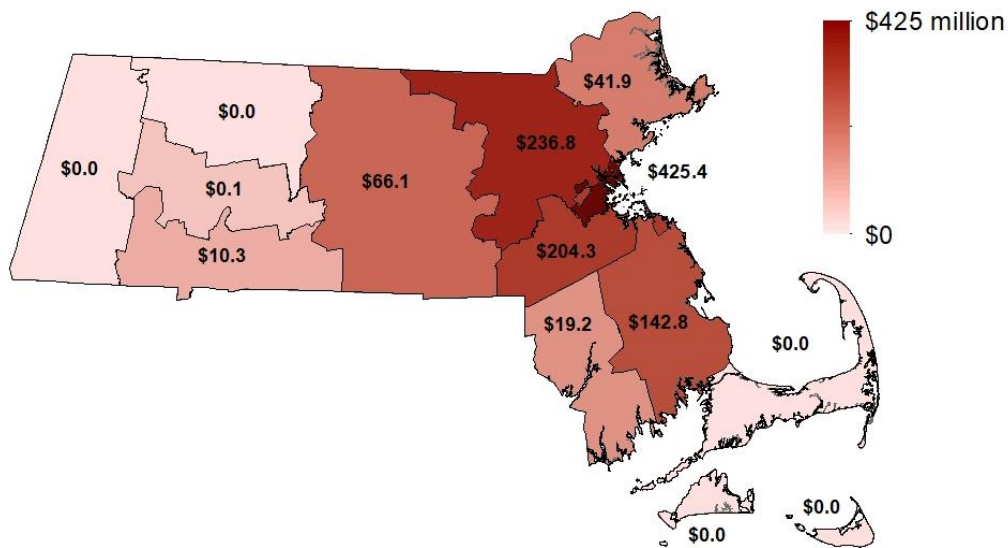
This section presents and summarizes Encore Boston Harbor’s spending on construction, the location and characteristics of the contractors, and the location and characteristics of the construction workers.

Construction Spending and Contractor Characteristics

Wynn Resorts spent \$1.6 billion to build the Encore Boston Harbor (EBH) casino. This amount differs from the larger amount that is commonly reported in the press. The larger amount represents total investment of which construction is a component. The difference between investment and construction includes design fees; furniture, fixtures, and equipment (FF&E); operating supplies and equipment (OSE); license/application fees; and pre-opening expenses. Examples of some of this additional spending includes hundreds of beds, mattresses, and televisions for the hotel; thousands of slot machines and gaming tables for the casino; and tens of thousands of individual cups, glasses, plates, pots, pans, and sets of cutlery for the restaurants and bars. This study excludes the economic impacts of non-construction expenditures because the equipment is primarily bought on contract from out-of-state manufacturers and wholesalers. Furthermore, most of the other expenditures are either dealt with in other aspects of SEIGMA’s work or are inapplicable to the economic impact modeling. Insofar as local companies are being used for service, maintenance, and other ongoing activities, their impacts will be captured in the operating impact study that will be completed for EBH in the future and will be similar to other operating reports completed by the SEIGMA team such as that for [Plainridge Park Casino](#).

Overall, almost three-quarters of the \$1.6 billion of total construction spending was awarded to companies in Massachusetts (\$1.1 billion). Within the Commonwealth, 27 percent of the total contract amount was in Suffolk County (\$425.4 million) followed by 15 percent in Middlesex County (\$236.8 million) (Figure 4). Companies in seven other counties won the remaining 30 percent of total contracts by value, though the drop-off is steep: Norfolk and Plymouth Counties account for 21 percent of the 30 percent. There were no construction contracts awarded to companies in the Cape and Islands, Berkshire County, and Franklin County.

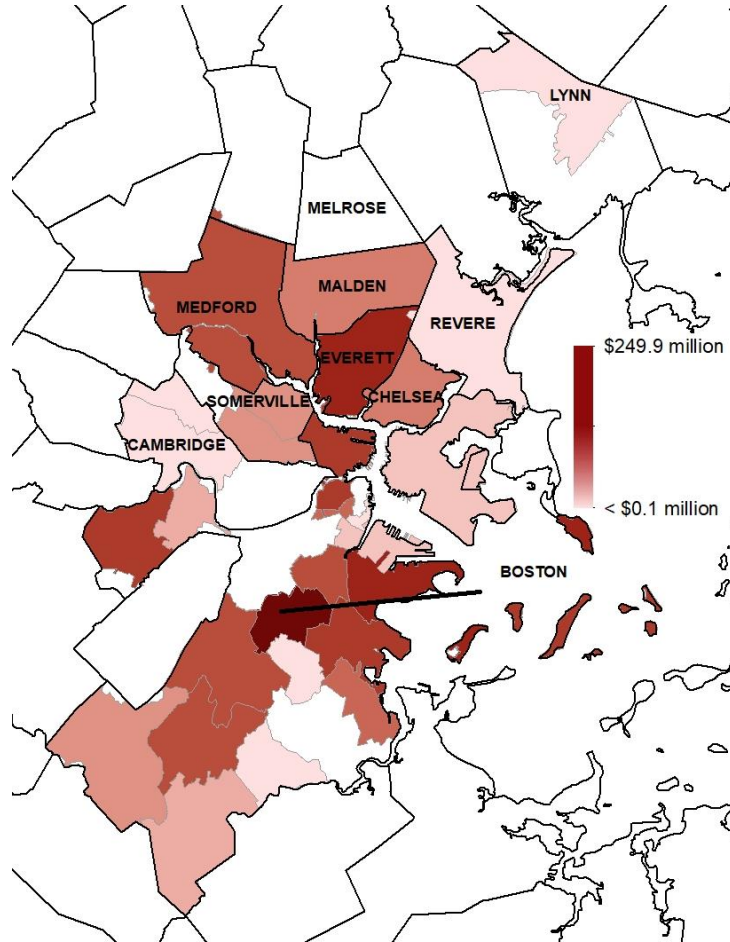
Figure 4. Total Contract Values by Massachusetts County



Source: Suffolk Construction Company and UMDI calculations

Taking a closer look at the MGC-designated host and surrounding communities (H&SC), 28 percent of all Massachusetts-based spending went to companies in these cities and towns (Figure 5). Of this nearly \$445 million, almost 90 percent or \$398 million went to companies in Boston, three-quarters of which is attributable to the presence of Suffolk, the prime contractor (Table 1). After Boston, Everett was the largest destination for contracts in this region with \$32 million of spending.

Figure 5. Total Contract Values by ZIP Code in Host and Surrounding Communities



Source: Suffolk Construction Company and UMDI calculations

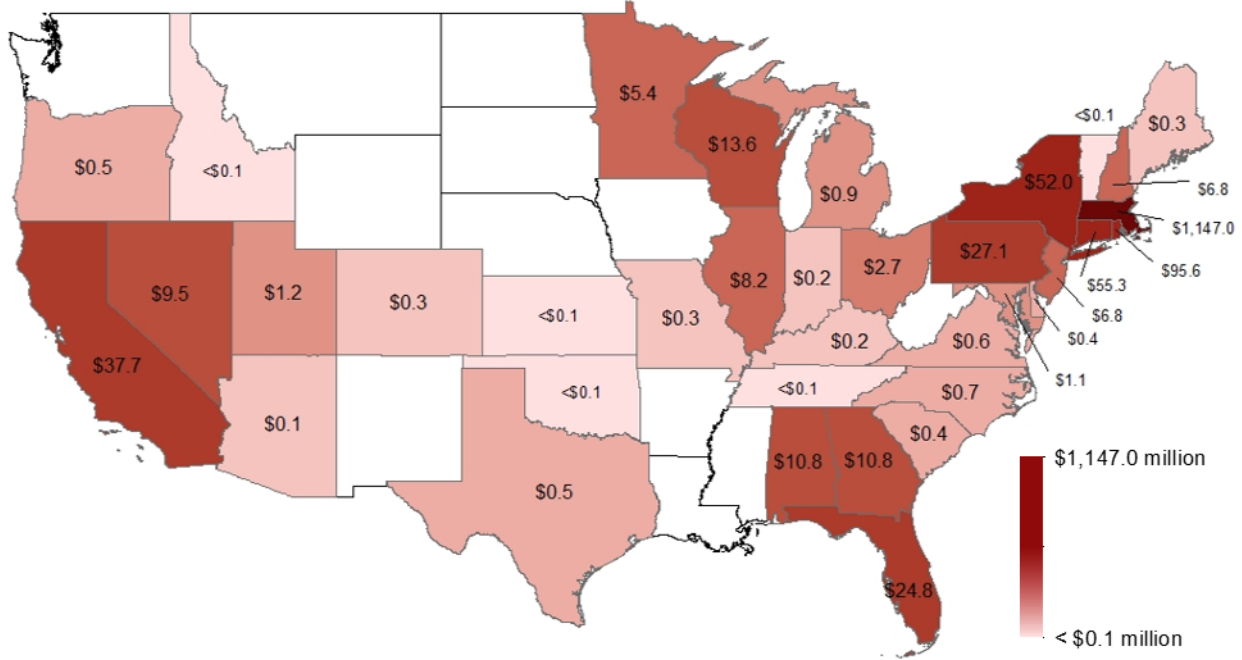
Table 1. Total Contract Values by ZIP Code in Host and Surrounding Communities

Town/Zip	Contract Value (\$M)	Town/Zip	Contract Value (\$M)
Everett	\$31.6	Cambridge	<\$0.1
02149	\$31.6	02138	<\$0.1
Boston	\$397.5	02140	<\$0.1
02108	\$11.4	Chelsea	\$2.4
02110	<\$0.1	02150	\$2.4
02111	\$0.6	Lynn	<\$0.1
02114	\$15.5	01904	<\$0.1
02118	\$8.0	Malden	\$2.8
02119	\$249.9	02148	\$2.8
02121	<\$0.1	Medford	\$7.7
02122	\$4.3	02155	\$7.7
02125	\$15.6	Melrose	\$0.0
02126	<\$0.1	Revere	<\$0.1
02127	\$31.9	02151	<\$0.1
02128	\$0.2	Somerville	\$2.6
02129	\$19.0	02143	\$1.0
02130	\$9.1	02145	\$1.7
02131	\$8.6	Total	\$444.7
02132	\$0.8		
02134	\$0.6		
02135	\$21.4		
02136	\$0.4		
02210	\$0.2		

Source: Suffolk Construction Company and UMDI calculations

While nearly 75 percent of the construction value was awarded to companies in Massachusetts, the remaining quarter went out-of-state. All but \$71 million (or 4 percent) of the \$1.6 billion remained in the U.S. Although Figure 6 shows contracts distributed to 37 states around the country, most of them outside of Massachusetts are relatively small. After Massachusetts, Rhode Island had the next highest value of construction contracts for Encore Boston Harbor, though it only received \$95.6 million (i.e., eight percent of the value going to Massachusetts companies). Connecticut and New York are the only other states with over \$50 million of contracts. Together, companies in Massachusetts, Rhode Island, Connecticut, and New York won 85 percent of all construction contracts by value.

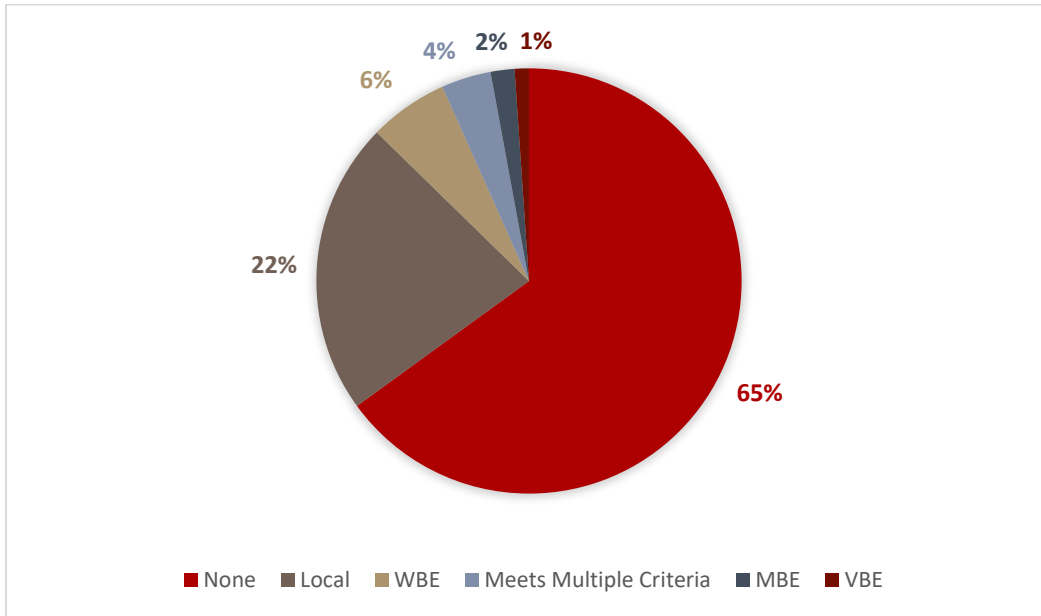
Figure 6. Total Contract Values by State



Source: Suffolk Construction Company and UMDI calculations

In addition to data on the location of companies, Suffolk collected data on the diversity criteria of each general contractor and subcontractor. These data were collected to evaluate whether EBH met the diversity and local contracting commitments it made in its license application. These criteria are applied to the ownership of the companies and count women-, minority-, and veteran-owned business enterprises (WBE, MBE, and VBE, respectively). The demographic characteristics of their workers were collected separately and are presented later in this report. Encore also made local spending commitments. Just over one-third of the total construction budget was awarded to companies that met at least one of the diversity or location criteria. This was led by local business with 22 percent (\$355 million) of total contract value. Among firms meeting one of the diversity criteria, WBEs were awarded the most construction spending at six percent (or \$96 million) of contracts by value. Also shown in Figure 7 are firms that met multiple criteria, i.e. any combination of local and diverse or meeting multiple diversity categories, e.g. a minority woman owned business.

Figure 7. Contract Value by Company Diversity and Location Criteria



Source: Suffolk Construction Company and UMDI calculations

Employment, Compensation, and Worker Characteristics

Over 150 individual contracts were issued during the construction of Encore Boston Harbor, many of which included multiple subcontracting companies. Each company in turn hired workers to carry out its obligations. We did not have worker counts but were able to infer them based on average hours worked. That calculation suggests over 6,700 individuals worked on the site at some point over the five-year construction period.

These workers cumulatively worked 5.2 million hours. Due to the nature of construction, the typical worker is not on-site for the complete duration of the build. For instance, trade workers cycle in and out as their specific expertise is required. Therefore, we do not expect to see large average hours worked per worker. For this project, the average hours per worker is just over 760 hours or 19 forty-hour weeks. When converted to full-time equivalents, the total hours worked results in nearly 2,500 FTEs.⁷

The companies that were awarded contracts compensated their Massachusetts-based workers nearly \$247 million. Total compensation differs from wages in that total compensation considers the value of both wage or salary and benefits (i.e., paid time off, health care, and retirement benefits). The average worker received roughly \$36,500 in total compensation at an average hourly rate of \$47.89 per hour. Using data from the Bureau of Economic Analysis’s National Income and Product Accounts, we calculated national average hourly compensation for construction workers over the analysis period to be \$35.83. This data is not available at the state level. The Bureau of Labor Statistics provides state and national data on average wages for construction workers. This data shows that average wages in Massachusetts are roughly 30 percent higher than the national average. Though directly applying this

⁷ A full-time equivalent is the number of workers that would be needed if each worker had a full-time, full-year schedule. It is obtained by dividing total hours worked by 2,080—the number of hours in a 40-hour per week, 52-week schedule.

finding to estimate state-level compensation is imprecise, it does suggest that the compensation of construction workers at EBH is at least in line with state norms if not higher.

We found that workers residing in Everett and the surrounding communities earned slightly lower average hourly compensation than the average for all workers (Table 2). This finding aligns with our previous work on MGM Springfield and Plainridge Park Casino. We believe that the most likely explanation is that the labor for most of the expected trades (ironworkers, electricians, pipefitters, etc.) can be found locally while workers would only come from far away if they had specialized knowledge and skills that would justify higher pay.

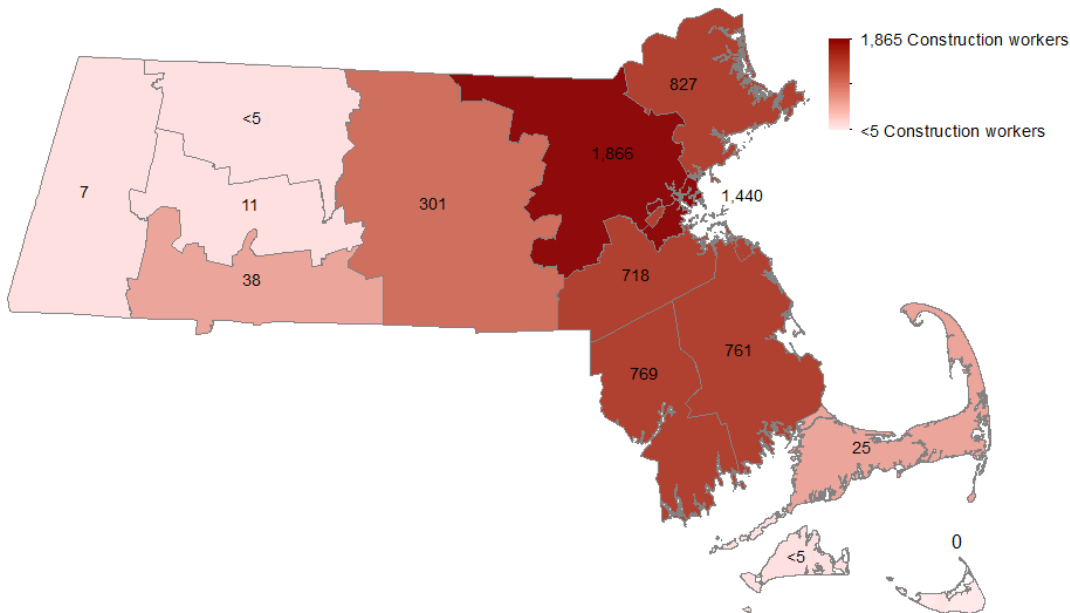
Table 2. Average Hours and Compensation for Everett and Surrounding Communities

Geography	Total Hours	Total Gross Pay	Average Hourly Comp.
Everett	248,814	\$10,994,195	\$44.19
Surrounding Communities	1,301,988	\$60,530,378	\$46.49
All Workers	5,153,333	\$246,816,126	\$47.89

Source: Suffolk Construction Company and UMDI calculations

Within the Commonwealth, about half of workers (3,306 or 49 percent) reside in either Middlesex or Suffolk Counties (Figure 8). After these two counties, workers are spread relatively evenly across the remaining counties of eastern Massachusetts, while dropping off quickly with distance from Everett.

Figure 8. Estimate of Workers by Massachusetts County⁸

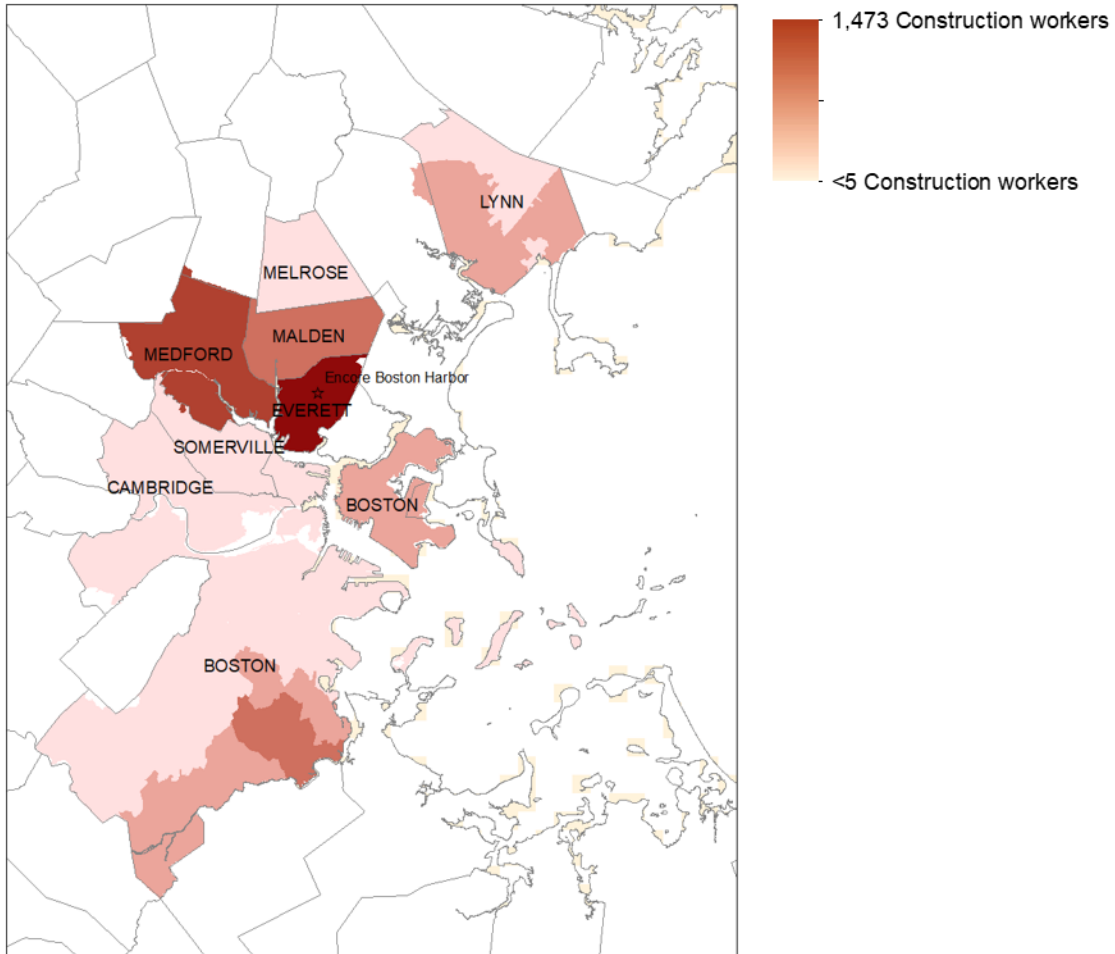


Source: Suffolk Construction Company and UMDI calculations

⁸ Here as elsewhere in this section, the count of workers was estimated using data on hours worked.

Most of the 3,306 workers who reside in Middlesex and Suffolk Counties live in the H&SC (2,036 of 3,306 or 62 percent). This share is slightly lower than the H&SC's 67 percent share of contract value going to these same counties. This means that the workers are more widely distributed across the region than the companies that employ them, which is also consistent with our findings from the other casinos. Within the H&SC, 11 percent or 327 workers reside in Everett (Figure 9; Table 3).

Figure 9. Count of Workers by ZIP Code in Host and Surrounding Communities



Source: Suffolk Construction Company and UMDI calculations

Table 3. Count of Workers by ZIP Code in Host and Surrounding Communities⁹

City/Town/ZIP	Worker Count	City/Town/ZIP	Worker Count
Boston	1,000	Cambridge	18
02109	0	02138	0
02111	4	02139	2
02113	16	02140	8
02114	1	02141	9
02115	6	Everett	327
02116	1	02149	327
02118	13	Lynn	189
02119	59	01901	0
02120	11	01902	82
02121	76	01904	38
02122	78	01905	68
02124	148	Malden	172
02125	50	02148	171
02126	67	02644	2
02127	51	Medford	225
02128	128	02155	225
02129	58	Melrose	45
02130	16	02176	45
02131	47	Somerville	60
02132	62	02143	9
02134	6	02144	23
02135	12	02145	28
02136	82	Total H&SC	2,036
02210	1		
02215	6		

Source: Suffolk Construction Company and UMDI calculations

Note: Totals may not match due to rounding.

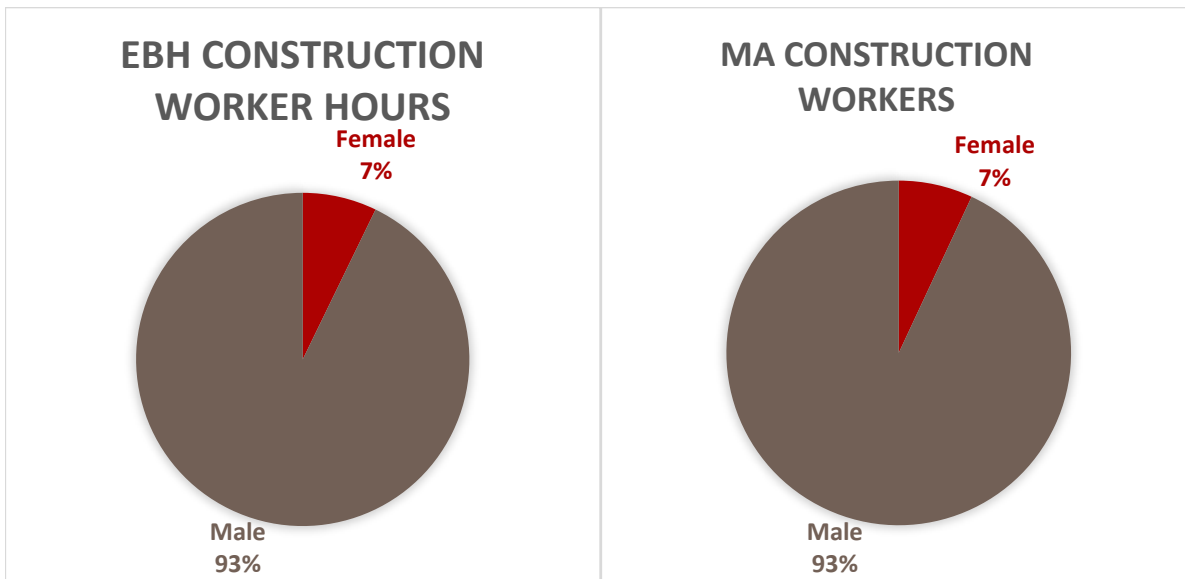
In addition to the location of workers, Suffolk collected various demographic characteristics on all construction workers working on projects at the EBH site. The data available to us for this study did not include a count of construction workers by location. However, it did include both total hours worked and hours worked by women, veteran, or minority workers. We used this count of hours to show the proportion of the project work that was carried out by members of these various groups. In the following charts, we compared the distribution of hours to the distribution of employment or working age population. Though comparing hours to people is imperfect, we believe it is sufficient for showing

⁹ Job count estimates are based on hours worked by ZIP code and have been rounded to the nearest whole job. Those zip codes with zero values are actually non-zero values representing less than 380 hours of work.

how the distribution of work on the project compares to the distribution of work and workers elsewhere.

Women represented seven percent of all hours worked (Figure 10). Though low in absolute terms, this finding reflects the ongoing low share of women in construction occupations, which nationally is also in the single digits.¹⁰ Furthermore, the share of total hours worked by women is equal to the proportion of Massachusetts construction workers who are female.

Figure 10. Share of Encore Boston Harbor Construction Worker Hours by Gender and Statewide Construction Employment by Gender

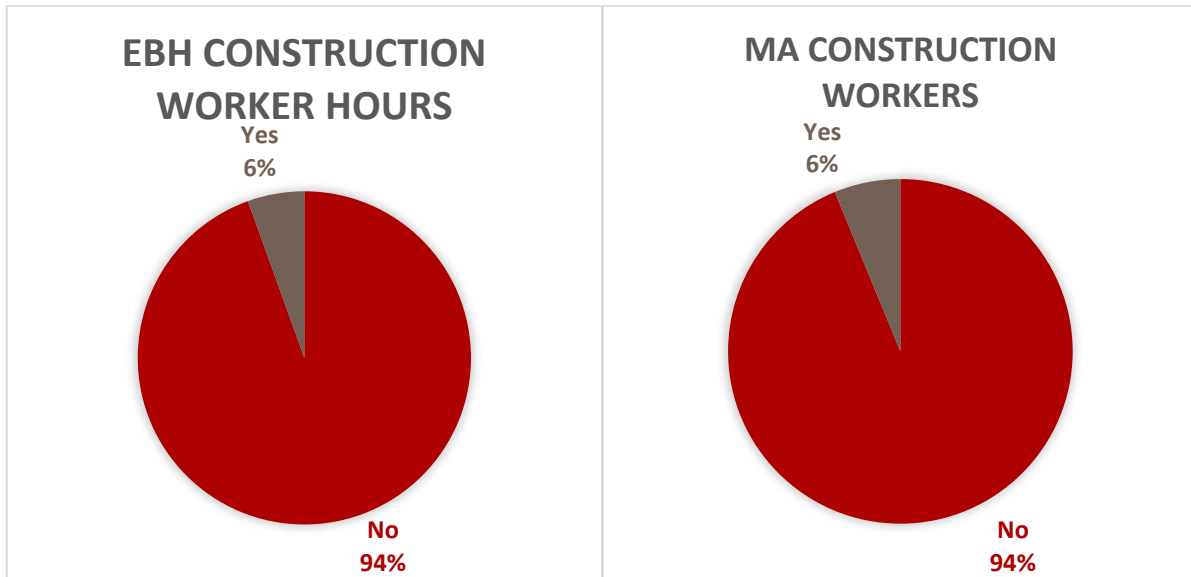


Source: Suffolk Construction Company and UMDI Calculations and American Community Survey 5yr 2013-2017

The share of hours by veteran status suggests that most workers were not veterans (Figure 11). That is also the case with the construction workers at large. For all Massachusetts-based workers, six percent of total hours worked were by veterans. As with the data on gender, the results are comparable to the composition of construction workers at the state level.

¹⁰ See *Employed persons by detailed occupation, sex, race, and Hispanic or Latino ethnicity* from the Current Population Survey <https://www.bls.gov/cps/cpsaat11.htm>.

Figure 11. Share of Encore Boston Harbor Construction Worker Hours by Veteran Status and Statewide Construction Employment by Veteran Status



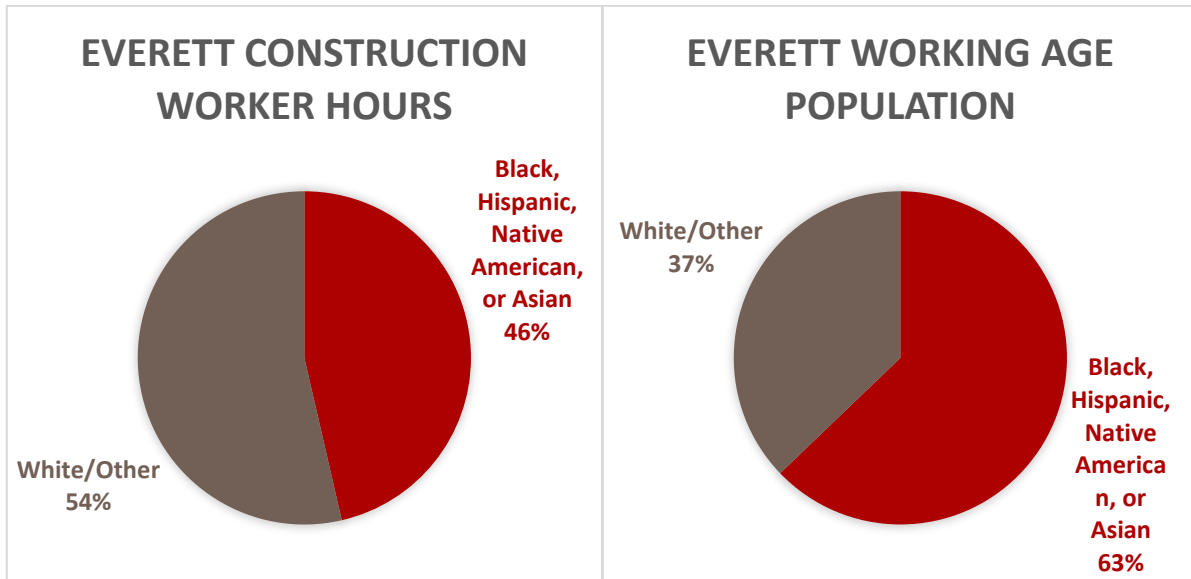
Source: Suffolk Construction Company and UMDI Calculations and American Community Survey 5yr 2013-2017

Finally, we examined the data on workers by race and ethnicity. In this data, workers chose one option that they most identified with: White/Other, Hispanic, Black, Asian, and American Indian/Native American. Overall, we found that the race/ethnicity mix of workers closely resembled that of the working age populations from which they were drawn. Statewide, 61 percent of all construction hours went to workers who identified as White/Other while the remaining 39 percent went to Black, Hispanic, Native American, or Asian workers. That split suggests a more diverse workforce than the statewide workforce, which is three-quarters White Non-Hispanic.

The hours worked by Everett residents were more likely to be done by non-White workers than those for the state: 46 percent Black, Hispanic, Native American, or Asian compared to 39 percent (Figure 12). When placed in the context of Everett’s working age population, the share of hours worked by minority residents of Everett is less than their share of the working age population of Everett: 46 percent of construction worker hours compared to 63 percent of the working age population. Due to data constraints, we were not able to compare the hours worked to only the racial/ethnic composition of those in construction occupations.¹¹

¹¹Though data is available from the US Census Bureau for occupation by race and ethnicity at the city level, the margins of error in the available sources make them unreliable for this purpose.

Figure 12. Race/Ethnicity of Encore Boston Harbor Construction Worker Hours in Everett and Everett's Working Age Population¹²



Source: Suffolk Construction Company, UMDI calculations, and American Community Survey 5yr 2013-2017

¹² The U.S. Census considers Hispanic to be an ethnicity rather than a race. As a result, one can be White and Hispanic or Black and Hispanic. For groups other than Hispanic, this chart only counts those who claimed no Hispanic heritage. Similarly, anyone of any race claiming Hispanic heritage is counted only as Hispanic. This method avoids double-counting individuals.

Economic Impacts of Construction

The following pages describe the direct connections between the activities at the Encore Boston Harbor construction site and the regions of the state. The companies and workers who are active participants in the economic activities associated with building the casino constitute the direct impacts. However, the total economic impacts of construction extend beyond these direct activities. Each company hired to work on the site has its own suppliers and vendors who gain business by virtue of their customers being busier. Every worker that receives a paycheck returns back home to his or her neighborhood. They spend these dollars on housing, entertainment, education, and so on. These transactions, called indirect and induced effects respectively, create economic impacts attributable to the casino that, together with the direct effects, describe the total economic impacts. A glossary of economic impact terms is provided on Page 4 of this report. For modeling purposes, the 14 counties of Massachusetts were combined into six regions as shown in Table 4.

Table 4. Regional Configuration of SEIGMA’s REMI PI+ Model

Model Region	County
Berkshires	Berkshire
Cape and Islands	Barnstable
	Dukes
	Nantucket
Central	Worcester
Metro Boston	Essex
	Middlesex
	Norfolk
	Suffolk
Pioneer Valley	Franklin
	Hampden
	Hampshire
Southeast	Bristol
	Plymouth

Summary

The results of the economic modeling found that, statewide, the construction of Encore Boston Harbor (EBH) created or supported an average of 2,505 jobs per year, peaking at 3,351 in 2017, which was also the peak year of construction employment at [MGM Springfield](#). These totals, shown in Table 5, include employees directly hired to work on the construction of EBH, as well as individuals hired at downstream suppliers (business-to-business or indirect jobs). An example of a new indirect job is one that is created at the firm providing wires to the electrical contractor. Table 5 also includes jobs created by these newly-employed workers spending their wages in their home communities (induced jobs). An example of an induced job would include those created at restaurants frequented by new direct and indirect employees. Indirect employment is low in this scenario because Massachusetts imports many of the inputs to construction (e.g. steel, drywall, wiring, etc.) thus creating indirect jobs out-of-state.

Table 5. Direct, Indirect, and Induced Statewide Jobs from Encore Boston Harbor Construction

Total Employment	2015	2016	2017	2018	2019	Average
EBH Construction Workers (Direct)	601	1,804	1,804	1,804	752	1,353
Business to Business (Indirect)	94	274	269	255	98	198
Total Induced	398	1,205	1,277	1,289	599	953
<i>Consumption-Based</i>	<i>238</i>	<i>697</i>	<i>687</i>	<i>700</i>	<i>305</i>	<i>525</i>
<i>Other Induced</i>	<i>160</i>	<i>507</i>	<i>590</i>	<i>589</i>	<i>294</i>	<i>428</i>
Total	1,093	3,283	3,351	3,348	1,448	2,505

Source: Suffolk Construction Company, UMDI calculations, and Regional Economic Models, Inc.

Table 6 shows that 1,608 jobs were created in the construction sector over the analysis period, which is two-thirds of the 2,505 total shown in Table 5. Most of these were individuals employed in constructing the casino. However, 13 percent of these jobs were supported by new construction demand caused by marginal increases in the demand for other commercial and residential structures. The remaining top impacted sectors are mainly distributed among those supported by the expenditure of new personal income (Retail, Health Care, and Accommodation and Food Services). State and Local Government jobs were supported by general economic growth.

Table 6. Statewide Employment Changes in the Top Five Impacted Sectors from Encore Boston Harbor Construction

Impacted Sector	Metro Boston	Rest of MA	Massachusetts
Construction	1,125	484	1,608
Health care and social assistance	97	43	139
Retail trade	85	55	140
State and Local Government	78	46	124
Accommodation and food services	58	30	87

Source: Suffolk Construction Company, UMDI calculations, and Regional Economic Models, Inc.

The total new economic activity created by the construction of EBH is shown in Table 7. The annual average provides a sense of the contributions in a typical year while the cumulative number shows the total new economic activity accruing to each region and the Commonwealth over the five-year analysis period. The budget of \$1.6 billion resulted in \$1.1 billion of in-state spending which yielded \$2.6 billion of new business activity in the Commonwealth (Figure 13). On net, after accounting for the value of the goods and services used up in production, the economy of Massachusetts created total new value of \$1.6 billion over five years.

Table 7. New Economic Activity by Region (\$M) from Encore Boston Harbor Construction

Region	Total (Output)		Net New (Value-Added)	
	Annual Avg.	Cum.	Annual Avg.	Cum.
Metro Boston	\$407	\$2,034	\$247	\$1,233
Southeast	\$75	\$376	\$45	\$225
Pioneer Valley	\$5	\$24	\$3	\$14
Central	\$33	\$163	\$19	\$97
Berkshires	\$0	\$2	\$0	\$1
Cape and Islands	\$4	\$22	\$3	\$14
MA	\$524	\$2,621	\$317	\$1,584

Source: Suffolk Construction Company, UMDI calculations, and Regional Economic Models, Inc.

Note: Totals may not match due to rounding.

Figure 13. Relationship between Summary Statewide Economic Impacts from Encore Boston Harbor Construction



Source: Suffolk Construction Company, UMDI calculations, and Regional Economic Models, Inc.

Detailed Results

The summary results presented above provide a snapshot and give a high-level sense of how the construction of Encore Boston Harbor impacted Massachusetts. This section tracks the impacts through the model starting from construction spending to give a better sense of how these various concepts are related.

The best place to start is with the impacts on output (also known as sales or business revenues). It is the simplest way to see how Massachusetts' share of nearly \$1.6 billion of total construction spending rippled across the state and created multiplied impacts. In each region, the cumulative output impacts exceed the direct spending that occurred in that region. Nearly 80 percent of total statewide impacts accrued to the Metro Boston region.

Table 8 shows that part of the explanation is that, as the host region for the casino, Metro Boston received most (79 percent) of the direct construction spending that remained in Massachusetts. Furthermore, as the economic hub of the state, a substantial share of all economic activity passes through or otherwise interacts with Metro Boston. As a result, 76 percent of all additional output statewide accrues to the region.

Table 8. Total Impacts on Output of Encore Boston Harbor Construction (\$M)

Region		2015	2016	2017	2018	2019	Average	Cum.
Metro Boston	Direct	\$80.75	\$242.26	\$242.26	\$242.26	\$100.94	\$181.7	\$908.5
	Add'l	\$75.8	\$249.8	\$298.2	\$316.3	\$185.7	\$225.2	\$1,125.8
	Total	\$156.5	\$492.0	\$540.5	\$558.6	\$286.7	\$406.9	\$2,034.3
Southeast	Direct	\$14.40	\$43.21	\$43.21	\$43.21	\$18.00	\$32.4	\$162.0
	Add'l	\$12.8	\$44.1	\$56.9	\$61.6	\$38.1	\$42.7	\$213.6
	Total	\$27.2	\$87.3	\$100.1	\$104.8	\$56.1	\$75.1	\$375.6
Pioneer Valley	Direct	\$0.93	\$2.79	\$2.79	\$2.79	\$1.16	\$2.1	\$10.5
	Add'l	\$0.9	\$3.0	\$3.7	\$3.9	\$2.2	\$2.8	\$13.8
	Total	\$1.8	\$5.8	\$6.5	\$6.7	\$3.4	\$4.9	\$24.3
Central	Direct	\$5.87	\$17.62	\$17.62	\$17.62	\$7.34	\$13.2	\$66.1
	Add'l	\$6.3	\$20.8	\$25.7	\$27.5	\$16.6	\$19.4	\$96.9
	Total	\$12.1	\$38.5	\$43.3	\$45.1	\$23.9	\$32.6	\$162.9
Berkshires	Direct	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.0	\$0.0
	Add'l	\$0.2	\$0.5	\$0.5	\$0.5	\$0.3	\$0.4	\$1.8
	Total	\$0.2	\$0.5	\$0.5	\$0.5	\$0.3	\$0.4	\$1.8
Cape and Islands	Direct	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.0	\$0.0
	Add'l	\$1.3	\$4.4	\$5.9	\$6.4	\$4.2	\$4.4	\$22.2
	Total	\$1.3	\$4.4	\$5.9	\$6.4	\$4.2	\$4.4	\$22.2
MA	Direct	\$101.96	\$305.88	\$305.88	\$305.88	\$127.45	\$229.4	\$1,147.0
	Add'l	\$97.2	\$322.7	\$390.9	\$416.1	\$247.1	\$294.8	\$1,474.1
	Total	\$199.2	\$628.6	\$696.8	\$722.0	\$374.6	\$524.2	\$2,621.1

Source: Suffolk Construction Company, UMDI calculations, and Regional Economic Models, Inc.

Note: Totals may not match due to rounding.

While the economic activity of the project is concentrated in Metro Boston due to the reasons above, all other regions benefit from this project. Most counties in the state host businesses that received contracts and/or are home to workers that participated in the project. Even the Cape and Islands and Berkshires regions, which were awarded no contracts, still show new output due to intrastate trade and commuting relationships. Overall, \$2.6 billion of new output was created over the construction period. This resulted in every dollar of construction activity creating another \$0.65 of economic activity inside Massachusetts after accounting for out-of-state suppliers and other leakages due to trade and commuting. Put another way, for every \$1.55 of construction spending another \$1 of business revenues was created. If only in-state spending is evaluated (i.e. out-of-state leakages are ignored), these numbers increase. Each dollar of construction spending that remained in-state created another \$1.29 of economic activity or for every \$0.78 of construction spending another \$1 of business revenues were created.

Output in turn creates \$1.6 billion of value added, otherwise known as *net* economic impact. Output counts every transaction in the economy, including all business-to-business transactions, which results in an overestimate of the new value created in an economy. A detailed description of the difference between output and value added is provided in *Appendix 3: Output versus Value Added*. Value added (shown in Table 9), also called gross product, follows the same regional trend as output.

Table 9. Total Impacts on Value Added of Encore Boston Harbor Construction (\$M)

Region	2015	2016	2017	2018	2019	Average	Cum.
Metro Boston	\$93.6	\$295.3	\$327.2	\$339.2	\$177.3	\$246.5	\$1,232.6
Southeast	\$16.2	\$52.0	\$59.9	\$62.9	\$34.2	\$45.0	\$225.1
Pioneer Valley	\$1.1	\$3.4	\$3.9	\$4.0	\$2.0	\$2.9	\$14.4
Central	\$7.2	\$22.8	\$25.8	\$26.9	\$14.5	\$19.4	\$97.1
Berkshires	\$0.1	\$0.3	\$0.3	\$0.3	\$0.2	\$0.2	\$1.1
Cape and Islands	\$0.8	\$2.8	\$3.7	\$4.0	\$2.6	\$2.8	\$14.0
MA	\$118.9	\$376.5	\$420.7	\$437.3	\$230.8	\$316.9	\$1,584.3

Source: Suffolk Construction Company, UMDI calculations, and Regional Economic Models, Inc.

Note: Totals may not match due to rounding.

To create the economic activity represented by output and value added, labor is needed. Since most of the jobs on-site lasted less than one year, they produced less than the average annual output and compensation of an annualized construction job. Therefore, the in-state employment multiplier is lower than the output multiplier at 1.85 compared to 2.29, meaning that every in-state job created 0.24 additional jobs. Put another way, for every 1.2 jobs held by Massachusetts residents at the construction site, one additional job was created elsewhere in Massachusetts. Employment cannot be summed over time, so a cumulative total is not provided in Table 10. Instead, the annual average gives a better estimate of the total number of jobs that were created or supported by construction.

Table 10. Total Impacts on Employment of Encore Boston Harbor Construction (Job-Years)

Region		2015	2016	2017	2018	2019	Average
Metro Boston	Direct	431	1,294	1,294	1,294	539	970
	Add'l	334	996	1,021	1,011	431	759
	Total	765	2,290	2,315	2,305	970	1,729
Southeast	Direct	136	408	408	408	170	306
	Add'l	97	295	317	323	159	238
	Total	233	703	725	730	329	544
Pioneer Valley	Direct	5	14	14	14	6	10
	Add'l	7	20	22	21	9	16
	Total	11	34	35	35	15	26
Central	Direct	27	80	80	80	33	60
	Add'l	43	134	148	150	75	110
	Total	70	214	229	230	109	170
Berkshires	Direct	1	2	2	2	1	1
	Add'l	1	2	2	2	1	1
	Total	1	4	4	4	2	3
Cape and Islands	Direct	2	7	7	7	3	5
	Add'l	10	31	36	38	21	27
	Total	12	38	43	45	24	33
MA	Direct	601	1,804	1,804	1,804	752	1,353
	Add'l	492	1,479	1,547	1,544	696	1,151
	Total	1,093	3,283	3,351	3,348	1,448	2,505

Source: Suffolk Construction Company, UMDI calculations, and Regional Economic Models, Inc.

Note: Totals may not match due to rounding.

Every job, whether on the construction site or created by ripple effects, comes with a paycheck. Not surprisingly, personal income shown in Table 11 follows the same pattern as employment around the state as seen in Table 10. Workers in Metro Boston gained a total of \$716 million of new income as a result of the construction of EBH. The state as a whole gained \$1 billion of new income. In total, the contractors working on EBH paid nearly \$247 million of compensation to Massachusetts workers. This resulted in a multiplier of 4.21, meaning that every in-state dollar of EBH construction compensation created an additional \$3.21 of new income in Massachusetts.¹³

¹³ It is important to note that this multiplier is likely to be high as it is comparing the income of only Massachusetts-based construction workers to the economic impacts created by all workers. If all income paid to EBH construction workers was available for this analysis, this multiplier would likely be somewhat lower. A similar logic applies to the calculation of the employment multiplier. Employment was imputed using hours worked, which was only available for Massachusetts-based construction workers.

Table 11. Total Impacts on Personal Income of Encore Boston Harbor Construction (\$M)

Region		2015	2016	2017	2018	2019	Average	Cum.
Metro Boston	Direct	\$15.65	\$46.94	\$46.94	\$46.94	\$19.56	\$35.2	\$176.0
	Add'l	\$36.2	\$117.5	\$138.2	\$154.4	\$93.2	\$107.9	\$539.6
	Total	\$51.9	\$164.5	\$185.1	\$201.3	\$112.8	\$143.1	\$715.6
Southeast	Direct	\$4.99	\$14.98	\$14.98	\$14.98	\$6.24	\$11.2	\$56.2
	Add'l	\$9.9	\$32.1	\$38.2	\$43.7	\$28.2	\$30.4	\$152.1
	Total	\$14.9	\$47.1	\$53.2	\$58.6	\$34.5	\$41.7	\$208.3
Pioneer Valley	Direct	\$0.16	\$0.49	\$0.49	\$0.49	\$0.21	\$0.4	\$1.8
	Add'l	\$0.6	\$2.0	\$2.4	\$2.6	\$1.4	\$1.8	\$9.0
	Total	\$0.8	\$2.5	\$2.9	\$3.0	\$1.6	\$2.2	\$10.8
Central	Direct	\$1.02	\$3.05	\$3.05	\$3.05	\$1.27	\$2.3	\$11.4
	Add'l	\$4.8	\$15.7	\$18.9	\$20.5	\$12.3	\$14.5	\$72.3
	Total	\$5.8	\$18.8	\$21.9	\$23.6	\$13.6	\$16.7	\$83.7
Berkshires	Direct	\$0.03	\$0.09	\$0.09	\$0.09	\$0.04	\$0.1	\$0.3
	Add'l	\$0.1	\$0.2	\$0.2	\$0.2	\$0.1	\$0.2	\$0.8
	Total	\$0.1	\$0.3	\$0.3	\$0.3	\$0.2	\$0.2	\$1.1
Cape and Islands	Direct	\$0.09	\$0.27	\$0.27	\$0.27	\$0.11	\$0.2	\$1.0
	Add'l	\$1.1	\$3.7	\$4.6	\$5.0	\$3.1	\$3.5	\$17.5
	Total	\$1.2	\$3.9	\$4.9	\$5.3	\$3.2	\$3.7	\$18.5
MA	Direct	\$21.94	\$65.82	\$65.82	\$65.82	\$27.42	\$49.4	\$246.8
	Add'l	\$52.7	\$171.3	\$202.5	\$226.4	\$138.3	\$158.3	\$791.3
	Total	\$74.7	\$237.2	\$268.3	\$292.2	\$165.8	\$207.6	\$1,038.1

Source: Suffolk Construction Company, UMDI calculations, and Regional Economic Models, Inc.

Note: Totals may not match due to rounding.

Personal income does not tell the whole story of increased buying power. The disposable income shown in Table 12 is what remains after taxes. Cumulatively, the model predicts new disposable income to be \$866 million or \$172 million less than the cumulative gains in personal income. What is left is available to households to fund their consumption wants and needs.

Table 12. Total Impacts on Disposable Personal Income of Encore Boston Harbor Construction (\$M)

Region	2015	2016	2017	2018	2019	Average	Cum.
Metro Boston	\$43.3	\$137.2	\$155.0	\$169.0	\$95.6	\$120.0	\$600.0
Southeast	\$12.2	\$38.6	\$43.9	\$48.6	\$29.0	\$34.5	\$172.3
Pioneer Valley	\$0.6	\$2.0	\$2.3	\$2.4	\$1.3	\$1.7	\$8.7
Central	\$4.8	\$15.5	\$18.1	\$19.6	\$11.4	\$13.9	\$69.3
Berkshires	\$0.1	\$0.2	\$0.2	\$0.2	\$0.1	\$0.2	\$0.9
Cape and Islands	\$1.0	\$3.3	\$4.0	\$4.4	\$2.7	\$3.1	\$15.3
MA	\$61.9	\$196.7	\$223.5	\$244.2	\$140.1	\$173.3	\$866.4

Source: Suffolk Construction Company, UMDI calculations, and Regional Economic Models, Inc.

Note: Totals may not match due to rounding.

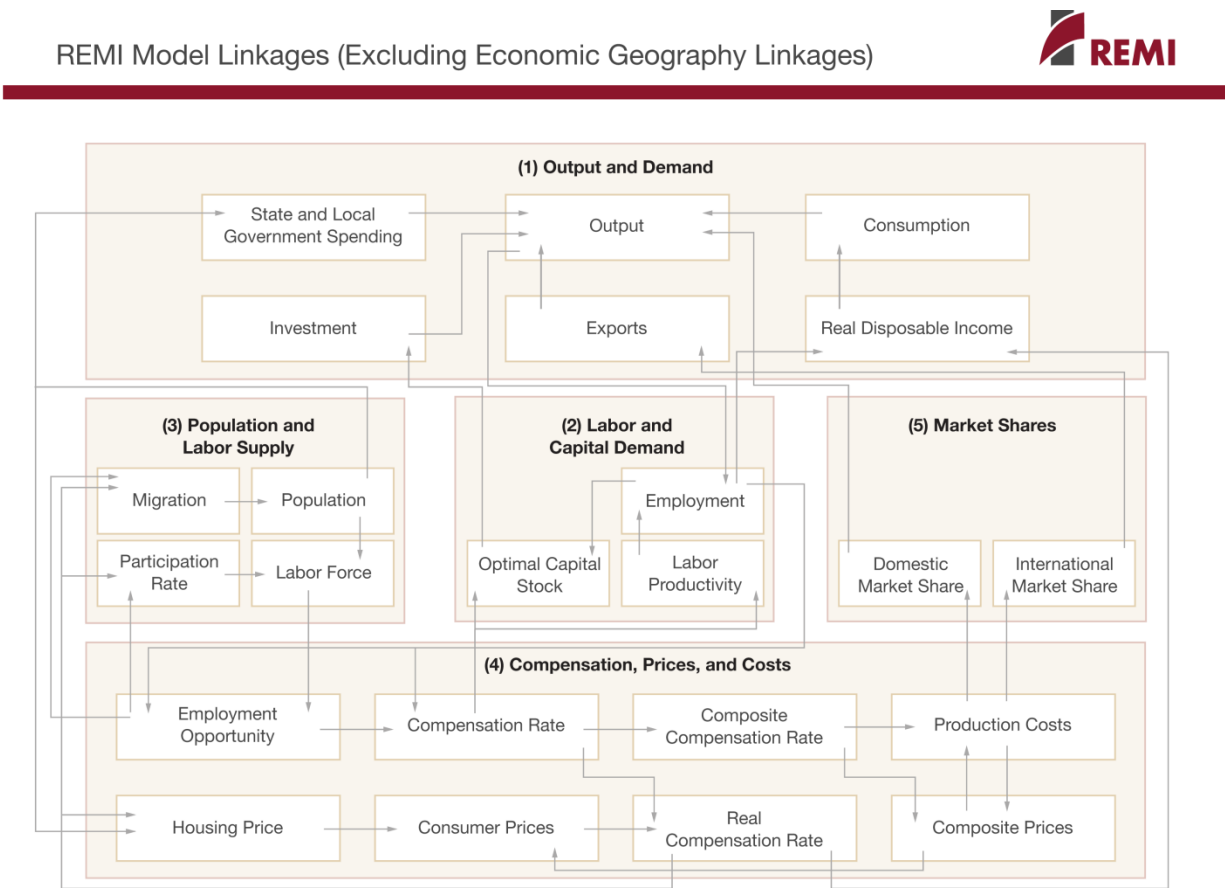
In summary, the construction of EBH creates total economic impacts that exceed its direct spending and employment impacts in all major regions of Massachusetts. The SEIGMA research team plans to continue to examine the economic impacts of EBH by gathering data on its operations. This data will enable the future evaluation of vendor and supplier spending, hiring, and wages (see previous report completed on [Plainridge Park Casino's operations and its economic impacts](#)). Coupled with the data from the patron survey conducted by the SEIGMA research team (see previous report detailing the [patron survey at Plainridge Park Casino](#)), this analysis would balance the spending and hiring of EBH with the effects of consumer spending reallocation from other regions of the state to EBH and the Everett waterfront.

Appendix 1: The PI+ Model

PI+ is a structural economic forecasting and policy analysis model. It integrates input-output, computable general equilibrium, econometric, and economic geography methodologies. The model is dynamic, with forecasts and simulations generated on an annual basis and behavioral responses to compensation, price, and other economic factors.

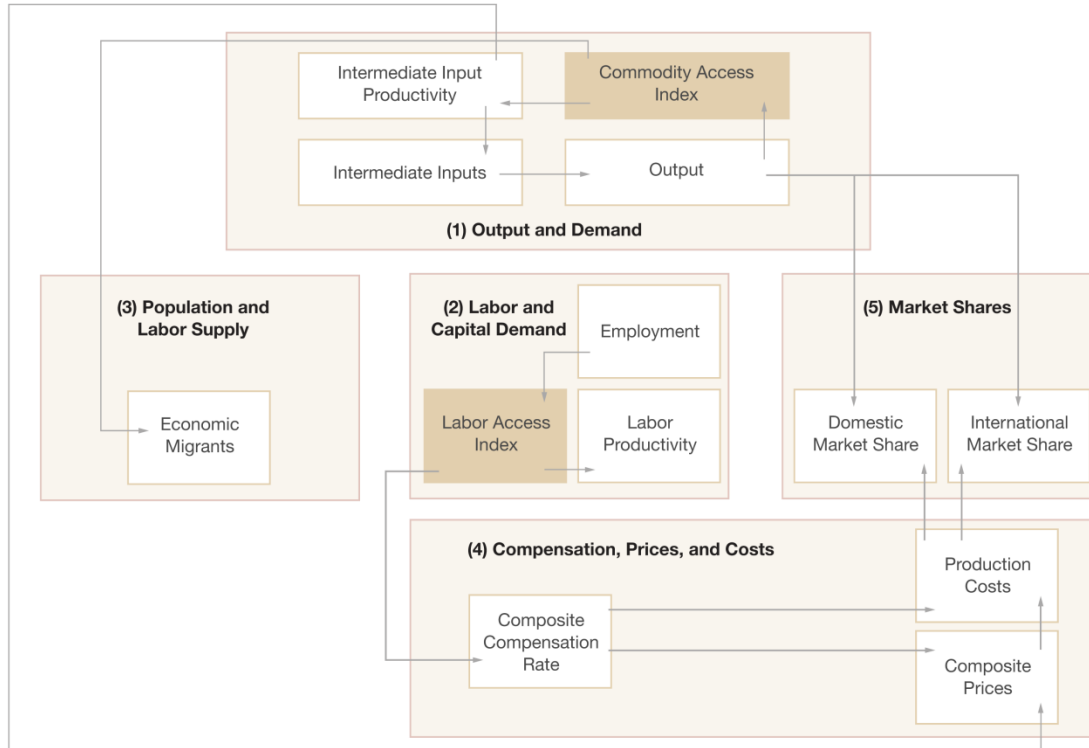
The model consists of thousands of simultaneous equations with a structure that is relatively straightforward. The exact number of equations used varies depending on the extent of industry, demographic, demand, and other detail in the specific model being used. The overall structure of the model can be summarized in five major blocks: (1) Output and Demand, (2) Labor and Capital Demand, (3) Population and Labor Supply, (4) Compensation, Prices, and Costs, and (5) Market Shares. The blocks and their key interactions are shown in Figure 14 and Figure 15.

Figure 14. REMI Model Linkages



Source: Regional Economic Models, Inc.

Figure 15. Economic Geography Linkages



Source: Regional Economic Models, Inc.

The Output and Demand block consists of output, demand, consumption, investment, government spending, exports, and imports, as well as feedback from output change due to the change in the productivity of intermediate inputs. The Labor and Capital Demand block includes labor intensity and productivity as well as demand for labor and capital. Labor force participation rate and migration equations are in the Population and Labor Supply block. The Compensation, Prices, and Costs block includes composite prices, determinants of production costs, the consumption price deflator, housing prices, and the compensation equations. The proportion of local, inter-regional, and export markets captured by each region is included in the Market Shares block.

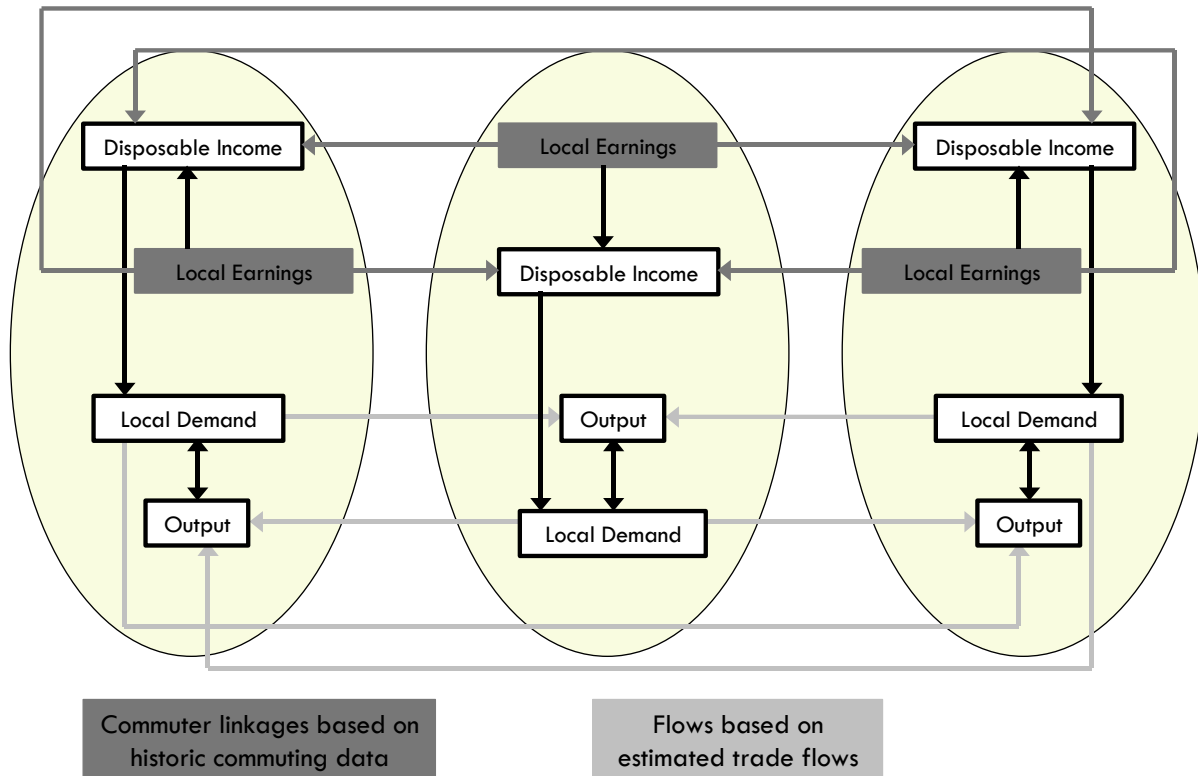
Models can be built as single region, multi-region, or multi-region national models. A region is defined broadly as a sub-national area and could consist of a state, province, county, city, or any combination of sub-national areas.

Single-region models consist of an individual region, called the home region. The rest of the nation is also represented in the model. However, since the home region is only a small part of the total nation, changes in the home region do not have an endogenous effect on the variables in the rest of the nation.

Multi-regional models have interactions among regions, such as trade and commuting flows. These interactions include trade flows from each region to each of the other regions. These flows are illustrated for a three-region model in Figure 16.

Figure 16. Trade and Commuter Flow Linkages

Trade and Commuter Flow Linkages



Source: Regional Economic Models, Inc.

Multiregional national models also include a central bank monetary response that constrains labor markets. Models that only encompass a relatively small portion of a nation are not endogenously constrained by changes in exchange rates or monetary responses.

Block 1. Output and Demand

This block includes output, demand, consumption, investment, government spending, import, commodity access, and export concepts. Output for each industry in the home region is determined by industry demand in all regions in the nation, the home region's share of each market, and international exports from the region.

For each industry, demand is determined by the amount of output, consumption, investment, and capital demand on that industry. Consumption depends on real disposable income per capita, relative prices, differential income elasticities, and population. Input productivity depends on access to inputs because a larger choice set of inputs means it is more likely that the input with the specific

characteristics required for the job will be found. In the capital stock adjustment process, investment occurs to fill the difference between optimal and actual capital stock for residential, non-residential, and equipment investment. Government spending changes are determined by changes in the population.

Block 2. Labor and Capital Demand

The Labor and Capital Demand block includes the determination of labor productivity, labor intensity, and the optimal capital stocks. Industry-specific labor productivity depends on the availability of workers with differentiated skills for the occupations used in each industry. The occupational labor supply and commuting costs determine firms' access to a specialized labor force.

Labor intensity is determined by the cost of labor relative to the other factor inputs, capital, and fuel. Demand for capital is driven by the optimal capital stock equation for both non-residential capital and equipment. Optimal capital stock for each industry depends on the relative cost of labor and capital, and the employment weighted by capital use for each industry. Employment in private industries is determined by the value added and employment per unit of value added in each industry.

Block 3. Population and Labor Supply

The Population and Labor Supply block includes detailed demographic information about the region. Population data is given for age, gender, and race, with birth and survival rates for each group. The size and labor force participation rate of each group determines the labor supply. These participation rates respond to changes in employment relative to the potential labor force and to changes in the real after-tax compensation rate. Migration includes retirement, military, international, and economic migration. Economic migration is determined by the relative real after-tax compensation rate, relative employment opportunity, and consumer access to variety.

Block 4. Compensation, Prices, and Costs

This block includes delivered prices, production costs, equipment cost, the consumption deflator, consumer prices, the price of housing, and the compensation equation. Economic geography concepts account for the productivity and price effects of access to specialized labor, goods, and services.

These prices measure the price of the industry output, taking into account the access to production locations. This access is important due to the specialization of production that takes place within each industry, and because transportation and transaction costs of distance are significant. Composite prices for each industry are then calculated based on the production costs of supplying regions, the effective distance to these regions, and the index of access to the variety of outputs in the industry relative to the access by other uses of the product.

The cost of production for each industry is determined by the cost of labor, capital, fuel, and intermediate inputs. Labor costs reflect a productivity adjustment to account for access to specialized labor, as well as underlying compensation rates. Capital costs include costs of non-residential structures and equipment, while fuel costs incorporate electricity, natural gas, and residual fuels.

The consumption deflator converts industry prices to prices for consumption commodities. For potential migrants, the consumer price is additionally calculated to include housing prices. Housing prices change from their initial level depending on changes in income and population density.

Compensation changes are due to changes in labor demand and supply conditions and changes in the national compensation rate. Changes in employment opportunities relative to the labor force and occupational demand change determine compensation rates by industry.

Block 5. Market Shares

The market shares equations measure the proportion of local and export markets that are captured by each industry. These depend on relative production costs, the estimated price elasticity of demand, and the effective distance between the home region and each of the other regions. The change in share of a specific area in any region depends on changes in its delivered price and the quantity it produces compared with the same factors for competitors in that market. The share of local and external markets then drives the exports from and imports to the home economy.

Appendix 2: Detailed Data Methodology

To properly model the impacts of the construction of Encore Boston Harbor in REMI's PI⁺ model, the relevant data pulled from Suffolk's database needed to be collected and adjusted for the model's use. Since all company and worker data was provided at the ZIP code level, the research team was able to aggregate the data to the model's six regions that are comprised of the 14 counties in Massachusetts (see Table 4).

More work was needed to prepare the data for the model's available variables and to adjust for its default relationships. Because PI⁺ uses headcount rather than FTEs or employed people as its concept of jobs, we used the worker hours as the starting point for our analysis. We were provided total headcount and hours for the project which we used to find average hours per worker. We applied this average to hours worked by ZIP code to estimate headcounts and then aggregated to the model regions. Similarly, we also aggregated construction spending to the model regions using the contracted company's ZIP code. A small number of contractors (less than three percent of total contract value) had invalid ZIP codes. Spending on these contracts was allocated to all ZIP codes based on their proportion of the total.

PI⁺ requires inputs to be by industry, region, and year. Because we did not receive data across time, we divided total spending and worker counts evenly across the construction period using the number of months of construction activity in each year.

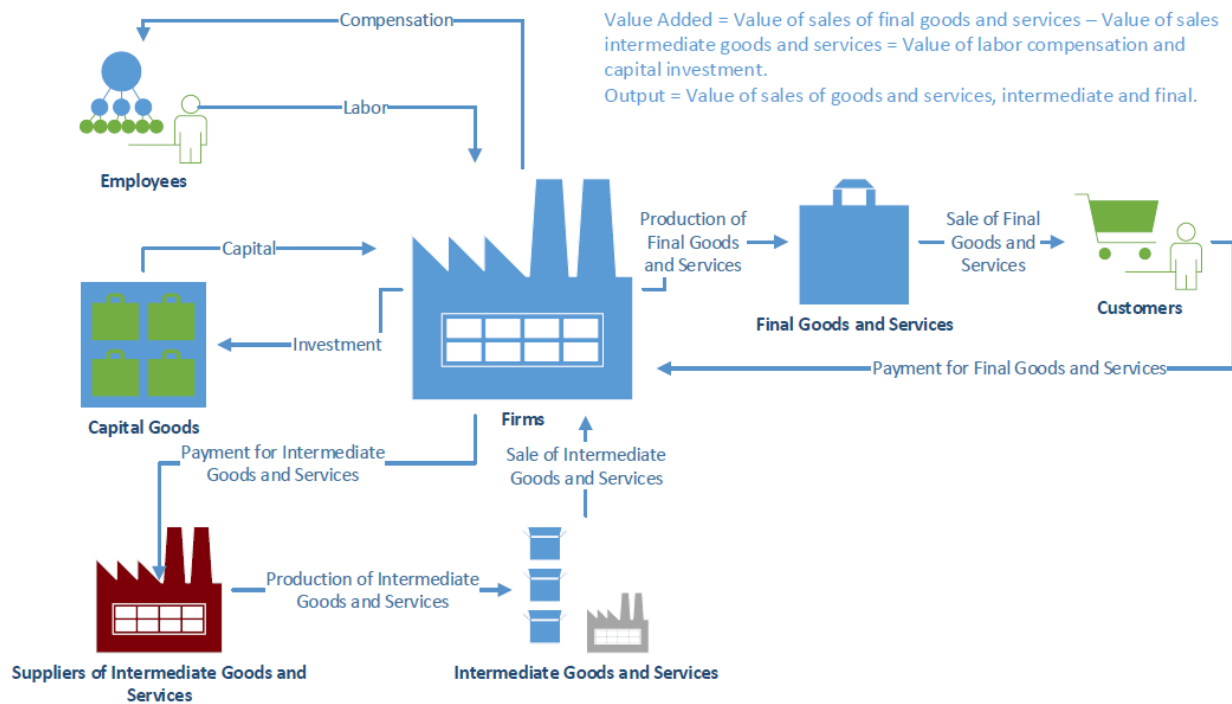
Due to existing economic linkages, PI⁺ can run a complete economic impact model just using the workers by industry, region, and year. For the purposes of this analysis, all activity was entered in the construction sector. The relevant default linkages for this analysis are average labor productivity, average compensation rate, and the typical intermediate inputs used in construction. Below, we have described what each of these linkages are, why we needed to adjust them, and how we adjusted them.

- Average labor productivity is the dollar value of production attributable to each worker (i.e., output per worker). In this context, labor productivity can be found for each region by dividing the contract value for that region by the number of workers living in that region. Since we know the actual labor productivity, we overrode the model's default values. To do this, we took the difference between the known output generated by the construction workers and the output the model would have automatically generated. We then adjusted the output for each region by this difference so that the actual change in employment and output would match what is known of the Encore Boston Harbor construction project.
- Average compensation rate is the total dollar value of wages, salaries, and benefits per worker. This value can be found by dividing total compensation by total workers. Similar to productivity, we know the actual values. Again, we adjusted compensation by the difference between known and expected values.
- Intermediate inputs are the goods and services purchased by one business from another to be incorporated into the first business's goods and services. For example, the steel or accounting services purchased by an auto manufacturer are intermediate inputs to auto manufacturing. Unlike most industries, many dissimilar businesses are gathered together in construction, such as electrical contractors, site preparation, and demolition. Normally, this collection of businesses is beneficial to the modeler as he or she must only know the total construction value without needing to know the actual distribution of budget between contractors. Since we know the distribution of contractors, we nullified the model's response and inputted our own values.

Appendix 3: Output versus Value Added

For any firm to produce goods and services to be sold on the market, it needs to pay for the things required to produce them. It needs to compensate workers for their labor, and it needs to invest in the capital goods (machinery, for example) which those workers will use. It also needs to purchase intermediate goods and services from other firms. Workers then use the firm’s capital goods to turn the intermediate goods and services into final goods and services. These final goods and services are the output of the firm and are equivalent to the value of its sales.

The concept of **value added** captures only the portion of the value of output which is directly created by the firm’s capital goods and labor. In other words, value added is the value of the final goods and services produced minus the value of the intermediate goods and services which were purchased to produce them. This can be interesting when examining an individual firm, since two firms can have similar outputs but very different value added, depending on the cost of their intermediate inputs.



Consider the example of two different t-shirt manufacturers whose economic impact on a region is being evaluated. Both of the manufacturers ultimately sell \$100 million of t-shirts, and in order to produce them, both manufacturers use \$50 million of cotton. However, the structure of their supply chains is different. One of the firms takes the cotton and performs every step required to turn the cotton into t-shirts at its facility. For this firm, value added is \$50 million (\$100 million of t-shirts minus \$50 million of cotton) and output is \$100 million. The other manufacturer instead opts to purchase fabric from a third party fabric manufacturer, which has taken the \$50 million of cotton and turned it into \$70 million of fabric. When considering the economic impact of this operation, both firms need to be considered. The fabric manufacturer has a value added of \$20 million (\$70 million of fabric minus \$50 million of cotton) and an output of \$70 million. The t-shirt manufacturer has a value added of \$30 million (\$100 million of t-shirts minus \$70 million of fabric) and an output of \$100 million, the same as the original factory. Considered together, this second scenario has a combined value added of \$50

million, the same as the first example, but a combined output of \$170 million, much higher than the initial example. The lesson from this is that while output is a useful economic metric in many contexts, it has the potential to double count the production of goods and services and is best when presented alongside value added for context.

Example: How change in supply chains can change output without changing value added

