ECONOMIC IMPACT ANALYSIS (EIA) FOR ADDITIONAL TIER OF EMISSIONS STANDARDS FOR NONROAD SPARK IGNITION ENGINES AND EQUIPMENT

REVISED DRAFT INDUSTRY PROFILE FOR MARINE SI INDUSTRY

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SECTION 1

INTRODUCTION

This industry profile presents background information on the marine spark-ignition (SI) industry and provides descriptive and numerical inputs for the economic impact analysis (EIA). The marine SI industry is dominated by recreational applications with some commercial use and includes markets for several types of boats, personal watercraft (PWC), and SI engines that power them. Producers and consumers are described for each market segment; product attributes and the effects of these attributes on production costs and demand are described as well. As part of this market characterization, particular emphasis is placed on assessing suppliers' industrial organization and cost of production and demanders' price responsiveness and substitution possibilities. The marine SI industry is divided into three applications areas: outboard (OB) boats, sterndrive and inboard (SD/I) boats, and PWC.

1.1 OB Boats

An OB boat is a vessel powered by one or more gasoline engines, which are located outside the hull at the back of the boat. The engine and drive unit are combined in a single package. An engine can easily be removed from the boat for inspection or repair, and it is quite common for the boat owner to change engines during the life of the vessel. The OB boat segment is the largest of the three application areas; in 2002, 213,000 units were sold, which is more than the combined sales of SD/I and PWC (National Marine Manufacturers Association [NMMA], 2005).

The OB application area can be further divided into "recreational" and "luxury" categories. The luxury category includes more-expensive vessels, for which the engine constitutes only a small portion of the cost of the entire vessel. The NMMA distinguishes between 14 types of OB vessels, 10 of which are considered recreational and 4 luxury.

1.2 SD/I Boats

SD/I vessels have an engine installed inside the hull of the vessel. An inboard vessel is a boat in which the engine is located inside the hull at the center of the boat with a

propeller shaft going through the rear of the boat. A sterndrive (or inboard/outboard) vessel is a boat in which the engine is located inside the hull at the back of the boat with a drive assembly coupled directly to the propeller, where the propeller shaft passes through the rear of the boat.

In contrast to OB vessels, the engine is an integral part of a SD/I vessel, which makes removal or replacement is significantly more difficult. Therefore, most repair work is done with the engine in place. Just like OBs, the SD/I application area is divided into recreational and luxury categories.

1.3 PWC

A PWC is defined as an inboard vessel that is less than 4 meters (13 feet) in length and uses an internal combustion engine powering a water jet pump as its primary source of propulsion. PWCs are designed to be operated by a person or persons positioned on, rather than within the confines of the hull. They are also designed with no open load carrying area that could retain water.

The PWC application area is divided into the entry level, high end, and performance categories based on the horsepower ratings of the vessel. These categories correspond to 50 to 100 hp, 100 to 175 hp, and over 175 hp accordingly. Our study considers two categories that were available in 2002: entry level and high end. The performance category was introduced in 2003.

1.4 Marine SI Engines

Marine SI engines within a given horsepower range exhibit a high degree of technological similarity, regardless of the specific application for which they are intended. Therefore, throughout the industry profile, marine SI engines are segmented into six horsepower size categories:

- Less than 25 hp: Of the engines in this category, 99.9 percent are OB engines. These engines have either one or two cylinders and are mostly two-stroke. They constituted an 18.74 percent share of the marine SI engine market in 2002.
- 25 to 50 hp: This category consists of OB engines only. They have either two or four cylinders and a two-stroke cycle. These engines had a 11 percent share of the marine SI engine market in 2002.

- 50 to 100 hp: About 80 percent of the engines in this category are OB, and PWC engines constitute the remaining 20 percent. The majority of these engines are two-stroke with two, three, or four cylinders and inline or V-block configuration. These engines comprised 21 percent of the marine SI engine market in 2002.

- 100 to 175 hp: Fifty-one percent of the engines in this category are PWC engines, 43 percent are OB, and 6 percent are inboard. In addition, 70 percent of them are two-stroke. These engines comprised 22 percent of the marine SI engine market in 2002.

- 175 to 300 hp: In this category, 52 percent of the engines are inboard, and 48 percent are OB. Engines in this category have either six or eight cylinders, and 37 percent of them are two-stroke. These engines had a 23 percent share of the marine SI engine market in 2002.

- Greater than 300 hp: This category includes only inboard engines. These engines have typically been derived or "marinized" from automotive engine blocks. These engines have 8 or 12 cylinders, a four-stroke cycle, and V-block configuration. In 2002 they represented only about 4.5 percent of the engines produced or imported in the U.S. marine SI market.

It is important to note that the 2002 model year, which this discussion is based upon, was a transition year for regulatory standards. This technology mix is not reflective of current or future sales.

SECTION 2

SUPPLY SIDE

To develop an understanding of the regulated industry and inform economic impact model development, this section provides information about industry supply-side issues. It includes a discussion of the inputs used to produce marine boats and the associated production costs. Particular emphasis is placed on engines' inputs because they are directly affected by the program. The section also includes a description of the firms that make up the supply chain and their market shares, a characterization of the markets and the competitiveness of the industry, and recent sales and price trends by segment.

2.1 OB Boats

The supply chain of the OB boat segment includes a variety of firms that perform different roles (Figure 2-1). Substantial volumes of OB engines are produced by independent engine manufacturers, sold to independent boat builders for newly manufactured boats, or sold directly to retailers or final consumers as replacement engines. In this case, the independent boat builders act as demanders (in the engines market) and suppliers (in the boat market). The remaining engines are frequently incorporated into vessels produced by by another division within the same parent company.

2.1.1 Factors of Production and Costs

Manufacturers combine materials, labor, and capital to produce OB boats (see Table 2-1). The latest economic census data show that material costs made up 56 percent of the total value of shipments in 2002.[1] Labor (15 percent) and capital expenditures (2 percent) accounted for a small share of the value of shipments.

[1]These data include commercial and military boats.

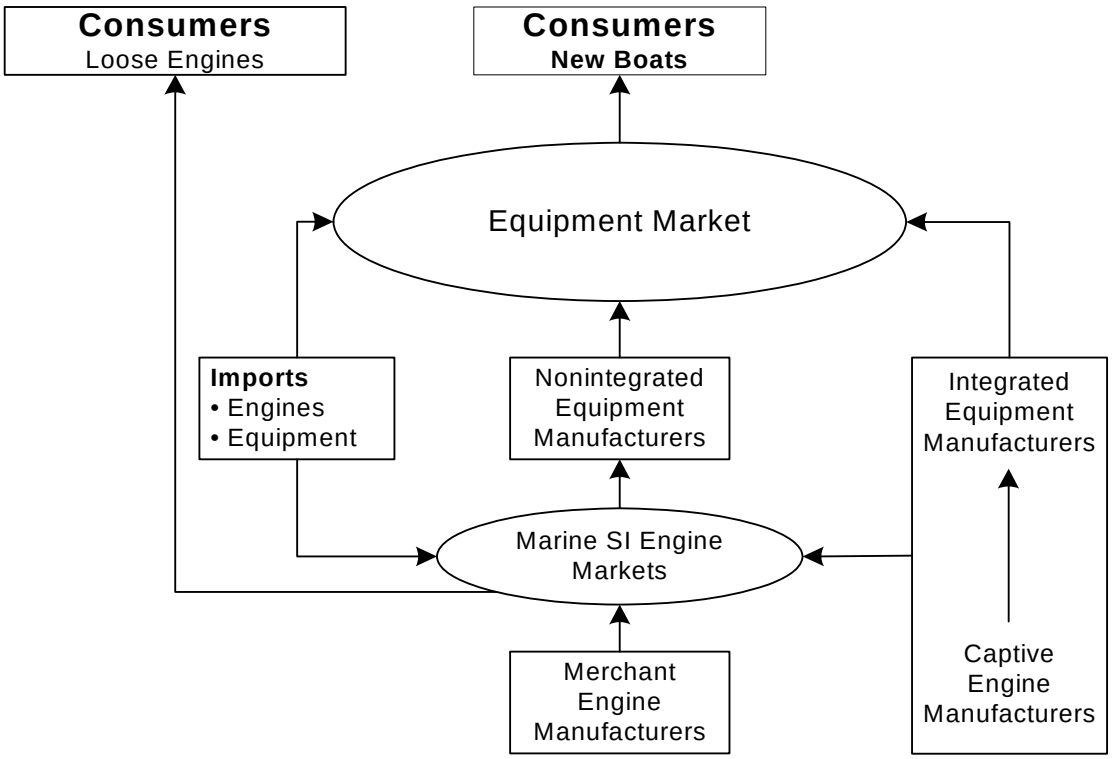

Figure 2-1. OB Marine Economic Model Conceptual Flow Chart

Table 2-1. OB Boats Cost of Manufacturing (2002)

NAICS	NAICS Definition	Value of Shipments ($Million)	Labor ($Million)	Cost of Materials ($Million)	Capital Expenditures ($Million)
3366121	Outboard motorboats, including commercial and military (except sailboats and lifeboats	3,089	469 (15%)	1,740 (56%)	54 (2%)

Source: U.S. Census Bureau. 2005a. "Boat Building: 2002." *2002 Economic Census: Manufacturing Industry Series*. EC02-311-336612. Table 5. Washington, DC: U.S. Census Bureau.

Material costs is a broad category and includes data on engine inputs and materials needed to manufacture the hulls of boats. Census data for the boat building industry as a whole (NAICS 336612) suggest that the cost of engines (gasoline and diesel) purchased to produce boats makes up approximately 10 percent of the value of shipments. However, this average likely understates the cost share of engines in the OB segment. Additional data collected from NMMA by EPA (Samulski, 2004) show that the engine cost share ranges from 60 to 80 percent of the OB vessel price. Hulls of marine SI boats are made of fiberglass plastic (FRP), rubber, wood, or aluminum, which accounted for less than 5 percent of the materials cost.

2.1.1.1 Marine SI Engines Used in OB Boats

For OB boats, the engine and drive unit are combined in a single package. Importantly, the engine can easily be removed from the boat for inspection or repair, and it is quite common for the boat owner to change engines during the life of the vessel. In addition, some OB vessels have more than one engine for increased power and versatility. As a result, the engine-per-vessel sales ratio is not one-to-one. For example, NMMA sales data show that the ratio of the engines per vessel sold in 2003 was approximately 4:3.

Engine suppliers in this segment fall into two broad categories. The most common type is the independent or "merchant" engine manufacturer who sells OB engines to nonaffiliated boat builders for newly manufactured boats and replacement engines sold directly to retailers or final consumers. The other type is an "integrated" manufacturer, that is, a manufacturer with boats and engine production processes owned by the same firm. In this case, OB boat builders incorporate engines produced by another division within the same parent company. These "integrated" firms share more of a merchant-like relationship than vertically integrated firms in other industries. What normally happens is that when a large engine manufacturer (such as Yamaha or Brunswick) wants to penetrate a certain market with their engines, they buy a boat builder in the target market and instruct them to use their companies engines. So even though one company may own a engine manufacturing division and the boat manufacturing division, these divisions will operate quite separately–similar to "independent" engine and boat manufacturers.

Based on the broader category: other engine equipment manufacturing (NAICS 333618), costs of materials represent about 64 percent of the value of shipments, followed by labor at about 12 percent, and capital expenditures at about 4 percent (see Table 2-2). A

majority of engine components such as engine blocks, cylinder heads, and exhaust systems use iron and aluminum as primary components. Intake manifolds and pistons use aluminum as a primary component; connecting rods, crankshafts, and valves use iron as their primary component. Material costs are dominated by cast and formed metal. Iron and steel accounted for 13 percent of material costs and aluminum accounted for 3 percent; no other raw materials contributed more than 1 percent of material costs.

Table 2-2. Engine Costs of Production (2002)

NAICS	Value of Shipments (10^6)	Labor (10^6)[a]	Cost of Materials (10^6)[a]	Capital Expenditures (10^6)[a]
333618 Other engine equipment manufacturing	$18,585.9	$2,144.8 (12%)	$11,800 (64%)	$754.8 (4%)

Materials Consumed by 333618	Cost (10^6)	Share of Total Materials Cost (%)
Iron and steel[b]	$1,442.3	13%
Aluminum[c]	$746.7	3%

[a] Percentages in parentheses refer to the percentage of the total value of shipments.

[b] NAICS codes 33211101, 33151001, 33120007, and 33120016.

[c] NAICS code 33152005.

Source: U.S. Census Bureau. 2005b. "Other Engine Equipment Manufacturing: 2002." *2002 Economic Census: Manufacturing Industry Series*. EC02-311-333618. Washington, DC: U.S. Census Bureau. Tables 1 and 7.

2.1.2 Market Structure: Products and Producers that Constitute the Market

Two distinctive product characteristics can be used to define the OB markets along product dimensions. First, the OB segment can be divided into recreational and luxury categories to distinguish less-expensive vessels from more-expensive ones. The NMMA distinguishes between 14 types of outboard vessels, 10 of which are considered recreational and 4 luxury (see Table 2-3). Buyers are unlikely to shift between these two groups of products on a large scale (i.e., there is no strong long-run substitution). The other feature of OB boats is the power rating of their engines. Consumers are more likely to view OBs with similar horsepower ratings as close substitutes, and it seems reasonable to discuss the OB markets by the six engine rating categories (described in Section 1).

With respect to the geographic distribution of the market, a strong case can be made that a national market for OB boats exists versus local or regional markets because significant economic barriers to exchange (i.e., transportation costs) do not seem to exist within the United States.

Table 2-3. OB Application Category by Type of Boat

Recreational Vessels	Luxury Vessels
Bass boat	Express cruiser
Center console	Express fish boat
Fish-N-Ski	Performance boat
Deck boat	Runabout cuddy
Pontoon boat	
Other fish boat	
Runabout bowrider	
Tournament ski	
Utility	
Walkaround	

Source: National Marine Manufacturers Association (NMMA). December 2004. <www.nmma.org/facts/>.

2.1.2.1 Company Information

Leading manufacturers that participate in OB boat markets are reported in Table 2-4 with their respective market shares. In 2003, Genmar led the market with 17 percent of the market share, trailed by Brunswick with 11 percent. However, a recent purchase of Genmar's aluminum division by Brunswick set them as a leading producer of OB marine boats in 2004.

U.S.-based Mercury, which is owned by Brunswick, had more than a 50 percent OB engine market share in 2002 (see Table 2-5). Bombardier, Yamaha, and Honda pose substantial competition to Brunswick.

2.2 SD/I Boats

As with the OB boat industry, the supply chain of the SD/I market includes boat manufacturers that solely build boats and purchase engines (Figure 2-2). However, this supply chain has no distinct inboard engine market. Instead, automotive engines produced dominantly by merchant engine manufacturers are purchased and modified for marine use (marinized) by either boat manufacturers or firms that specialize in marinizing and selling engines to boat builders. Data show that a majority of the engines in this market are GM

Table 2-4. OB Boat Market Shares (2003)

Manufacturer	Market Share
Genmar	17.0%
Brunswick Corporation	11.0%
Tracker Marine	9.0%
Yamaha	3.0%
Other small builders	60.0%

Source: *Boating Industry*. 2004. "Independent's Day." September issue.

Table 2-5. Market Share of Top-Five OB SI Engine Manufacturers

Manufacture	Ultimate Parent Company Data		OB Market Share (2002)
	Revenue ($Million)	Employment	
Brunswick Corporation	$4,129	23,225	55.1%
Bombardier International	$16,025	64,600	28.6%
Yamaha Motor Company Ltd.	$5,107	23,903	11.8%
Honda Motor Company Ltd.	$78,222	131,600	3.0%
Tohatsu	NA	350	1.0%

Sources: Dun & Bradstreet. Small Business Solutions. <http://smallbusiness.dnb.com/default.asp>.
Hoover's Online. <http://www.hoovers.com/>.
ReferenceUSA. <http://www.referenceusa.com/>.
Yahoo Finance. <http://finance.yahoo.com/>.
Power Systems Research (PSR). 2002. OELink™. <http://www.powersys.com/OELink.htm>.

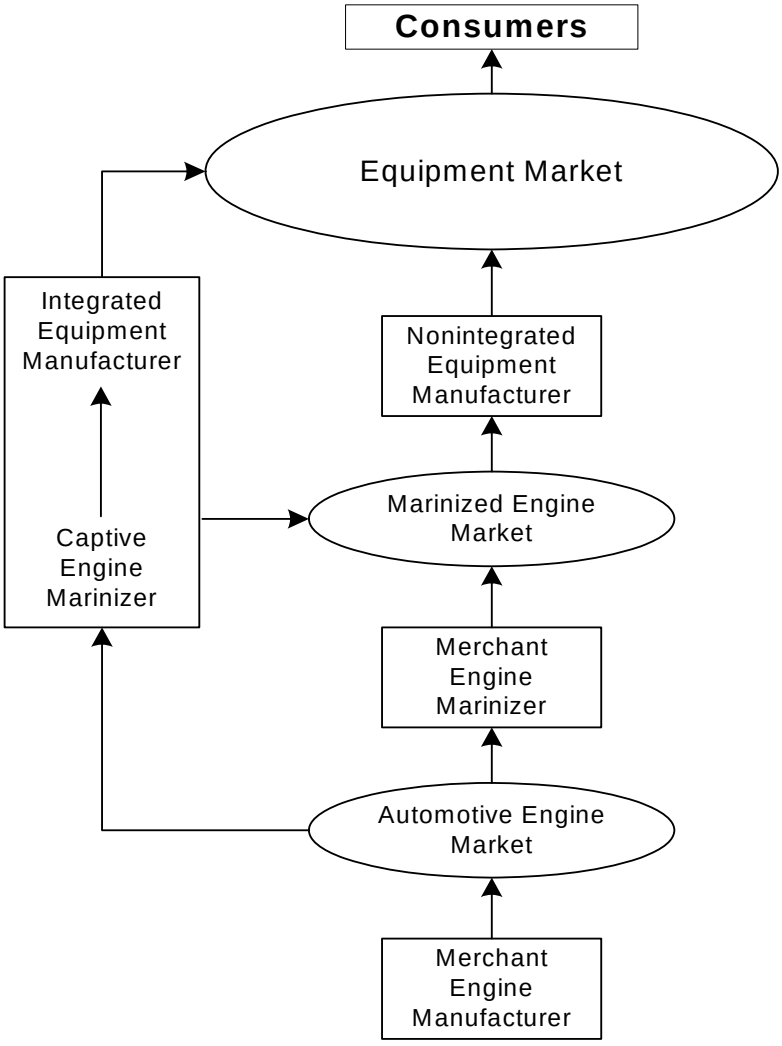

Figure 2-2. Inboard Marine Economic Model Conceptual Flow Chart

Powertrain Vortec engines produced in Mexico and sold to marinizers and boat manufacturers in the United States.

2.2.1 Factors of Production and Costs

EPA Census data show that SD/I boat manufacturing has similar input cost shares as the OB boat industry. As shown in Table 2-6, material costs constitute between 50 to 62

percent of the value of shipments. Labor costs equal 16 percent, and capital expenditures comprise 3 percent of the value of shipments.

Table 2-6. SD/I Boats Cost of Production (2002)

NAICS	NAICS Description	Value of Shipments ($Million)	Labor ($Million)	Cost of Materials ($Million)	Capital Expenditures ($Million)
3366125	Inboard-outdrive boats, including commercial and military (except sailboats and lifeboats)	1,586	259 (16%)	988 (62%)	43 (3%)
3366123	Inboard motorboats, including commercial and military (except sailboats and lifeboats)	2,384	427 (18%)	1,197 (50%)	47 (2%)

Source: U.S. Census Bureau. 2005a. "Boat Building: 2002." *2002 Economic Census: Manufacturing Industry Series*. EC02-311-336612. Table 5. Washington, DC: U.S. Census Bureau.

The cost of engines (gasoline and diesel) purchased to produce boats makes up approximately 20 percent of the delivered materials cost for the boat-building industry. This value is generally consistent with EPA estimates (Samulski, 2004) showing that the engine cost share ranges from 40 percent for recreational vessels to 20 percent for luxury vessels.

SD/I boats have an engine-to-boat ratio greater than one. However, because an engine is an integral part of the vessel, there are few loose engine sales. In addition, a substantial number of luxury vessels also come equipped with two engines.

2.2.1.1 Marine SI Engines Used in SD/I Boats

Gasoline SD/I engines are generally derived from land-based counterparts. Engine marinizers buy automotive engine blocks and modify them for use on boats. Because of the good power/weight ratio of gasoline engines, most SD/I engines are not modified to produce more power than the base engines were originally designed to produce. In some airboat applications, aircraft engines are used.

Engine suppliers in this segment fall into two broad categories. The most common type is independent or "merchant" engine manufacturer; they buy automotive engines, marinize the engines, and sell them to nonaffiliated boat builders for newly manufactured boats. The other type is an "integrated" manufacturer, that is, a manufacturer with boats production processes and engine marinizing processes owned by the same firm. In this case, SD/I boat builders incorporate engines marinized by another division within the same parent company. Similar to engine suppliers in the OB segment, these "integrated" manufacturers share a merchant-like relationship, where each division operates largely independently.

Typical SD/I Marinization Process. Marine engines are built from base engines designed for use in cars and trucks. Currently, the vast majority of base engines are General Motor (GM) engines that range in size from a 3.0-liter in-line four-cylinder engine to an 8.2-liter V8 engine, and they range in power from about 100 to 300 kW. These engines are sold without front accessory drives or intake and exhaust manifolds. Also, no carbureted versions of these engines are offered; they are either sold with electronic fuel injection or no fuel system at all. Relatively small numbers of Toyota four-stroke and Mazda rotary engines are also used.

Marinizers convert the base engines into marine engines in the following ways:

- Choose and optimize the fuel management system.
- Configure a marine cooling system.
- Add intake and exhaust manifolds and accessory drives and units.

Fuel and Air Management. Historically, marine engines have been carbureted. Today this technology seems to be going away but is still offered as a cheaper alternative to electronic fuel injection. Less than half of new engines are sold with carburetors. GM does not offer carburetors or their associated intake manifolds because they are not used in the higher volume, automotive applications. Therefore, marinizers who produce carbureted engines must purchase the fuel systems and intake manifolds elsewhere.

The 3.0-liter and 4.3-liter base engines are offered with throttle body fuel-injection systems as an option. All of the larger engines are offered with multiport fuel injection as an option. Although GM offers a base marine calibration for its electronic control module, it also offers software allowing marinizers to perform their own engine calibrations. For most

engines sold, the marinizers will alter the calibrations to optimize engine operation. Except for some small market niches, the marinizers do not calibrate the engines for more power.

Cooling System. Marine engines are generally packaged in small compartments without much air flow for cooling. In addition, Coast Guard safety regulations require that surface temperatures be kept cool on the engine and exhaust manifold. Typically, marine exhaust systems are designed with surface temperatures below 93°C (200°F). To do this, manufacturers use ambient (raw) water or fresh water cooling.

Most gasoline marine engines are cooled with raw water. This means that ambient water is pumped through the engine to the exhaust manifold and mixed with the exhaust. The exhaust/water mixture is then dumped under water. Mixing the water with exhaust has three advantages:

- cools the exhaust and protects rubber couplings in sterndrives,
- acts as a muffler to reduce noise, and
- helps tune the exhaust back pressure.

An alternative to raw water cooling is fresh water cooling. In a fresh water system, raw water is used to cool the recirculated engine coolant ("fresh water"). The raw water is generally still used to cool the exhaust manifold and exits the engine with the exhaust. However, some systems use the engine coolant to cool the exhaust manifold.

Some gasoline engines, mostly inboards, have fresh water cooling systems that provide two advantages:

- Engine corrosion problems are reduced, especially when the boat is used in salt water. Fresh water systems keep salt water, which can be corrosive, out of the engine. Because salt emulsifies at about 68°C, thermostats in fresh water systems are set around 60°C to 62°C.
- Marinizers can achieve much better control of the engine temperature. By reducing variables in engine operation, combustion can be better optimized.[2]

[2]Conversation between Tim Fileman at Flagship Marine and Mike Samulski at EPA, February 10, 1999.

There are trade-offs with using a fresh water system. The fresh water system costs more because of the added pump and heat exchanger. Also, this system is not as efficient for cooling the engine as pumping raw water directly to the engine.

Other Additions. As mentioned above, marinizers add intake manifolds to carbureted engines. As part of the cooling system, marinizers must add water-jacketed exhaust manifolds, pumps, and heat exchangers. SD/I engines may also have larger oil pans to help keep oil temperatures down. Because of the unique marine engine designs, marinizers also add their own front accessory drive assembly. Finally, sterndrive engines also must be coupled with the lower drive unit.

High-Performance SD/I Marinization Process. There is a niche in the SD/I markets where customers are willing to sacrifice engine durability for a high power-to-weight ratio. Marinizers that address this niche do so by increasing the fueling of the engine, optimizing the spark-timing for power, and modifying the exhaust manifold for better tuning. In some cases, the marinizers may also increase the displacement of the engine by boring out the cylinders. Other components such as cam rails and pistons may also be modified. Turbochargers or superchargers may also be added.

High performance engine manufacutrers typically use specialty racing blocks which are similar to the GM engines. However, these engine blocks but are built to have larger cylinders, cooling passages, tighter tolerances, and more durable construction. Engines using these specialty blocks may have rated power ranging from 375 to more than 800 kW.

2.2.2 Market Structure: Products and Producers that Constitute the Market

Similar to the OB boat markets, two distinctive product characteristics help define the SD/I markets along product dimensions. First, the SD/I boat markets can be divided into "recreational" and "luxury" categories to distinguish less-expensive vessels from more-expensive ones. Buyers are unlikely to substitute between these two groups of boats because of the different activities each type of boat supports. The other feature of SD/I boats is the power rating of its engine, and consumers are more likely to view marine SI engines with similar horsepower ratings as close substitutes. Again, it seems reasonable to delineate the SD/I boat markets by engine rating categories (see Section 1).

With respect to the geographic distribution of the market, there are national SD/I boat markets versus local or regional markets because there are no significant economic barriers to exchange (i.e., transportation costs), particularly within the United States.

2.2.2.1 Company Information

The largest firms in the SD/I boat industry, such as Mercury (Brunswick) and Genmar, have all types of product lines. Several other large firms are more specialized. The smallest firms have vessel production lines in only one or a few segments. Production of skiboat and wakeboat types of inboard vessels is dominated by small firms. The large, integrated boat manufacturers do not have a presence in this category. No information was available on cruisers' type of inboard category (Ehlert Publishing Group, 2004).

U.S.-based Mercury (Brunswick) dominates the SD/I marine SI engine application areas with more than 50 percent of the market share (see Table 2-7). U.S.-based Indmar, Pleasurecraft, and Marine Power also hold substantial market shares in this segment.

Table 2-7. Market Share of Top-Five SD/I Marine SI Engine Manufacturers

	Ultimate Parent Company Data		
Manufacture	**Revenue ($Million)**	**Employment**	**SD/I Market Share (2002)**
Brunswick Corporation	$4,129	23,225	59.7%
Volvo AB	$23,400	75,740	22.9%
Indmar Products Company, Inc.	$5	65	9.5%
Pleasurecraft Marine	NA	20	5.8%
Marine Power	$2	26	2.1%

Sources: Dun & Bradstreet. Small Business Solutions. <http://smallbusiness.dnb.com/default.asp>.

Hoover's Online. <http://www.hoovers.com/>.

ReferenceUSA. <http://www.referenceusa.com/>.

Yahoo Finance. <http://finance.yahoo.com/>.

Power Systems Research (PSR). 2002. OELink™. <http://www.powersys.com/OELink.htm>.

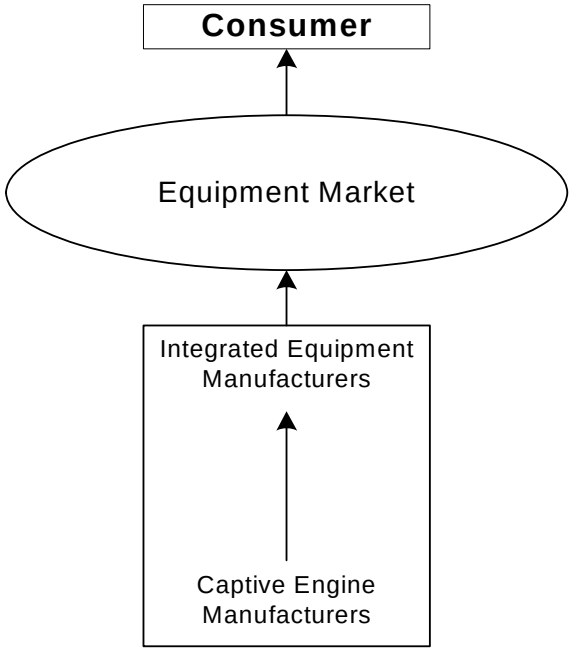

Figure 2-3. PWC Economic Model Conceptual Flow Chart

2.3 PWC Vessels

The supply chain of the PWC segment is easier to characterize than the other two marine segments because PWC manufacturers integrate the boat and engine production processes (Figure 2-3). In this case, all PWC builders incorporate engines produced by another division within the same parent company.

2.3.1 Factors of Production and Costs

The 2002 U.S. Census Manufacturing Series information on materials consumed by kind was not available for PWC (NAICS 3369995417). However, the Census does report costs associated with manufacturing the equipment in the All Other Transportation Equipment Manufacturing Category (NAICS 336999), which also includes ATVs, golf carts, go-karts, snowmobiles, race cars, and similar vehicles. PWC manufacturing has similar input cost shares as the other segments. As shown in Table 2-8, material costs constitute 60

percent of the value of shipments. Labor costs equal approximately 10 percent, and capital expenditures comprise 3 percent of the value of shipments.

2.3.1.1 PWC Engines

PWC vessels are each propelled by a single engine with a jet drive. There are three power categories of the jet engines: 50 to 100 hp, 100 to 175 hp, and greater than 175 hp, which represent entry level, high end, and performance applications, respectively. The average price of PWC ranges from $7,000 to $9,000 (Samulski, 2004) and largely reflects the cost of engines.

Table 2-8. PWC Cost of Manufacturing (2002)

NAICS	Application Area	Value of Shipments ($Million)	Labor ($Million)	Cost of Materials ($Million)	Capital Expenditures ($Million)
336999	All Other Transportation Equipment Manufacturing	6,958	626 (9%)	4,260 (61%)	213 (3%)

[a] Includes commercial and military boats, excluding sailboats and lifeboats.

Source: U.S. Census Bureau. 2004. "All Other Transportation Equipment Manufacturing: 2002." *2002 Economic Census: Manufacturing Industry Series*. EC02-311-336999. Washington, DC: U.S. Census Bureau.

2.3.2 Market Structure: Products and Producers that Constitute the Market

As mentioned above, PWC markets are distinguished by three types of power categories: entry level, high end, and performance. As with the OB and SD/I segments, the geography of the PWC markets extends nationally because the markets do not appear to have significant economic barriers to exchange (i.e., transportation costs), particularly within the United States.

2.3.2.1 Company Information

The PWC markets in 2002 were dominated by imports such as Yamaha, Kawasaki, and Sea-Doo (subsidiary of Bombardier), and only 0.4 percent of the boats are produced domestically (by Aquajet) (see Table 2-9). Competition in 2004 included two successful

newcomers: Honda and Brunswick. Bombardier had a leading PWC production share in 2002 with 45.5 percent and was closely followed by Yamaha. For the 1999 to 2002 period, Bombardier market share dropped by 5 percent, while Yamaha's market share increased by the same amount to equal 45.1 percent in 2002 (Table 2-10). Other stakeholders in the 2002 production market were Kawasaki with 9 percent and U.S.-based Aquajet with 0.4 percent, who entered the market in 2001.

Table 2-9. Market Share of Top-Five PWC Marine SI Engine Manufacturers

	Ultimate Parent Company Data		
Manufacture	**Revenue ($Million)**	**Employment**	**PWC Market Share (2002)**
Yamaha Motor Company Ltd.	$5,107	23,903	49.4%
Bombardier International	$16,025	64,600	41.5%
Kawasaki Heavy Industries, Ltd.	$10,983	29,306	8.7%
Aquajet Corporation	NA	NA	0.4%

Sources: Dun & Bradstreet. Small Business Solutions. <http://smallbusiness.dnb.com/default.asp>.

Hoover's Online. <http://www.hoovers.com/>.

ReferenceUSA. <http://www.referenceusa.com/>.

Yahoo Finance. <http://finance.yahoo.com/>.

Power Systems Research (PSR). 2002. OELink™. <http://www.powersys.com/OELink.htm>.

Table 2-10. Market Share of PWC Manufacturers (1999–2002)

Parent Company Name	1999	2000	2001	2002
Aquajet Corporation	0	0	25	267
Market Share	(0.0%)	(0.0%)	(0.03%)	(0.4%)
Bombardier International	58,889	39,187	35,892	34,014
Market Share	(50.9%)	(44.4%)	(47.91%)	(45.5%)
Kawasaki Heavy Industries, Ltd.	15,232	10,788	6,403	6,724
Market Share	(13.2%)	(12.2%)	(8.55%)	(9.0%)
Polaris Industries Inc.	6,069	0	0	0
Market Share	(5.2%)	(0.0%)	(0.0%)	(0.0%)
Suzuki Motor Corporation/Arctic Cat Inc.	3,260	0	0	0
Market Share	(2.8%)	(0.0%)	(0.00%)	(0.0%)
Yamaha Motor Company Ltd.	32,224	38,656	32,859	33,743
Market Share	(27.9%)	(43.8%)	(43.87%)	(45.1%)
Total	115,674	88,313	74,909	74,748

Source Power Systems Research (PSR). 2002. OELink™. <http://www.powersys.com/OELink.htm>.

2.4 Pricing Behavior in Marine SI Markets

The discussion of pricing behavior generally focuses on perfect competition (price-taking behavior) versus imperfect competition (the lack of price-taking behavior). The central issue is whether individual firms have sufficient market power to influence the market price. We highlight the differences between perfect and imperfect competition below and discuss conditions that exist in the marine markets that justify an assumption of competitive pricing behavior.

Standard neoclassical theory assumes perfect competition; that is, buyers and sellers take the market price as given and thus are “price-takers.” In a competitive equilibrium, the market price equals the value society (consumers) places on the marginal product, as well as the marginal cost to society (producers).

In contrast, imperfect competition implies firms have some ability to influence the market price of the output they produce. One of the classic reasons firms may be able to do this is their ability to produce commodities with unique attributes that differentiate them from competitors’ products. This allows them to limit supply, which in turn increases the market price, given a downward-sloping demand curve. Decreasing the quantity produced

increases the monopolist's profits but decreases total social surplus because a less than optimal amount of the product is being consumed. As a result, the value society (consumers) places on the marginal product, the market price, *exceeds* the marginal cost to society (producers) of producing the last unit in these markets. Thus, social welfare could be increased by inducing the monopolist to increase production.

As discussed above, several of the marine SI markets are highly concentrated and thus have the potential for the emergence of imperfect competition and price-setting behavior. Nonetheless, our analysis suggests that mitigating factors will limit this potential for raising price above marginal cost; thus, that the assumption of perfect competition is justified. We discuss the mitigating factors below.

Generally, a credible threat of entry encourages competition. Industries with high profits provide incentives to new firms to enter and force the market price to their competitive levels. In all of the marine markets, it appears that there are candidate domestic and international firms that can enter any of these markets in a short period of time. Other data on capacity utilization rates published by the Federal Reserve (aerospace and miscellaneous transportation equipment [NAICS 3364-9]) suggest that potential excess capacity exists in the broad industry group that includes the marine industry. February 2005 data show industry utilization rates of 65 percent, which is well below the average between 1974 and 2002 (72 percent). If this industry data reflect the excess capacity conditions that exist in the marine markets, the data provide additional evidence that the ability to raise price above marginal cost is limited by existing idle capacity.

Other theories of entry conditions place less emphasis on the importance of concentration measures as a determinant of pricing behavior and instead examine the role of potential competition. For example, three conditions of perfectly contestable markets (Viscusi et al., 1992) show how potential competition can lead to competitive behavior. These conditions include the following:

- New firms have access to the same production technology, input prices, products, and demand information as existing firms.
- All costs associated with entry can be fully recovered.
- After learning about the new firms' entry, existing firms cannot adjust prices before these new firms supply the market.

Although the extent to which these conditions are satisfied in marine markets is unclear, the theory suggests high concentration alone will not necessarily lead to arguments against competitive pricing behavior.

2.5 Market Trends

Recent market statistics are presented as a means to assess the future of marine production. Information on production and pricing trends is provided in this section, as well as a comparison of foreign production (imports) versus domestic production, where available.

2.5.1 OB Boats

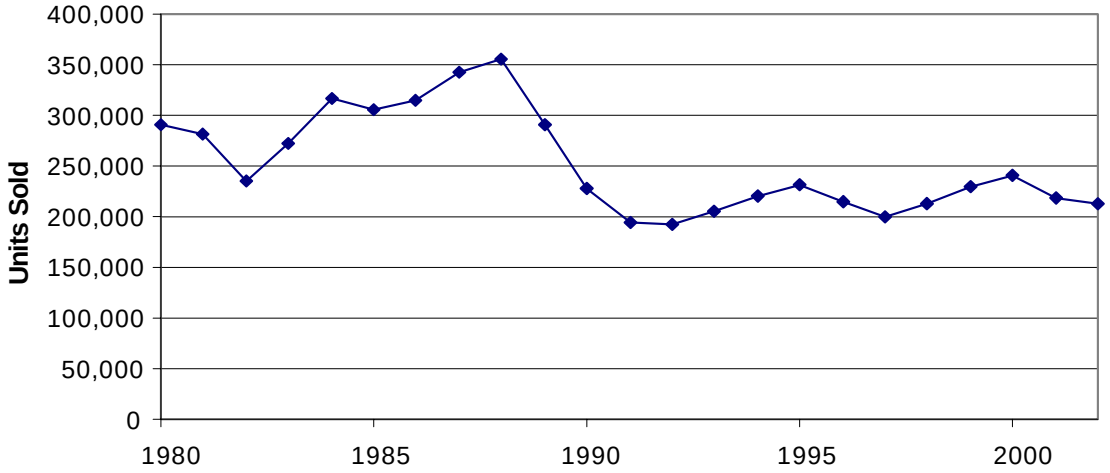

Figure 2-4. Marine SI OB Boats Application Category Annual Sales (1980–2002)

Source: National Marine Manufacturers Association (NMMA). December 2004. "Annual Retail Unit Sales." <www.nmma.org/facts/boatingstats/2002/files/unitsales.asp>.

The OB marine SI boats annual sales data are presented in Figure 2-4. Sales in the OB marine industry peaked in 1987 with approximately 350,000 units sold. In the past decade, sales of OB marine SI boats have been relatively steady at about 225,000 unit sales per year (NMMA, 2004).

2.5.2 SD/I Boats

The SD/I marine SI boats annual sales data are presented in Figure 2-5. A rapid increase in sales from 1984 to 1989 was followed by relatively low sales in the 1991 to 1993 period and a decrease in the number of unit sales in 1999. In 2002, there were just under 100,0000 unit sales of sterndrive/inboard vessels.

2.5.3 PWC

The PWC boats market actualized in 1991 and found its peak in 1995 with 200,000 units sold. Figure 2-6, which demonstrates annual unit sales of PWC boats from 1991 to 2002, shows that the market has been declining over the past decade. The most recent NMMA data, however, show an increase in unit sales in 2004. This suggests that the market might be leveling off to assume its average around 75,000 annual unit sales.

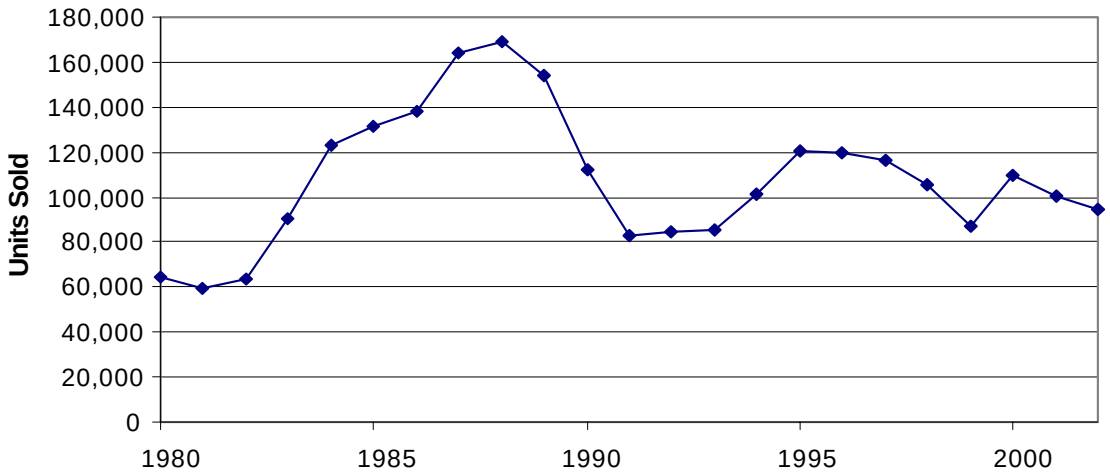

Figure 2-5. Marine SI SD/I Boats Application Category Annual Sales (1980–2002)

Source: National Marine Manufacturers Association (NMMA). December 2004. "Annual Retail Unit Sales." <www.nmma.org/facts/boatingstats/2002/files/unitsales.asp>.

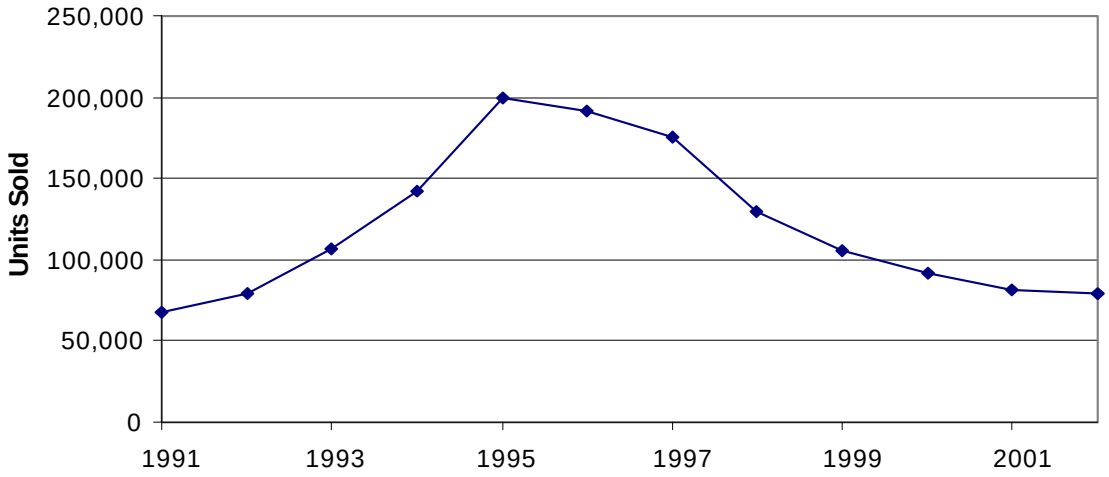

Figure 2-6. Marine SI PWC Application Category Annual Sales (1991–2002)

Source: Power Systems Research (PSR). 2002. OELink™. <http://www.powersys.com/OELink.htm>.

2.5.4 Marine SI Engines

As shown in Table 2-11, domestic production of marine SI engines in the SD/I application category declined significantly from 1998 to 2002, falling from 94 percent of the total at the beginning of the period to 36 percent in the most recent year. In contrast, the domestic share of OB marine SI engine production has remained almost constant from 1998 to 2002, with 75 to 80 percent being produced in the United States. Almost all PWC were imported throughout the entire 5-year period.

Table 2-11. Marine SI Engine Market Trends by Application Area (1998–2002)

Year	Application Area	Domestic Production	Percentage of Total	Imports	Percentage of Total
2002	SD/I	37,157	36.0%	65,921	64.0%
	OB	222,923	73.7%	79,412	26.3%
	PWC	267	0.4%	74,481	99.6%
2001	SD/I	36,028	35.4%	65,880	64.6%
	OB	162,220	69.7%	70,420	30.3%
	PWC	25	–0.03%	75,154	99.97%
2000	SD/I	102,757	93.7%	6,962	6.3%
	OB	222,857	76.0%	70,490	24.0%
	PWC	0	0.0%	88,631	100.0%
1999	SD/I	114,094	95.5%	5,399	4.5%
	OB	258,969	78.3%	71,852	21.7%
	PWC	5,480	4.7%	110,194	95.3%
1998	SD/I	99,252	94.2%	6,071	5.8%
	OB	246,232	76.3%	76,323	23.7%
	PWC	9,081	6.6%	128,355	93.4%

Source: Power Systems Research (PSR). 2002. OELink™. <http://www.powersys.com/OELink.htm>.

Price trends for the marine SI engine manufacturing industry are shown in Figure 2-7. No data are available for the marine SI engine industry specifically, but data for the other engine manufacturing industry (NAICS 333618) are provided as an indicator of trends for marine SI engine products. Over the last decade, the other engine U.S. producer price index (PPI) has had less variability than manufacturing as a whole but has followed a similar upward trend.

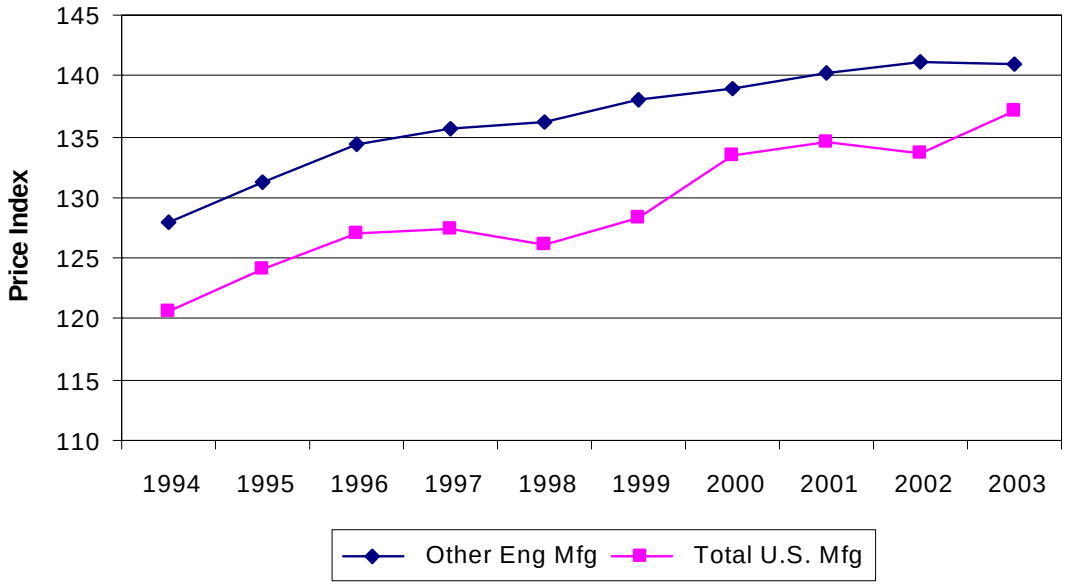

Figure 2-7. Price Trends for the Marine SI Engine Manufacturing Industry (1994–2003)

Source: U.S. Bureau of Labor Statistics (BLS). Producer Price Index Series. Series: PCU 333618 333618, PCUOMFG--OMFG--. <http://data.bls.gov/PDQ/outside.jsp?survey=pc>.

SECTION 3

DEMAND SIDE

Estimating the economic effects of a regulation requires characterizing various aspects of the demand for marine segments. In this section, we describe typical uses and the factors that influence consumption choices. This information provides the context for the likely demand responses associated with the proposed regulation.

3.1 Recreational Users

A recent boat-building industry survey found that the vast majority of boat consumers are individuals, rather than commercial or other users (CCA, 2000). As shown in Table 3-1, individual recreational consumers accounted for approximately 80 percent of users in 1996.

Table 3-1. U.S. Boat-Building Consumption by User Type (1996)

	Share of Total
Individual consumer	79.4%
Commercial	13.7%
Other	6.9%

Source: Center for Competitive Analysis (CCA), University of Missouri. 2000. "The U.S. Boat Building and Repairing Industry: National Trends and Characteristics." Available at <http://www.umsl.edu/~cca/IndustryReports/BBR-final-July2000.pdf>.

3.2 Factors that Influence Consumption Choices

Recreational choices are a function of tastes, income, prices, and prices of related goods and services. According to a recent NMMA survey (Left Brain Marketing, 2004), new recreational boating expenditures appear to compete with other large discretional expenditures such as new cars and trucks, vacations, and home improvements. The data also show the types of recreation activities the industry views as close substitutes (see Table 3-2).

Table 3-2. Customer Adoption Cycle for Various Recreational Products (2004)

Response Type	Boat	Camper/ RV	Tent	Golf Clubs	Snowmobile	Snow Skis	Motorcycle	ATV
Interested in buying	41.5%	46.4%	38.9%	42.6%	8.7%	19.6%	22.8%	20.9%
Not interested in buying	58.5%	53.6%	61.1%	57.4%	91.3%	80.4%	77.2%	79.1%

Source: Left Brain Marketing. 2004. "Barriers and Competitors Quantitative Study: Final Report." Prepared for the National Marine Manufacturers Association.

According to the 2003 Consumer Expenditure Survey (BLS, 2004), approximately 1.1 percent of Americans' average annual expenditures are used for other entertainment supplies, equipment, and services, which includes motorized recreational vehicles and boats (see Table 3-3). There is little variation in expenditure shares by geography. For example, expenditure shares range from a low of 0.7 percent in the Northeast to 1.6 percent in the South. Expenditure shares do vary by income class (less than 1.0 percent for consumers reporting income less than $50,000 and over to 1.6 percent for consumers with income over $70,000 (see Table 3-4). This is consistent with the perception that recreational boating is a luxury good and demand for boats increases with income. However, recreational boating expenditures still represent only a small fraction of total consumer expenditures.

Table 3-3. Other Entertainment Supplies, Equipment, and Services, which Include Motorized Recreational Vehicles and Boats (2003)

All consumers, United States	1.1%
South	1.2%
Midwest	0.9%
West	1.6%
Northeast	0.7%

Source: U.S. Bureau of Labor Statistics. 2004. "Consumer Expenditure Survey (CEX), Tables Created by BLS." Tables 52. Available at <http://www.bls.gov/cex/home.htm#tables>.

Table 3-4. Income before Taxes: Shares of Average Annual Expenditures and Sources of Income, Consumer Expenditure Survey (2003)

	Other Entertainment Supplies, Equipment, and Services
Complete Reporting of Income	
Total complete reporting	1.1
Less than $5,000	0.6
$5,000 to $9,999	0.3
$10,000 to $14,999	0.3
$15,000 to $19,999	0.5
$20,000 to $29,999	0.9
$30,000 to $39,999	1.4
$40,000 to $49,999	0.8
$50,000 to $69,999	1.0
$70,000 and over	1.5

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