

The Economic Impact of BMW on South Carolina



The Division of Research



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Executive Summary

In 1992 South Carolina reached a milestone in economic development. While the U.S. economy was mired in recession, BMW AG announced it would construct an advanced automotive assembly plant on 1,039 acres of Spartanburg County farmland along Interstate 85, potentially employing thousands of workers. Ten years later, the promise of 1992 has turned into reality, with a powerful economic impact that has spread across South Carolina.

Known worldwide as the “ultimate driving machine,” BMW has proven to be an enduring economic development driver. Since groundbreaking in 1993, BMW Manufacturing Corp. has continually ramped up its investment as it adds new product lines—including the Z3 roadster and X5 Sports Activity Vehicle. With a total investment of \$1.9 billion in South Carolina, the facility now employs more than 4,300 workers. Yet the economic impact extends far beyond these direct infusions of jobs and capital. The Spartanburg County plant has formed strong links with the local economy. Importantly, BMW purchases inputs from 33 South Carolina suppliers, who then make further local purchases, creating an extensive South Carolina-based supply chain in the automotive sector. Further, the employees working directly at BMW earn high incomes that stimulate local spending. This expenditure circulates throughout South Carolina communities, creating more jobs and incomes for individuals and businesses not directly tied to the plant.

This study provides a comprehensive economic assessment of BMW’s quantitative and qualitative effects on economic development in South Carolina. The central findings are striking.

- In all, BMW’s South Carolina investment supports 16,691 jobs and produces \$691 million in wages and salaries annually in the state.
- The employment multiplier effect is 3.9. This means that for every direct job at the South Carolina facility, almost three additional jobs are created elsewhere in the economy. A typical employment multiplier for South Carolina in-

dustries and services is closer to two.

- The total economic output associated with BMW’s annual economic activities is more than \$4.1 billion in South Carolina (based on operations in 2001). This total impact is the result of an economic multiplier that emanates from the plant’s operations and capital expenditures.
- BMW’s investment also contributes substantially to local government and school finance. Fiscal benefits are presented for the state and for the four upstate counties most affected by BMW’s presence: Anderson, Greenville, Laurens, and Spartanburg. After accounting for the costs incurred by state government, South Carolina receives \$27.6 million in net revenues each year.
- County benefits are net of costs of providing services to citizens. Overall, the four Upstate counties receive \$2.4 million annually in additional net revenue. This additional money can be spent on meeting the many public sector needs that require additional funding—without any additional burden on local taxpayers.
- Finally, the local school districts in these four counties gain \$3.2 million annually, providing significant revenue for K-12 improvements.

Beyond employment, income, and tax impacts, the study explores contributions of BMW to South Carolina’s overall competitiveness. Above all, BMW bolsters the state’s competitive economic development by forming strong ties with local suppliers. The supplier network is crucial, anchoring the investment in South Carolina. Through suppliers, BMW channels continual improvements in technology, management, and organizational skills. BMW plays an active role in improving the capabilities of its suppliers.

BMW forms the crux of a local automotive cluster that can change rapidly with the global marketplace. The South Carolina plant is in the forefront of agile (or flexible) manufacturing. Linked to BMW’s worldwide production and distribution network, the Greer facility serves as a model of rapid response to the continually changing demand for specific automobiles. BMW produces 80 percent of its cars to order. Specifications for each of these

individual cars are handled by a sophisticated computing system that feeds information from markets around the world.

The transfer of know-how and skills through the global BMW network—needed for agile production—benefits the local labor force. In particular, the South Carolina skill base grows as BMW trains advanced engineers. The mix of American-to-German process engineers was 40 percent to 60 percent in the mid-1990s. By the time production for the X5 model had begun in the late 1990s, the ratio of American-to-German engineers had increased to 90:10.

BMW is also a leader in environmental practices and management. In 1998, the plant was awarded ISO 14001 environmental certification for meeting or exceeding international environmental standards.

In 2000, the Environmental Protection Agency accepted BMW as a charter member of the Agency's National Performance Track. So far, BMW is the only automobile company to be included on the EPA's list. This enables BMW to reconfigure the Spartanburg County facility to meet forecasted demand without constant EPA intervention. Staying ahead of the curve on environmental issues has not only contributed to the preservation of South Carolina's environment but it has also helped BMW meet its customers' demands.

Beyond the advantages brought to South Carolina through the development of a competitive automotive cluster, the study examines the broader role BMW has played in the manufacturing revival of the state. Prior to BMW's location decision, South Carolina's economy faced continual job losses in manufacturing. To help revitalize the

state's industrial base, South Carolina—like many other governments around the country and the world—has provided incentives to firms like BMW. The state has acted aggressively to build the physical capital base, focusing on a strategy to attract industry from both foreign and domestic sources. The incentive package offered BMW appears to be modest compared with other recent automotive investments in the U.S. South.

By understanding BMW's economic contribution to South Carolina, it is possible to understand the conditions for successful economic development. This represents the first cost-benefit study of a major automobile investment in the South. The study shows that, with support from the state and local communities, BMW provides a concrete example of how economic benefits can potentially spread throughout a region.

In sum, this study provides a comprehensive economic analysis of BMW, including employment and income impacts as well as an assessment of the net fiscal benefits (additional government revenue versus costs). The study finds that BMW influences the prosperity of many Palmetto State citizens, directly and indirectly. Moreover, through the introduction of custom manufacturing, through agile production techniques, and by transferring knowledge through its local supplier network, BMW's investment has a far-reaching effect on the state's competitiveness.

By investing far more than initially promised and by forming a deeply rooted automotive cluster in the state, BMW's legacy during its first decade has proven to be enormously positive—for the company *and* for South Carolina. The future appears just as auspicious.








A History of BMW in South Carolina	
 <p><i>Production Workers</i></p>  <p><i>Greer Area Facility</i></p> <p>1992 June—S.C. plant announced. September—Groundbreaking ceremony.</p> <p>1993 April—Construction begun.</p>  <p><i>Finished Product</i></p> <p>1994 January—First production associates hired. July—Associates move into facility. September—S.C. assembly line completes first U.S. 318i.</p>	<p>1995 March—First U.S.-made 318i shipped. July—ISO 9002 quality certification awarded. September—First Z3 roadster came off r1 assembly line.</p>  <p><i>"Goldeneye"</i> Release Date: November 1995</p> <p>1997 January—Production of M (motorsport) roadsters begun, with production of Z3 and M coupes</p>  <p><i>BMW Z3</i></p> <p>the following year. October—100,000th roadster produced.</p> <p>1998 January—Coupe production begins. May—Expansion to permit production of X5s announced.</p>  <p><i>BMW Coupe</i></p> <p>November—ISO 14001 environmental certification awarded.</p> <p>1999 September—U.S. X5 production begun. 200,000th roadster produced.</p> <p>2000 June—\$300 million expansion announced.</p> <p>2001 January—50,000th X5 produced. February—250,000th roadster produced. August—100,000th X5 produced.</p>  <p><i>BMW X5</i></p>

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The Economic Impact of BMW on South Carolina

Introduction

In 1992, BMW (Munich-based Bayerische Motoren Werke AG) announced that it would locate its North American manufacturing facility in Spartanburg County, South Carolina. BMW began construction on the plant in 1993 and shipped its first car, a 318i sedan, in 1995. The 23-month span from the groundbreaking in South Carolina to the first shipment is considered the fastest automotive start-up in history.

BMW's venture into North American manufacturing was a major move forward in the global expansion of the renowned Bavarian company, which began producing automobiles in 1928. The 1,039-acre site along Interstate 85 in Spartanburg County represents the company's first full assembly plant outside Germany. The venture was also a milestone for South Carolina, which had little previous automotive assembly experience prior to BMW. (The Anderson Motor Company built a total of 5,553 specialty cars from 1916-1925 in Rock Hill. It turned out, however, that the autos were too expensive and could not compete with the Ford Model A.) BMW's 1992 announcement drew worldwide attention to the state, including many articles about the favorable climate for competitive industries.¹

No doubt the investment has proven to be mutually beneficial for the company and the state. The site has vastly exceeded its initial commitment of 2,000 jobs and \$600 million in capital investment. The site has witnessed several significant expansions since 1995 as new product lines have been developed. South Carolinians now build BMW's popular Z3 roadster, M-series roadsters and coupes, and the X5 Sports Activity Vehicle. In all, BMW has invested \$1.9 billion in direct investment in South Carolina and employs more than 4,300 "associates."² Annual compensation reached \$345 million in 2001. Clearly, the Upstate plant substantially augments the income base of South Carolina as a whole. Suppliers have invested an additional \$2.1 billion (through July 2001), further fueling regional growth and development.

Prior to BMW's location decision, South Carolina's economy was in transition.³ The textile industry, which migrated to the area in the late 19th century to take advantage of low wages and abundant hydro-power found along the Upstate's many rivers, formed the region's manufacturing backbone throughout most of the 20th century. Since the early 1970s, however, this important industry no longer has been a source of net job creation. New businesses have developed in the state, but the manufacturing sector—the ticket to the middle-class for many citizens—began to seriously erode.

Undeniably, the BMW location decision represented a major achievement in South Carolina's promotion of economic development. The investment by one of the world's most sophisticated manufacturers—producing a unique, universally respected brand—highlights South Carolina's assets as a profitable business location. To be sure, the BMW facility represents the most recognized investment ever made in South Carolina. With superior management and production techniques, the facility promotes the region's economic restructuring. In an area that has witnessed steady job losses in the traditional nondurable goods (textiles and apparel) sector, BMW adds thousands of high-wage, high-value-added, high-skill jobs.

The company's commitment to South Carolina and to the local communities surrounding the plant has strengthened in the decade since the original announcement. In 2002, BMW is deeply rooted in the Upstate. Yet, beyond press reports and preliminary analyses, BMW's impact has not been evaluated in any detail. To date, there has been no comprehensive assessment of the investment's ramifications for economic development. Accordingly, the Division of Research (DOR) at the Moore School of Business, the University of South Carolina, has undertaken a comprehensive study of the economic impact of the BMW system in South Carolina. The results are presented in this document.

The study evaluates the key economic issues raised by the BMW investment, including:

- The total economic impact of investment, measuring the extent to which BMW provides employment and income for South Carolina residents, both directly and indirectly.
- The fiscal benefits and costs to the state and to local entities. These effects are based on the best available data and economic modeling techniques.
- BMW's influence on upgrading and enhancing the technological and manufacturing competitiveness of South Carolina.
- The investment in the context of South Carolina's industry recruitment incentives.

Essentially, this study documents BMW's quantitative and qualitative impact on South Carolina's economy and places these results in the context of the state's development as it enters the 21st century. No doubt, the continued investments in Spartanburg County represent strong economic gains for the state and local communities. Indeed, it is hard to imagine the state *without* BMW and the extensive local linkages that bind the region with the global economy. While the findings presented here focus on an automotive cluster that stretches along Interstate 85 and throughout South Carolina, they carry lessons for anyone interested in regional economic growth.

This study was financially supported by BMW Manufacturing Corp. Nevertheless, the research team at the Moore School of Business independently designed the methodology and assumes full responsibility

for the integrity of the results. The study is based on an objective research design and widely accepted economic modeling techniques, using conservative assumptions that are biased toward understating BMW's role in economic development.

The remainder of the study is organized as follows.

- The next (second) section presents the central quantitative results, beginning with an overview of the methods, followed by a summary of the major findings: the employment and income effects and the fiscal implications for state and local governments.
- The third section discusses the qualitative impacts of the plant operations, emphasizing the importance of bringing advanced production and management techniques to the Upstate.
- The fourth section places these results in the wider context of economic development and competitiveness in South Carolina.
- In the fifth section, the function of economic development incentives in the plant's location decision is explored. Development incentives continue to be a source of great interest, and some misunderstanding, in South Carolina and elsewhere.
- The last section concludes the study.

A Synopsis of BMW



Bavarian Motor Works (BMW) was formed in 1916 when two small aircraft engine manufacturers merged. In 1923, BMW began to build motorcycles, then its first car in 1928. BMW is now the only multi-brand automaker that utilizes a pure, premium brand strategy. BMW's white-and-blue logo is recognizable worldwide, and recalls the company's start as an aircraft engine manufacturer. It symbolizes a pilot's view through a propeller as alternating white and blue segments.

The BMW Group now consists of three primary business segments. The BMW Automobiles Segment develops, manufactures, assembles, and sells automobiles. It includes off-road vehicles, spare parts, and accessories. The BMW Motorcycle Segment develops, manufactures, assembles, and sells motorcycles, and also includes spare parts and accessories. The Financial Services Segment focuses on leasing automobiles and financing credit for customers and dealers. The BMW Automobiles Segment sells several lines of automobiles. The 3-series, 5-series, and 7-series span the low-to-high ends of the luxury automobile market, respectively. The newer additions to the product line include the popular Z3 roadster and coupe, the M roadster and coupe, and the X5 Sports Activity Vehicle, all of which are manufactured at the South Carolina plant.

BMW's Economic and Fiscal Impact

The modern BMW manufacturing facility situated along Interstate 85 is a symbol of the Palmetto State's economy. Yet, what are the real economic effects of this massive investment on 1,039 acres of formerly agricultural land? This section answers this question by investigating the extensive ties between the facility and the larger economy, showing the effects of producing (or "manufacturing") BMWs in the Upstate on the lives and livelihoods of citizens throughout South Carolina and beyond.

The primary research involves estimating the employment and income impacts generated by BMW's capital investment and ongoing operations. The basis for the impact is the economic multiplier concept. Economic impact analysis entails calculating the extent to which BMW's direct activities stimulate further

economic effects, spreading employment and income, as well as tax revenue for the local and state governments. Based on an economic model tailored to explain the BMW manufacturing system, the analysis provides a basis for evaluating the cluster of business activities that develop indirectly around a leading manufacturer.

While the techniques of impact analysis require economic training to understand fully, the crux of the analysis can be stated in straightforward prose. To arrive at economic impact estimates, economists model the *total* effects of spending and income circulating through the economy. The total economic impact sums *direct, indirect, and induced* effects stemming from the plant. Each of these effects is explained in this section (a complete methodology discussion is given in Appendix A).

Economic Impact Definitions

Direct Impact. *These are BMW's expenditures that are injected into the state's economy.*

Indirect Impact. *These are the ripple effects on other industries based on impact analysis.*

Induced Impact. *These are impacts of household expenditures from wages and salaries.*

Total Impact. *This sums the direct, indirect, and induced impacts.*

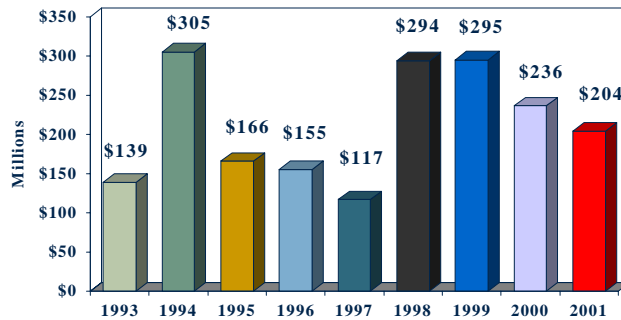
Economic Effects

Figure 1 shows BMW's investment in South Carolina since 1993. Now consider the impact of this investment and the activity generated on jobs and income. The economic impacts begin with the *direct* effects of the automobile plant in South Carolina. Raising income and employment in South Carolina is a paramount goal for policy makers and an ongoing concern of all citizens. The direct BMW contribution is job creation and economic activity at the plant itself. There was no similar automotive activity before the 1992 announcement, so it has brought entirely new money to the state that would otherwise not exist. Direct employment in the plant has reached more than 4,300 full-time equivalents (2001 figures). The steady growth of direct job creation since 1993 can be seen in Figure 2.

Besides direct labor, BMW Manufacturing Corp. purchases materials, supplies, and services from local businesses, which create additional jobs and income. BMW's North American supplier network is com-



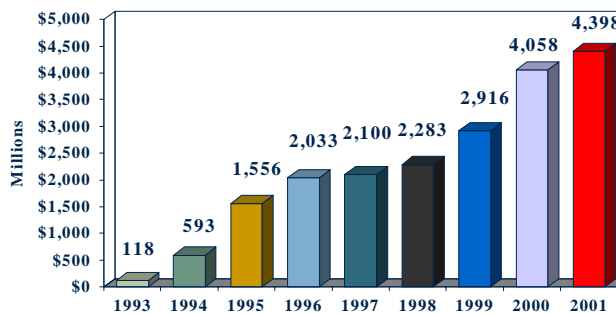
Figure 1. BMW's Annual Investment in South Carolina



Total BMW Investment through 2001: \$1.911 billion
Total Supplier Investment through July 2001: \$2.1 billion
 Source: BMW Manufacturing Corp.



Figure 2. BMW's Job Creation in South Carolina



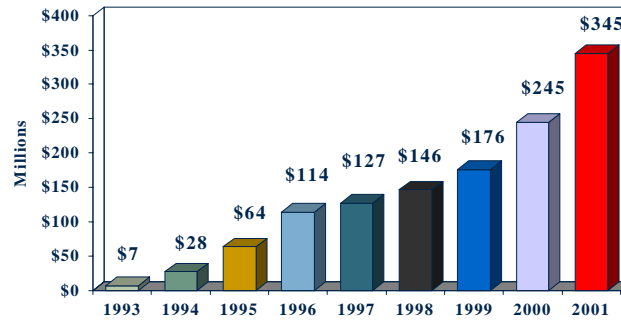
Total BMW Job Creation through 2001: 4,398
Total Supplier Job Creation 1992-10/01: 6,712
 Source: BMW Manufacturing Corp.

posed of 126 companies throughout the United States, Canada, and Mexico. In South Carolina, 27 new automotive suppliers have clustered close to the Greer-area plant, while 6 additional pre-existing local suppliers have obtained supply contracts. Within a two hours' drive, these suppliers must meet precision delivery schedules for parts required by BMW. In all, BMW's business supports more than 6,700 supplier jobs (2001 figures), creating the first round of employment impacts beyond the direct effects. The income gained by suppliers through BMW contracts is then re-spent. Consequently, suppliers lead to additional *indirect* employment and earnings as their purchases spread into the wider economy.

Beyond BMW's economic ripple effect through suppliers, another chain of activity is touched off by wage and salary payments (Figure 3). This income is largely spent in the local economy. In impact analy-



Figure 3. BMW's Total Compensation in South Carolina



Source: BMW Manufacturing Corp.

sis, this is the *induced* effect. The induced effect begins with BMW's \$345 million in direct personal income paid to employees; subsequently, the employee income is spent at Upstate retail establishments, on various services, and at other businesses, leading to further rounds of spending and income.

The cascading impact of spending and income diminishes as it extends deeper into the local economy. In each round of the spending and income cycle, some of the income's impact is dampened as the money is taxed, saved, or used to buy goods and services outside of the community and the state. Hence there is an extensive "multiplier" effect from BMW's operations and capital investment that continues, but grows smaller, as the spending tapers off, turning into less income, which is then spent as a smaller amount.

The total impact—summing the direct, indirect, and induced effects—accounts for all economic activity that stems from the BMW plant. The direct effects of BMW's impact are obtained from records of BMW's employment, payroll, and input purchases from local suppliers. The total effect is more complicated and involves economic modeling. Given direct information available from BMW Manufacturing Corp., the researchers used IMPLAN, an input-output model calibrated to the South Carolina economy (including counties) that calculates the total impact. (A full explanation of the methodology is in the Appendix A.) The model produces a set of summary statistics (multipliers) describing BMW's total economic impact. The multipliers are defined as the ratio of total to direct impacts.

Employment, income, and output effects are the most common metrics for evaluating economic effects or impact. The results of the economic impact analysis reveal powerful effects of a major automotive plant on local employment, income, and economic output. These total economic impacts are displayed in Figures 4 through 6. Each chart shows the direct and combined indirect and induced effects that make up this total impact.

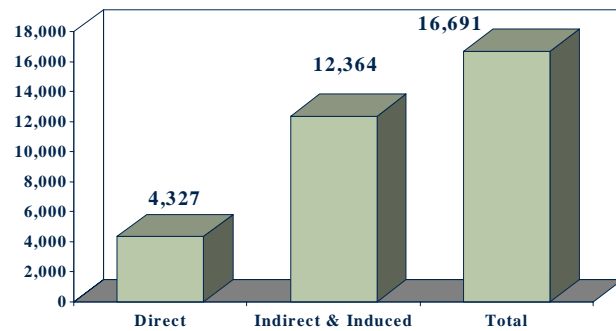
The figures reveal that, through the multiplier effect, BMW's South Carolina investment supports 16,691 total jobs in South Carolina. Given that 4,327 workers are directly employed at the plant, this total job impact yields a multiplier of 3.9. That is, for every direct job in South Carolina, almost three additional jobs are created elsewhere in the economy. A typical employment multiplier for South Carolina industries and services is closer to two. While most of the direct and indirect jobs are in the manufacturing sector, the multiplier effects support jobs in virtually every sector of the state's economy. A breakdown of the indirect and induced employment impacts by sector is given in Appendix B.

The figures also show that the BMW manufacturing operations generate \$691 million in total personal income for state citizens. The plant itself accounts for \$345 million in wages and salaries directly, while indirect and induced effects cause the rest. Dividing the total income effect by the total job effect yields income per job of \$41,424 (\$691 million/16,691). This compares with direct income per job ratio of \$79,753 (\$345 million/4,327).

Finally, the model yields a total economic output associated with BMW's annual economic activities (2001) in South Carolina of more than \$4.3 billion. Economic output is a broader measure than income, measuring the overall value of



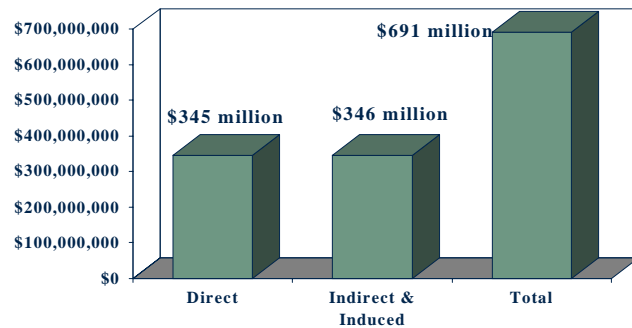
Figure 4. BMW's Economic Impact on Employment



Source: Division of Research, Moore School of Business, University of South Carolina.



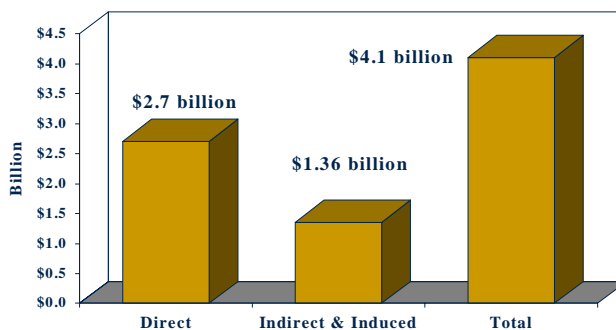
Figure 5. BMW's Economic Impact on Wages and Salaries



Source: Division of Research, Moore School of Business, University of South Carolina.



Figure 6. BMW's Economic Impact on Output



Source: Division of Research, Moore School of Business, University of South Carolina.

economic activities associated with BMW in South Carolina. The Upstate plant itself accounts for \$749 million in annual economic output, and the remainder is determined through its linkages with the economy at large.

BMW's economic impact is also exerted through extensive international trade activities emanating from the Port of Charleston. Total imports and exports from the Port of Charleston are given in Figure 7, along with taxes and duties paid since 1993. While this study did not calculate the economic impact of BMW on the port, it is certain that the effects are considerable. In general, international trade through the South Carolina Ports Authority's facilities results in more than 80,000 jobs for the state, adds \$2.6 billion in wages, and contributes \$314 million in state and local taxes annually.⁴ BMW is a major player in the port, both through exports and imports. Exports bring new money to South Carolina from the 120 countries to which the cars are shipped; the diversity of markets helps stabilize the South Carolina manufacturing base, as the Greer-area plant is not dependent on the health of the U.S. market alone. Beyond the taxes and duties paid, BMW imports benefit the state's economy because the Spartanburg County facility houses an import car processing area, which serves as a final inspection checkpoint—before delivery to dealers throughout the southern United States—for BMWs imported from overseas.



Figure 7. Trade Effects of BMW, 1993-2002

- SC Exports, 1993 through 2001
 - 257,970 vehicles
- SC Imports, 1993 through 2001
 - 213,064 vehicles
- Taxes & Duties, 1992 through 2002
 - \$252.4 million in U.S. import fees

Fiscal Effects

Beyond job and income creation, citizens want to know whether an investment supported by state and local governments “pays for itself.” Major industrial projects add to a community's tax base, but also place demands on the local infrastructure, service operations, and the educational system. Public policy makers and local citizens are often concerned about whether the benefits outweigh the costs of new development. Thus, it is important to understand the potential net fiscal benefits—money that can finance new state/local programs and improvements in education, transportation, health, public safety, and other vital government functions.

This study used the results of the economic impact analysis to calculate local and state fiscal impacts. Based on a reasonable set of assumptions and using economic models designed specifically to calculate local impacts, the results show that BMW provides definite net fiscal benefits for the state and local communities.

To assess the net fiscal effects of the plant on South Carolina, the results of the income impact analysis serve as inputs into an assessment of the governmental costs and benefits. The net fiscal effects (benefits less costs) are determined for the state, the county, and the school district. These fiscal impacts account for the additional costs of public services and education resulting from BMW's presence. That is, because the ben-

efits are calculated net of costs, they represent incremental funds for improving local government services and education. It should be stressed that these are *conservative estimates*. For example, the analysis assumes that all BMW employees are new residents who place new costs on the local area that otherwise would not have been incurred. To the extent that BMW employees already lived in the area, they will not place any additional burdens on local governments. According to BMW's hiring policies, a vast majority of BMW employees were likely already living in the area. This assumption, therefore, means that new local government costs are overstated and hence local net benefits are understated.

In Table 1, the annual net fiscal benefits are presented for state and local governments. These figures represent annual revenue collections in excess of the additional costs incurred by government. There are two primary sources of costs at the state level: increased state education costs and the value of Enterprise Program Job Development Credits. However, the substantial earnings impact of BMW results in \$27.6 million in tax revenue each year after accounting for the increased state costs.

In Table 1, local benefits are presented for the four Upstate counties most affected by BMW's presence: Anderson, Greenville, Laurens, and Spartanburg. The county benefits are also net of costs of providing services to citizens. Overall, the four counties receive \$2.4 million annually in additional net revenue, money that can be spent on meeting the many services that require additional funding. Spartanburg (\$1.4 million) and Greenville (\$518,000) gain the most, yet Laurens and Anderson also receive over \$200,000

South Carolina State Government: \$27,647,167		
<u>Local Impact</u>		
	<i>County Government</i>	<i>School Districts</i>
Anderson	\$214,559	\$100,593
Greenville	\$518,310	\$566,553
Laurens	\$270,613	\$200,731
Spartanburg	\$1,414,250	\$2,295,819
<i>Four-County Total</i>	<i>\$2,417,369</i>	<i>\$3,163,636</i>

in new revenue. The local school districts gain \$3.2 million annually, contributing significant revenue for K-12 improvements that would otherwise have to be picked up by other taxpayers, or else curtailed.

In a nutshell, the impacts given in this section provide solid, quantitative evidence of BMW's contribution to economic prosperity in South Carolina. The large employment multiplier works to the benefit of citizens across the state. Moreover, the incremental funds received by local governments and schools spread the gains across all local residents.

BMW's Competitiveness Effects

Job and income creation form the basis for economic development. This study also examined how BMW has affected economic development more broadly, through enhancing the technological and manufacturing capabilities of the state. Here, the investments are judged according to their contribution to regional competitiveness.

This analysis is based on surveys and interviews with BMW personnel and local suppliers. Although hard to quantify, these competitive benefits indicate that BMW's investment is a long-term commitment to South Carolina's development. Citizens and policy makers become legitimately concerned about "foot-loose" investment and plants that may move to another location or country according to shifting labor costs, exchange rates, or other factors. BMW's dedication to advancing manufacturing and its role as a leading corporate citizen suggest that the investment is firmly rooted in the economy. The advanced manufacturing techniques discussed in this section underscore that the BMW investments will endure and that, at the same time, the company's operations are likely to remain viable in the state. As a leader in the global automotive marketplace, BMW infuses the state's business climate with globally competitive best-practices in manufacturing productivity, labor force development, and environmental management.

Competitiveness factors, probed through interviews with BMW, derive from the well-known case studies on national competitiveness by Harvard economist Michael Porter.⁵ BMW contributes to regional competitiveness by establishing a stable economic "cluster." An industry cluster is a geographical concentration of industries that drive down costs through proximity to key suppliers, specific labor skills, and other advantages of local networks. Clusters are local webs connecting specialized suppliers and services. Key features of cluster competitiveness include technology transfer and knowledge transfer (including management and production expertise). The industry cluster concept has been widely applied to regions in which the competitiveness of a region is based on the competitiveness of the industries.

In the cluster framework, competitive economic development is based on firms that continually innovate and respond to market opportunities. Bound together through the economic linkages discussed earlier, a

cluster perseveres through continually upgrading managerial and labor force skills and better supplier/customer relations. A cluster's impact shows up through higher productivity, new business formation, and innovation. In short, the local businesses and institutions that constitute a cluster succeed through mutual interests.

The formation of South Carolina's automotive sector after BMW's 1992 announcement is a classic example of the clustering phenomenon. It is hard to overestimate its importance to regional economic development. The cluster enhances the competitive advantages of the state through two major channels: (i) supply linkages and (ii) technology, management and organizational competence. These two features of the automotive cluster in South Carolina are discussed next.

Supplier Linkages

A key aspect in analyzing the benefits of regional clusters is the link between the primary assembler and suppliers. The influence of supplier relations on competitiveness can be difficult to measure. Even so, the supplier network is crucial, anchoring the investment in the local area. The BMW supplier relationship is the core of the regional automotive cluster and forms channels for continual improvements in technology, management, and organizational skills.

In general, highly developed supplier linkages create synergies by locating in close proximity.⁶ In fact, BMW strongly encourages suppliers to locate near the South Carolina plant to lower costs. As mentioned earlier, 33 BMW suppliers are located in South Carolina. The geographic clustering of suppliers can be seen in the map displayed in Figure 8.

BMW's South Carolina facility interfaces with suppliers through two divisions, procurement and logistics. The procurement division is focused on developing BMW's supply base. Logistics is involved in integrating existing suppliers into BMW's supply chain. Both groups work closely with suppliers to ensure that their competencies are aligned with the needs of the plant. Currently, each group has six full-time staffers who work both on- and off-site with suppliers.

Suppliers, then, must be in constant communication with the plant. When BMW makes a decision, whether building a new factory or launching a new model, the German company is known to move quickly—as the initial record-setting 23-month ramp-up from plant announcement to first assembly attests. Suppliers must be ready to fulfill BMW's exacting needs, often on short notice. This is particularly true when BMW begins making minor modifications to its line while in production, which is common for custom manufacturing—the hallmark of the company's branding. The ability to react to demand is a defining quality for any of BMW's suppliers. These capabilities are not always present in South

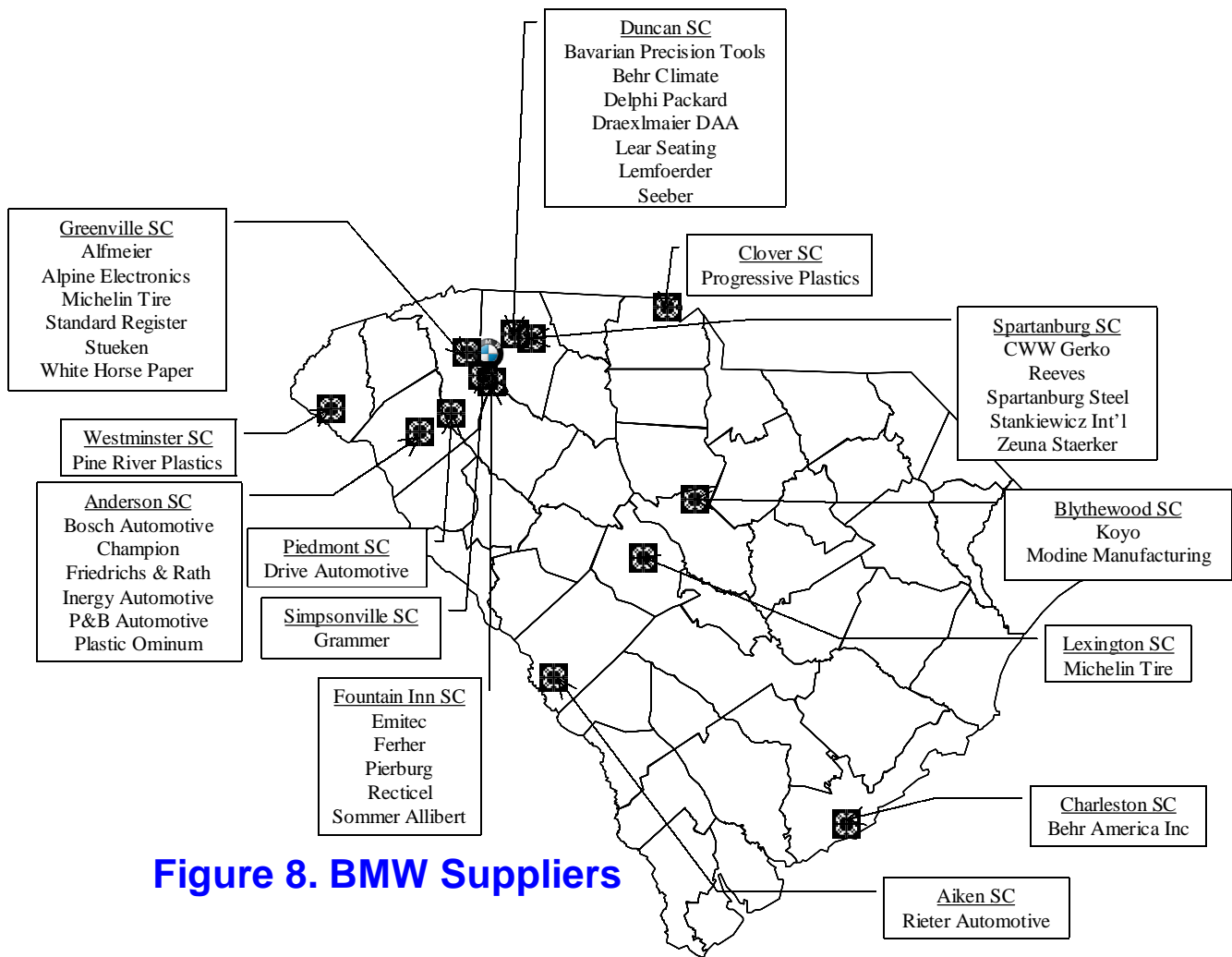


Figure 8. BMW Suppliers

Carolina’s manufacturing base. This was particularly true when BMW first moved into the Spartanburg County facility.

For local concerns struggling to meet BMW’s high standards, BMW plays an active role in improving the capabilities of its suppliers. When a supplier is having problems, BMW’s development group steps in to find a resolution. Typically, BMW and its suppliers will form cross-functional teams to attack the problem. The engagement begins with identification of the problem, agreement on the objective, and a time line for a resolution of the issue. Some of these issues might include addressing quality, production capacity for a new line, or a change in design requirements.

Suppliers must be especially nimble to meet BMW’s orders. It is a little known fact that BMW produces 80 percent of its cars to order. Specifications for each of these individual cars are handled by a sophisticated in-house enterprise-wide computing system. Although the system is centralized in Munich, the production line controlling systems are managed at BMW’s manufacturing sites. The heart of BMW’s

BMW's Booming Business

BMW is thriving in the 21st century. Sales are up significantly throughout the 120 countries where BMW ships its cars. The German manufacturer reached a new sales record in 2001, delivering 905,653 models to customers. This represents a 10.2 percent increase compared with 2000. Notably, the volume of BMWs delivered to U.S. customers has tripled over the last 10 years. BMW's recent expansion associated with the introduction of the X5 Sports Activity Vehicle accounted for the addition of 2,100 new associates at the South Carolina plant.

manufacturing process is enabled by two systems: the production control and production logistic systems. These two systems are worldwide standards for all BMW manufacturing facilities. To keep BMW's just-in-time supply chain running smoothly, BMW integrates these two systems with their suppliers through its enterprise resource planning software. To ensure that BMW receives the highest quality from its suppliers, last year BMW implemented a quality management module. This implementation creates a direct electronic connection between BMW and its suppliers and provides a direct feedback loop to the suppliers. As most of BMW's part deliveries are sequences, this information sharing with its suppliers is critical to keeping the production line moving.

Since the mid-1990s, BMW has seen a fundamental change in its relationship with suppliers and their level of involvement in the assembly process. Initially, suppliers simply supplied individual parts for assembly. As demand has increased in recent years, however, suppliers bear more responsibility for delivering modular components to the South Carolina facility.

This long-term evaluation of supplier partnerships is part of the BMW culture. In Europe, BMW has for decades concentrated on improving its suppliers' capabilities. Historically there has been a close relationship between German car manufacturers and their German suppliers. Often there are agreements between manufacturers and suppliers to support the development of new parts for specific new car models by the suppliers. Since these developments are usually costly, manufacturers often help suppliers financially or contractually agree to purchase a certain quantity. To be sure, this is not the case for every supplier, but only for those that are deemed strategically important to the car manufacturer. However, suppliers often do a huge part of the development of new components for car manufacturers and work closely with them.

Today at the Spartanburg County facility, the manufacturer-supplier partnership has manifested itself in the procurement and logistics supplier development groups. The sole responsibility of these groups is to develop lasting supplier capabilities. The supply linkages underscore the advantages of BMW's investment in South Carolina. Prior to 1992, there were few competitive automotive suppliers in the state (Bosch and Michelin excepted).

South Carolina Supplier Stories

Some suppliers followed BMW and helped develop South Carolina's automotive sector. The Lear Seating plant in Duncan is a good example. Based in Michigan, Lear is one of the world's largest auto-parts manufacturers and a Fortune 150 company. The company built the South Carolina facility in 1994 to supply seats for the Z3 Roadster. Lear doubled the size of the South Carolina plant in 1998, adding 100 workers to make seats for BMW's X5 Sports Activity Vehicle.

Other suppliers existed in South Carolina prior to BMW's arrival. Spartanburg Steel serves as an interesting case. Founded in 1962, the company has enjoyed steady growth in South Carolina. Spartanburg Steel started supplying BMW in 1994 with the Z3. The fastest growth, however, came after BMW's X5 business was secured. The company, which supplies other automotive companies with stampings, now has a stable Southeastern customer base, whereas before it mainly supplied northern plants. Moreover, managers claim that BMW's emphasis on precision engineering has spurred improvements in reliability and quality, "taking us to a higher level." Thus, BMW's concern for product integrity and quality spreads throughout the supply chain. This leads suppliers to upgrade work force skills. Spartanburg Steel has responded to BMW's advanced engineering requirements by training and re-training its workers, putting more emphasis on problem-solving skills, statistics, and other technical subjects. The company has also made significant capital investments to support its business with BMW. Today, robots weld and presses stamp some 280 metal parts for BMW, which accounts for more than half of Spartanburg Steel's production.

There are as many supplier stories as there are suppliers in South Carolina (currently 33). BMW has generated business for large international companies like Michelin Tire (with plants located in Greenville and Lexington, South Carolina) and small local firms like Progressive Plastics (based in Clover, South Carolina). A locally owned business (11 employees) that traditionally served the textile industry, Progressive Plastics now makes rubber pieces for BMW to mount under the hood to diminish wind noise. Hence, as the manufacturing base of South Carolina evolves, so do its companies, large and small.⁷

After ten years of work to establish linkages between the Munich-based company and South Carolina, BMW's supplier base has mostly stabilized in terms of quality and capacity. As a result, BMW is now able to take a more proactive (rather than the typically reactive) approach to supplier relations. Supplier development initiatives are now more focused on preparing suppliers for new launches and increasing their capacity. To remain competitive and capture sufficient margin from its operation, BMW is reducing new product development from five years to 30 months. To make all of this happen, BMW meets with its suppliers up to two years in advance to work out potential issues that could affect the launch of a new product.

In addition to improving supplier quality, BMW is beginning to move some non-core responsibilities to its suppliers. For instance, several South Carolina suppliers are involved with the design of component parts. To accomplish this, supplier engineers work closely with the BMW center of engineering competency in Munich. Shifting these peripheral design responsibilities to suppliers allows BMW to focus on its core competencies, such as drive train design.

High quality is not the only requirement of a BMW supplier. Suppliers must also have the project management talent and automated supply chain management systems. To help, BMW has a dedicated supplier development group in its logistics group. When necessary, this group helps local suppliers determine

system requirements and sets up computer systems to meet demand forecasts. In one instance, this group put 15 BMW employees on-site with one of their suppliers.

For regional competitiveness, a major advantage of BMW's vanguard role in supplier relationships is that it offers spillover benefits for the automotive cluster. Not only is supplier improvement beneficial for BMW, but it also helps suppliers attract contracts from other automotive manufacturers, such as DaimlerChrysler, Ford, and GM. This strengthens the automotive cluster in South Carolina, raising its overall competitiveness in a sector sought by all regions for development.

Cluster Competencies

Leading foreign investors like BMW transmit globally competitive practices to economies. Research on foreign investment demonstrates that successful foreign investors must possess firm-specific competitive advantages or core competencies which compensate for their lack of familiarity with the market and production conditions that differ from the home country.⁸ These compensating advantages enable investors to succeed in unfamiliar terrain.

In turn, leading foreign investors serve as conduits for upgrading quality standards throughout a local economy. Hence, a major advantage of investors like BMW is the introduction of new practices and competencies in the host economy that previously did not exist. They exemplify and demonstrate best practices in manufacturing that would be missing without the investor's presence. The following discussion presents related findings of case study research on BMW.

The core competencies brought into South Carolina by BMW Manufacturing Corp. center around the concept of flexible, or agile, production. Much has been written about the vaunted flexible manufacturing techniques of Japanese

With the Help of Computer Software, BMW Boosts Production and Integrates Suppliers

High customer demand for the X5 and Z3 models prompted the Spartanburg County plant to install new computer software to help BMW improve relationships with customers, suppliers, and partners. The result has been increased production and competitiveness for BMW and its suppliers.

The software platform enabled BMW to improve integration of suppliers into OEM business processes, which dramatically improves productivity and reduces cost. Technological capabilities have enabled both suppliers and BMW to see real time order information and production schedules. The platform also helps both suppliers and BMW coordinate purchase documents and schedule releases, as well as prepare invoices and share engineering documents. This seamless collaboration between business partners allows everyone in the supply chain to have accurate pipeline visibility to the more than 1,500 components listed on the X5's or Z3's bill of materials. The software supports both engineering and high-volume production of the customizable vehicle line. The platform has decreased supply chain errors (through effective communication), improved production capacity (through improved JIT coordination), and increased the firm's flexibility to change production schedules at a moment's notice. Additionally, BMW has developed online applications for supplier quote creations and programs for analysis of parts production.

manufacturers and how their innovations have revitalized U.S. industry. Japanese flexibility is known to have supplanted the mass standardized production that dated back to Henry Ford's assembly-line innovations.⁹ Less is known about German competencies in this regard.¹⁰ To be sure, German manufacturers did not invent the just-in-time inventory system, continual improvement, and other features of lean, agile production. Even so, they are quickly adapting and improving the new methods and spreading them globally. With the South Carolina plant, BMW is now in the forefront of agile manufacturing. Linked to BMW's worldwide production and distribution network, the Spartanburg County facility is a model of flexibility and rapid response to the continually changing demand for specific automobiles.

From the outset, BMW endeavored to create a flexible plant with minimum barriers and maximum interaction across functions. The offices for the three principal manufacturing operations—assembly, body, and paint shops—are centrally located, and office workers have a direct view of the factory floor. On the shop floor, the only walls are around the paint shop, necessary to keep it uncontaminated from the rest of the building.



The open environment allows for a key aspect of agile production: interaction among associates. The global BMW system relies on an exchange of labor and know-how, but the plant is a pioneer in spreading competencies within the factory itself. Production line workers are organized in self-directed teams. These teams perform certain tasks but make sure that all team members are able to replace somebody else, if necessary. This allows for quick changes when necessary. The team approach instills a commitment in the associates to ensure the survival of their company as well as their own job security.

To upgrade its labor force skills, BMW has ongoing training initiatives. These initiatives include an on-the-job apprenticeship system and partnerships with local technical schools. The ongoing partnership with technical colleges demonstrates BMW's commitment to improving the quality of South Carolina's work force.

The transfer of know-how and cross-fertilization of skills needed for agile production benefits the local labor force. When the doors to the plant first opened, the mix of American-to-German process engineers was 40 percent to 60 percent. Like most complex assembly processes, there were mistakes made and lessons learned. American employees learned the German way to assemble and launch a new vehicle.

Over time, through a mostly trial-and-error process, the South Carolina production team improved its newly acquired skill set and began to develop its own assembly techniques. A major challenge was the assembly of the X5 line. At this time, American staff members were beginning to replace the German counterparts, and the ratio of American-to-German process engineers had changed to a 50:50 mix. By the time production for the latest BMW model, the X5, had begun, the ratio of American-to-German engineers had increased to 90:10. In interviews, members of the original group, who had brought the Z3 from the production line to the world's highways, were notably proud of their accomplishments. The staffers, mostly American, who run BMW's facility are not only self-sufficient, but are also developing best practices for the rest of BMW's worldwide manufacturing network.

Besides innovations in labor practices, BMW has brought notable production advantages to South Carolina manufacturing. The high-technology precision and efficiency of the assembly process is unparalleled. A short tour along the assembly line reveals these competencies. A highly integrated materials handling system has been put in place to move vehicles through the assembly process. Assembly operations begin in the body shop where an overhead conveyor carries parts to workers. Subassemblies are produced here from individually stamped metal parts and components. These subassemblies become BMW bodies when they are welded together and frames, doors, grills, fenders, and hoods are added. A conveyor system then takes the bodies from the body shop to the paint shop. Doors are removed and carried through trim operations by an electrified monorail system. When the bodies arrive at the trim line, they are placed on a conveyor again, which tilts 90 degrees to allow easy access to the underbody. Once in the final assembly area, battery-powered automatic guided vehicles deliver engines. At the same time, a hybrid automatic guided vehicle carries the body. These vehicles feature lift platforms that automatically adjust so workers can comfortably install brake lines, carpets, dashboards, seats, glass, and doors. The body is then transferred to a conveyor where the engine, rear axle, and tires are put in place. Vehicle fluids are added and

An Innovation for the Automobile Industry: BMW's Camera Stations

In 1995, when the Spartanburg plant opened, quality inspection was a painstaking and expensive process. Line workers would tear down one car a day to check assembly quality and measure installation variance. But since October 1998, BMW has installed camera stations to inspect every vehicle built. This new innovation has revolutionized the way BMW measures and inspects quality, and it has other automobile manufacturers trying to visit the Spartanburg plant.

The robot-mounted cameras inspect each vehicle on the line, and data are processed immediately by an intelligent computer system. The repeatability analysis allows management to see even the smallest trends or changes in variance. If a problem is detected, the line is stopped immediately and the problem corrected. When recurring problems are apparent, BMW can either redesign or troubleshoot its own processes or work with its module suppliers to improve their processes. The cameras have given BMW an effective tool in reducing process variation.

The technology has been a great success. BMW has improved its manufacturing processes, improved vehicle quality, and increased throughput, thereby reducing costs of manufacturing. Since BMW's introduction of camera stations, other automobile manufacturers and parts suppliers have started to follow BMW's lead.

quality tests performed before associates drive the BMW off the assembly line. After a test drive, the American-made BMWs are ready for shipment. At each step, the precision of German production technology, engineering, and quality control is manifest.

BMW's South Carolina facility is currently employing cutting-edge production techniques to assemble its Z3 and X5 lines. One of the most innovative production technologies is the V-Star measurement system. The V-Star system uses strategically placed cameras to constantly measure the production line's accuracy. The key benefit of the system is that it has allowed the facility to increase the speed of production while maintaining high quality standards. The increase in speed is gained because the V-Star system allows production engineers to feed real time set-up information into the line during production. Doing so allows engineers to make small adjustments to the line set up before quality problems appear. Not only is the V-Star production management system making a difference at the BMW facility, it is also being picked up by BMW's suppliers.

In addition to state-of-the-art manufacturing quality control systems, BMW is currently designing and virtually assembling its products using advanced 3-D modeling programs. This has allowed both engineers in Munich and production experts in Spartanburg County to identify assembly problems before they happen. To facilitate the identification of potential production issues, BMW sends several of its South Carolina employees to Munich to participate in knowledge-sharing sessions. In fact, during a non-launch year, several South Carolina production staff members may find themselves in Munich two or three times a year.

Spreading Environmental Sustainability

BMW has turned to its suppliers to ensure that the entire process of manufacturing BMW vehicles is environmentally sound. To this end, BMW has prepared voluntary supplier environmental guidelines. Although the guidelines are not a prerequisite for BMW's suppliers, they serve as a vehicle by which BMW can convey its values to its suppliers. The guidelines include items such as:

- A pledge for suppliers to reduce their environmental impact and emission of waste whenever possible.
- Recognition that periodic environmental audits are important for identifying areas of improvement.
- A pledge to submit to the principles contained in the Montreal Protocol regarding the elimination of Ozone-depleting chemicals.
- The pledge to accurately report toxic chemical emissions to the EPA.
- The pledge to eliminate all packaging waste and deliver all parts in 100 percent returnable containers.

Another area where BMW is at the forefront of competitive manufacturing in South Carolina is sustainable development and environmental practices. There is a steadfast commitment to environmental protection. For example, the South Carolina automotive plant is the first in the United States to use a water-based primer matched to base coat paints, which reduces air emissions. Moreover, the plant's wastewater is pretreated and meets the highest standards before discharge into the local treatment plant. In 1998, the plant was awarded ISO 14001 environmental certification for meeting or exceeding international environmental standards.

BMW has had a long history of outstanding environmental performance. Deeply held environmental principles are not restricted to German manufacturing facilities. Once committed to an environmental standard for one plant, BMW implements the same practice throughout its worldwide operations. In effect, this practice ensures that no single facility lags behind any other in BMW's commitment to sustainable development. Executing an environmental strategy in this manner ensures that best practices continually elevate BMW's environment standards worldwide.

At its South Carolina facility, BMW always encourages proactive environmental policies. BMW's efforts in North America have not gone unnoticed. In December 2000, the Environmental Protection Agency accepted BMW as a charter member of the Agency's National Performance Track. So far, BMW is the only automobile company to be included on the EPA's list. At the local level, BMW has been included in South Carolina's environmental excellence program, and the South Carolina Wildlife Federation has presented BMW with its air conservation award.

By adopting such a proactive environmental policy, BMW has been able to increase its flexibility in dealing with capacity issues. Thanks to its conservative approach to emissions, BMW has been able to quickly reconfigure the Spartanburg facility to meet forecasted demand with little EPA intervention. Staying ahead of the curve on environmental issues has not only contributed to the preservation of South Carolina's environment, but has also helped BMW meet its customers' demands.

In sum, a well-developed supply chain along with the proper competencies must be in place for a regional manufacturing cluster to succeed. A viable cluster depends on a strong supplier network. A full complement of local suppliers helps anchor a cluster in the local economy, allaying concerns about "footloose" investment. The region becomes more competitive as the firms in the cluster transfer knowledge and innovative practices.

BMW's Investment and Economic Development in South Carolina

In 2002, with an automotive cluster now firmly rooted in South Carolina, it is easy to forget how different the manufacturing outlook appeared a decade earlier. When BMW made its location decision in 1992, the United States, Canada, and Mexico were in final negotiations over the North American Free Trade Agreement (NAFTA). A memorable moment in the U.S. presidential election campaign that year was candidate Ross Perot's campaign against jobs migrating to Mexico from the manufacturing regions of the United States—the "giant sucking sound."

The location of BMW has enabled Upstate South Carolina to buck the threatened de-industrialization trend. Ten years later, it is now possible to view 1992 as a watershed. Even before NAFTA, South Caro-

lina faced the erosion of textile and apparel jobs. After peaking at almost 230,000 jobs in 1973, the textile and apparel employment base has shrunk every year afterwards. The sector most responsible for South Carolina's transition from an agricultural to an industrial state was no longer viable as a source of secure employment. The future of South Carolina's manufacturing sector was uncertain.

By the end of the 1990s, the fog had lifted. The Upstate's job base had expanded by over 60,000, helping the unemployment rate fall to 3.0 percent, near full employment.¹¹ Every county in the region experienced a falling jobless rate during the booming 1990s. Through the 2001 U.S. recession, a major concern in the Upstate was the tight labor market and lack of available skilled workers. At the same time, the region's population grew 15.1 percent during the 1990s (in line with the state average), underscoring the need for expanding employment. Migration accounted for about 66 percent of the growth in the Upstate (well above the state average). About 7,000 of the new residents were international migrants, accounting for 6.0 percent of the population growth. Meanwhile, in the period 1990 to 1999, the Upstate's per capita income grew 48 percent, above the state average. The Upstate remains among the richer regions in South Carolina, trailing only the Low Country (which includes Beaufort and Hilton Head Island) in per capita income.

The investment of BMW, as well as other durable goods producers, has injected new life into the state's industrial sector—proving world-class manufacturing can thrive in the Palmetto State. Consequently, South Carolina and the Upstate region have posted employment gains in durable goods industries for the last decade. Today, the Upstate still is home to about 44 percent of all manufacturing employment in the state. As this section will show, the Upstate has diversified into durables manufacturing and other non-textile-related industries. As a result, the region has managed to maintain relatively high-income growth while preserving its manufacturing heritage. This recent manufacturing revival contrasts with a nationwide decline of manufacturing jobs.

Manufacturing employment in the United States has been diminishing in both relative and absolute terms for decades. Because of rapid job growth in services and trade, manufacturing nationwide has seen its share of total employment fall sharply over the last three decades. In 1970, manufacturing accounted for 27 percent of all nonfarm jobs in the United States. By 2001, this share had fallen to just 13 percent. In terms of absolute employment levels, the U.S. manufacturing sector has been shrinking since 1980. At that time, there were a total of 20.3 million jobs in manufacturing. In 2001, this figure was down to 17.7 million.

These long-term manufacturing job losses can be traced to three primary factors. First, the manufacturing sector has enjoyed productivity gains that have allowed firms to produce more output with fewer workers. That is, the growth of labor-saving technology in U.S. industry has contributed to the manufacturing

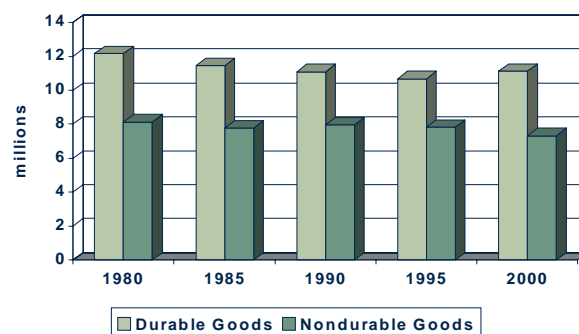
job losses. It is important to note that this piece of the puzzle implies that manufacturing *output* has not seen the same decline as has *employment*. Second, increased global mobility has played a role by allowing firms to locate outside the United States in search of lower production costs. This is especially true in the case of nondurable goods production and is a major reason for the ongoing loss of employment in the apparel industry. Finally, as U.S. household incomes have grown, there has been a relatively larger increase in the demand for services such as medical, legal, and entertainment services. The share of personal consumption allocated to services has grown tremendously relative to spending on tangible goods.

The absolute job losses seen in the U.S. manufacturing sector have come from both the durable and nondurable goods sectors. Figure 9 shows U.S. employment levels in these two industry divisions. Of note here is that for the nation, manufacturing is losing jobs in both nondurable and durable goods production.

In South Carolina and the Upstate area, many of the nationwide manufacturing patterns hold true. In both relative and absolute terms, there have been substantial manufacturing job losses. South Carolina has been among the most manufacturing-reliant states in the country. Therefore, the shift away from manufacturing in the United States certainly had the potential to devastate industry within the state. Because of South Carolina's particular reliance on textile and apparel jobs, the long-term decline in the sector has had a substantial impact on the changing face of the state's economy. In 1970, total manufacturing accounted for 40.5 percent of all nonfarm jobs in South Carolina. This share has fallen steadily since, reaching 18.1 percent in 2001. Similar to the U.S. pattern, manufacturing employment levels have fallen from 391,900 in 1980 to 332,100 in 2001.

An important difference between the United States and South Carolina's Upstate experiences, and one that BMW has played a key role in, is the strength of the durable goods sector. Between 1970 and 2000, durable goods employment in the United States was essentially flat. The number of jobs in 1970 stood at 11.2 million; during 2000, the figure was 11.1 million. However, employment in the durable goods sector in South Carolina almost doubled over the same period, from 84,400 jobs in 1970 to 160,500 in 2000. This incredible growth in durable goods employment has been vital in compensating for job losses in the state's textile and apparel industries. Despite a net loss of 69,500 nondurable goods jobs between 1970

Figure 9. U.S. Manufacturing Employment Levels (millions)

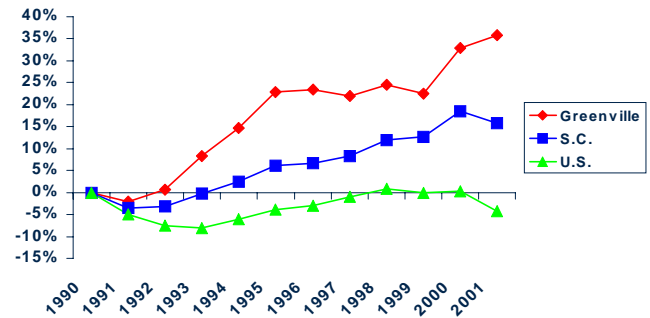


Source: U.S. Bureau of Labor Statistics.

and 2000, the state's manufacturing sector as a whole actually saw a net increase of 6,600 jobs over the same period because of the influx of durable goods producers.

While the state's durable goods sector has outperformed national trends for decades, the location of BMW in the Greenville-Spartanburg-Anderson metropolitan area in the early 1990s has helped spark impressive growth in that sector. Figure 10 shows the trend of durable goods employment between 1990 and 2001 for the United States, South Carolina, and the Greenville-Spartanburg-Anderson metro area. Durable goods employment change (percentage) for these three areas since 1990 are shown. This makes it easy to quickly gauge the relative growth rates of durable goods employment among different areas. The figure shows that durable goods employment in the United States has been virtually unchanged since 1990. Meanwhile, South Carolina, and the Greenville and Spartanburg areas in particular, have enjoyed relatively strong job growth in durable goods.

Figure 10. Durable Goods Employment Growth (Percentage Change Since 1990)



Source: Division of Research using data from the U.S. Bureau of Labor Statistics.

South Carolina and the Upstate region continue to have a larger share of total employment accounted for by manufacturing than does the nation as a whole. Further, the proportion of employment in the non-durable goods sector continues to fall. At a time when nondurable goods employment, specifically textiles and apparel employment, remains susceptible to ongoing trends toward increased efficiency and globalization, the future of manufacturing in South Carolina and the Upstate could appear threatened. However, a growing and stable base of durable goods jobs across the state and region results in an evolving and adapting manufacturing sector as opposed to a declining industrial base.

The manufacturing renaissance in Upstate South Carolina represents how regions transform through rebuilding the primary job base. Manufacturing operations bring new money flowing into the state from outside. BMW sales are overwhelmingly outside the state and indeed outside the country's borders. With markets in 120 countries. The money is not recycled from one sector of the state's economy to another—it is almost all an economic gain for the state's citizens—providing money that can be used to purchase goods and services from other regions and countries. Economic theory clearly states that regional growth and development depends on developing an export base. The diversified export base for BMW's output is

especially desirable. This point became clear during the 2001-2002 recession, when BMW exports from the Charleston port grew.

BMW has been a major catalyst in the regional industrial resurgence described in this section. Today, it would be absurd to dismiss the Upstate region as an old line, de-industrialized district where jobs migrate to Mexico and other low wage countries; instead, the automotive cluster around BMW has re-shaped Upstate South Carolina into one of North America's most competitive areas for manufacturing. Further, the success of BMW benefits the community by enticing other businesses to locate in the Upstate. As one location expert stated, "Companies don't like to be pioneers. They like seeing someone else succeed first. They like to see precedent. BMW has been successful, and the suppliers have been, too."¹²

Development Incentives

The manufacturing renaissance in the Upstate did not happen by accident. It is the result of long-standing public-private sector promotion of industry. Reindustrialization has remained part of the state's vision, from the administration of Ernest Hollings, who as governor in the 1960s developed the state's technical education system, to former governor Carroll Campbell, who ardently promoted new manufacturing investment with incentives and was instrumental in helping land BMW in 1992. South Carolina has acted aggressively to rebuild the physical capital base, focusing on a strategy to attract industry from both foreign and domestic sources. State and local development missions to foreign countries bore fruit as new plants sprouted where economic activity had been dormant.

In this section, the BMW investment is considered as a case where industrial promotion efforts and economic development incentives make sense. It can be argued that all employment and income associated with the plant, and the net fiscal effects presented earlier, would not exist without a pro-active, pro-business, pro-manufacturing effort. That is not to say that development incentives are the main reason BMW chose South Carolina, but rather that they make a difference when two sites with similar fundamental characteristics are considered.

It should be stressed that when states court companies, incentives are only part of the location decision. There are many other considerations companies have in determining where to locate. Some of the main location factors include access to market proximity, the presence of a strong manufacturing base, work force skills and union presence, land and energy costs, and infrastructure like highways, air transport, and ports.¹³

There are many reasons that BMW chose South Carolina over other possible sites. First of all, BMW was impressed with the personal attention that was extended to them by then South Carolina Governor

Campbell. Second, there are low unionization and labor costs in South Carolina relative to other possible sites. Third, South Carolina offered proximity to supplier and product markets.

In the final analysis, BMW argues that it chose South Carolina because the state has a set of fundamental assets:¹⁴

- a qualified work force with training provided through the Technical Education System;
- accessible transportation facilities, including a deep-water port at Charleston, a major airport, modern rail and road systems;
- public-private, pro-business partnerships;
- a site within an easy distribution range of a majority of BMW’s primary U.S. markets.

Although not the fundamental location determinant, incentives add to the attractiveness of a site. The large economic impact of automobile assembly plants make them a particular target for industrial recruitment. All recent automotive plant openings have been supported by state incentives. Initial incentive awards used to attract recent automotive plant investments are compared in Table 2. Indeed, BMW’s

Table 2. Recent Auto Plant Investments*

<i>Company</i>	<i>Announcement Date</i>	<i>Initial Employment Estimate</i>	<i>Announced State & Local Incentives (nominal millions)</i>	<i>Real Incentives‡ (2001 million \$)</i>	<i>Real Incentive‡ Cost per Job</i>
Hyundai (Alabama)	2002	2,000	\$118	\$118†	\$59,000†
Toyota (Alabama)	2001	350	\$29	\$29	\$82,857
Nissan (Mississippi)	2000	4,000	\$295	\$299	\$74,835
Honda (Alabama)	1999	1,500	\$158	\$165	\$110,290
GM (Michigan)	1998	700	\$107	\$114	\$162,287
Mercedes (Alabama)	1994	1,500	\$253	\$289	\$192,730
BMW (South Carolina)	1992	1,900	\$130	\$155	\$81,479
Toyota (Kentucky)	1986	3,000	\$147	\$214	\$71,404

*Inflation adjustments are made using GDP deflator series.

‡Includes only primary (real) incentive, not additional ongoing incentives.

†2002 dollars assumed equal to 2001 dollars.

Source: Division of Research; various sources.¹⁵

incentives were relatively modest, with \$130 million in incentives for 1,900 direct jobs promised at the time of the location decision. Alabama's Mercedes assembly plant promised about 1,700 direct jobs at a cost of \$250 million in incentives, almost twice BMW's incentive package for significantly less employment. It should be stressed also that BMW's employment (direct and indirect) has far exceeded the 1,900 jobs originally announced, which drastically reduces the incentive-per-job ratio. In any case, Table 2 suggests that the incentives given BMW were moderate in comparison with other automotive investments.

The \$130 million in development incentives offered to lure BMW to South Carolina included tax credits, tax abatements, job training allowances, and infrastructure improvements. Most of the incentives offered were designed to ensure labor and infrastructure quality appropriate to advanced manufacturing. Property tax breaks are designed to make South Carolina competitive with neighbors. Specifically, the state and local BMW incentives were the following:

- A property tax abatement or set "fee-in-lieu" of taxes (FILOT), valued at over \$70 million over 20 years (explained below).
- Labor training through the technical college system valued at \$5 million. This is customized job training through the special schools division of the State Board of Technical and Comprehensive Education, which provides training to South Carolinians for new employment made by corporate investment.
- A standard job creation income tax credit (\$300 to \$1,500 per new job created) valued at \$2.85 million per year for up to 15 years. The state of South Carolina has a five percent corporate profits tax. For BMW, the state established a multi-county industrial park (explained below) with a jobs tax credit for every permanent, full-time job created. In five years at \$1,500 per job, this would be worth \$15 million for 2,000 jobs. Unused credits can be carried forward for ten years.
- Industrial revenue bonds issued by the state that carry lower interest rates than those offered directly in financial markets.
- A plant site was purchased and then leased to BMW at \$1 per year. The land was purchased by the state, the Ports Authority, and Spartanburg County. The government agreed to purchase 900 acres of land near the Greenville-Spartanburg airport for an estimated cost of \$36.6 million; the state committed about \$31.6 million, and the local government about \$5 million. In addition to land, the state offered site improvements including sewers, utilities, and road improvements such as a highway overpass and commitment to widen existing roads along Interstate 85. There was also a \$55 million project at the adjacent airport for various improvements, including lengthening and strengthening a runway to accommodate a fully loaded 747 aircraft. The Federal Aviation Administration funded 90 percent of this project; the state paid for the remainder.
- \$6 million in revenue bonds issued by Spartanburg County to acquire property and improve utilities.
- \$10 million allocated for road work to improve roads around the plant site.

The largest incentive in monetary terms and least understood by the public is the property tax abatement. The push for reducing property taxes for businesses goes back to the 1970s when the state's manufacturing employment base began its dramatic decline. Property tax incentives for businesses were deemed to be crucial in luring new plants and expansions. Property tax reductions (through a variety of schemes) were believed to be among the most effective incentives because they would bring the manufacturing assessment down considerably and make South Carolina more competitive with neighboring states.

Today in South Carolina, economic development incentives change the property tax for manufacturers through the fee-in-lieu of taxes (FILOT) agreements, and special source revenue bonds in multi-county industrial parks (MCIP). Both FILOT and MCIP agreements have been used in BMW projects. The main features of these incentives are:

1. Fee-in-lieu of Taxes (FILOT)
 - Applies to manufacturing, not other classifications of property;
 - Allows County Councils to lower Assessment Ratio from 10.5% to 6% (and as low as 4% in large transactions);
 - Suspends ad valorem taxes and sets "fees";
 - Can stabilize millage rates for up to 30 years.

2. Multi-county industrial or business park (MCIP)
 - Multi-county agreement; many have one dominant and one nominal county;
 - No restriction on land area, time limit, or type of "industry or business";
 - Can have FILOT in MCIP;
 - All real and personal property is exempt from ad valorem taxes; an "amount equivalent" to property tax is owed.

3. Special Source Revenue Bonds
 - Are available in MCIPs and FILOTs;
 - Can lower tax revenues to all taxing entities through "credits."

The FILOT offered to BMW provides a substantial property tax savings, estimated at \$70 million for the initial investment. Without the incentive South Carolina officials believed that the local property tax was not competitive with other states, largely because of a high property assessment ratio placed on manufacturers. It was felt that an amendment to the state constitution, which would allow counties to negotiate a lower assessment ratio, would not stand. Thus, the "fee-in-lieu" was developed as an alternative.

There are distinct advantages to this form of property tax relief for manufacturers. The first is the ability to reduce the statutory manufacturing assessment ratio. The second is the ability to set the millage rate at

a fixed level without change over time. Finally, the tax incentive allows for a flexible payment schedule, “as long as the present value of the Company’s payments to the County equals the present value of the annual payments that would have been made pursuant to a standard calculation of regular fee-in-lieu payments.”¹⁶ The effect of the fee-in-lieu is a major reduction in property taxes for manufacturers wanting to invest in new plant and equipment.

The original intent of FILOTs and related incentives like the Multi-County Industrial Park was the reduction of the overall property tax liability of a large manufacturing investor. Since South Carolina’s taxes on manufacturing property are relatively high when compared with neighboring states, it was not attracting major industrial projects such as those that were revitalizing other southern states, including large automotive investments in Kentucky and Tennessee. Even when a company negotiates an assessment ratio of 6 percent, the firm’s property taxes will still be higher in South Carolina than in North Carolina or Georgia. A major FILOT advantage to firms, however, is not the reduction in taxes as much as the means to achieve a *predictable stream of payments* to local governments over time. Since FILOTs are set for periods as long as 20 to 30 years, long-term investors like BMW achieve stability in property tax payments.

Originally, when the law was first passed in 1987 during Governor Campbell’s administration, the incentive was only available to companies investing at least \$85 million or more. The logic was straightforward. Large-scale capital investments have huge, positive multiplier effects (as documented in this study) and put less pressure on infrastructure and other state and local expenses than numerous small projects. This incentive made the state competitive for world-class manufacturers. Theoretically, manufacturing concerns like BMW could locate in many areas, unlike commercial ventures that are tied to the local market. In fact, the FILOT did attract major international investors to South Carolina in the late 1980s and 1990s. Hence, property tax adjustments appear to be justified for large, capital-intensive plants with a national and international market base.

However, the minimum amount of investment for a company to be eligible has been lowered several times since the FILOT law was passed. The minimum investment required has been reduced from the original \$85 million, first to \$45 million in the early 1990s, and then \$5 million in 1995. These changes have led to more widespread use of the property tax incentive and have, for most practical purposes, eliminated South Carolina’s 10.5 percent assessment on new industrial property. At \$5 million, nearly any new capital investment by a manufacturer will be eligible for a FILOT. In fact, a minimum investment of only \$1 million is enough to be eligible for incentives in six extremely distressed South Carolina counties. This reduction in the minimum investment level has led to the increased use of FILOT agreements in South Carolina.

The common use of FILOTs makes the original agreement with BMW seem less like an incentive than a *de facto* tax policy for all manufacturers (recall that it accounts for over half of the original \$130 million incentive package). According to data from the South Carolina Department of Revenue, there have been over 320 FILOT agreements negotiated since the law passed in 1987. During the five-year period between 1989 and 1994 (covering the BMW award), there were about five FILOT agreements negotiated per year. The average amount of capital investment for these projects was about \$157 million, and the average fee paid by these companies in 1998 was about \$1 million (much smaller than the BMW agreement). This contrasts dramatically with the four-year period from 1995 through 1998, during which there have been an average of about 75 FILOT agreements negotiated per year. The average amount of capital investment for these 300 or so FILOTs was about \$15 million, and the average fee paid by these companies in 1998 was about \$130,000.

It should be recognized that the expansion of tax incentives is common among states, although each has its own approach to property tax adjustments. South Carolina's neighbors have a different portfolio of state and local taxes, and thus significant differences exist in the use of incentives. In North Carolina, abatements or reductions in real property taxes for development purposes do not exist, but the assessment on manufacturing is low. Other incentives can be offered. In Georgia and Tennessee, local development authorities become "owners" of the property and as such are not subject to property taxes. Reduced fees are assessed that essentially lowers the actual tax rate on the property of concern.

Today, the efficacy of incentives in promoting economic development is widely accepted in practice. Nevertheless, it makes sense to evaluate incentive awards on a case-by-case basis. While incentives are designed to make an area more competitive, they should be held to rigorous cost-benefit scrutiny. In this study, the fiscal impact analysis shows that automotive incentives yield net benefits to taxpayers. Even though BMW, like most recent investors, pays a set fee-in-lieu of property taxes, it still contributes substantially to the local government finances.

Other incentives offered to BMW besides the tax agreements already discussed should also be placed in the context of economic development. Some incentives like infrastructure improvements benefit businesses throughout the area and help develop additional industrial clusters. In particular, BMW's incentive package in South Carolina included improvements for local access roads around the site, lengthening the nearby airport's runway to accommodate fully loaded aircraft, and rail access that would facilitate transportation to the Port of Charleston. These improvements can make it more attractive to prospective businesses considering relocation.

Any evaluation of incentives should consider:

- The export-base potential of the investment;
- The overall economic impact;
- The net fiscal benefits;
- The potential for deepening supplier networks and clustering; and
- Spillover benefits for other businesses, including infrastructure improvements.

In the final analysis, economic development incentives, when properly designed, will attract new capital investment, an essential input fueling economic development and growth. Incentives can help establish regional clusters. According to an exhaustive study of backward (supplier) linkages throughout the world, there is a “role for judicious policy intervention to promote the creation and deepening of linkages.”¹⁷

BMW’s success in South Carolina shows that incentives can make a difference. The firm is a long-term investor, embedded in the local community as a corporate citizen. At the same time, long-term investors require a reliable access to quality labor and a predictable tax liability—suggesting that the labor training and FILOT agreements offered to BMW may be powerful inducements for location. It is clearly in a state’s best interest to provide an attractive and competitive economic climate for new businesses. If new businesses thrive, they will continue to grow and attract more investment to that area. This has been the distinct lesson of BMW.

Conclusion

In 1992, during the midst of an economic recession and rising concerns about the “deindustrialization of America,” BMW’s decision to invest in South Carolina demonstrated that a U.S. manufacturing presence remains essential to global businesses. Subsequently, BMW has been an engine of economic development in Upstate South Carolina. The operations bring billions of dollars to the region, which circulates through the economic multiplier effect to foment business development. Ten years after the decision, BMW’s complex of activities has created more than 16,000 jobs. A competitive automotive cluster is now ensconced in the South Carolina economy.

BMW has proven to be a long-term stakeholder in South Carolina. Beyond the economic multiplier effect that spreads direct and indirect employment and income throughout the state, BMW Manufacturing Corp. also supports a diverse group of community and educational organizations through financial donations and volunteer activity. The company forms partnerships with community groups; funds innovative education initiatives, social service programs, and cultural activities; and encourages volunteerism. Specifically, BMW Manufacturing Corp. has committed more than \$4 million to community organizations

in South Carolina. The annual BMW Charity Pro-Am, started in 2001, raises funds for dozens of charities.

Regarding education, BMW's promotional activities can be seen both as contributing to the local quality of life and at the same time helping to improve the future labor force. Educational initiatives include financial support for local libraries and employee volunteer work at local schools and colleges. BMW is also actively engaged in statewide educational programs, including the state's Governor's School for the Arts and Humanities and Governor's School for Science and Math. Technical colleges and universities also receive financial support for fellowships. BMW supports arts and cultural programs throughout South Carolina as well.

BMW avows to have a triple bottom line: economic goals, environmental goals, and social goals. This three-pronged strategy has not only made BMW Manufacturing Corp. a responsible corporate citizen, but has also allowed the company to achieve long-term competitive strength. At the South Carolina facility, BMW has devised a number of initiatives to increase work force diversity. The program has led to success in hiring and retaining women and minority candidates.

Worldwide, BMW has come to be known as a corporate leader, listed on the Dow Jones Sustainability index as well as the FTSE4 Good Europe ethics index. Yet every successful global business depends on success at the local level. In turn, local communities thrive when major corporate investors like BMW make significant long-term commitments to economic, environmental, and social goals.

Endnotes

¹ See, for example, Sally Solo, “Why Foreigners Flock to South Carolina,” *Fortune*, November 2, 1992, p. 48.

² BMW refers to employees as “associates.” This term will be used interchangeably with employment in this report. See BMW Plant Background—South Carolina Economic Impact; <http://www.bmwusfactory.com>, accessed March 2002.

³ See Division of Research, *South Carolina: An Economy in Transition*, Division of Research, The Moore School of Business, Columbia, S.C., 1987.

⁴ South Carolina Ports Fact Sheet 2001. <http://www.port-of-charleston.com/general/statistics/factsheet.asp>.

⁵ Michael Porter, *The Competitive Advantage of Nations*. New York: The Free Press, 1990. Republished with a new introduction, 1998. See also Michael Porter, “Location, Competition and Economic Development: Local Clusters in a Global Economy,” *Economic Development Quarterly* 14, no. 1, February 2000: 15-34; and Michael Porter, “Competitive Advantage, Agglomeration Economies, and Regional Policy,” *International Regional Science Review* 19, nos. 1 & 2, 1996.

⁶ See United Nations Committee on Trade and Development (UNCTAD), *Global Investment Report 2001: Promoting Linkages*, New York: UNCTAD, 2001.

⁷ The background on suppliers came from interviews conducted during March 2002. See also Christ Burritt, “Hit Hard by Textiles, S.C. Lifted by BMW Plant,” *The Atlanta Journal and Constitution*, April 8, 2001, Business, page 5E.

⁸ See Richard E. Caves, *Multinational Enterprise and Economic Analysis*. Cambridge University Press, Cambridge, U.K. (1996).

⁹ For a historical overview of the development of flexible, lean production methods in the automotive sector, see James P. Womack, Daniel T. Jones, and Daniel Roos, *The Machine that Changed the World*. New York: Harper Perennial, 1990. See also Martin Kenney and Richard Florida, *Beyond Mass Production*. New York: Oxford University Press, 1993.

¹⁰ A good review of German automotive manufacturing and flexible (agile) production can be found in L. Adam Bowman, *German Automotive Manufacturing: The United States Laboratory*, South Carolina Honors College thesis, University of South Carolina, Columbia, S.C., April 1998.

¹¹ The Upstate Region consists of eleven counties: Cherokee, Union, Laurens, Greenwood, McCormick, Spartanburg, Greenville, Anderson, Abbeville, Pickens, and Oconee.

¹² Chris Winston, “Corporate Site Selection Expert Praises Greenville-Spartanburg, S.C., Area,” *Spartanburg Herald-Journal*, January 11, 2001.

¹³ Reviews of incentives can be found in K.S. Chi and D. Leathery, *State Business Incentives: Trends and Options for the Future*, pp. 2-4, The Council of State Governments, Lexington, Kentucky, 1997; and P.S. Fisher and A.H. Peters, *Industrial Incentives: Competition Among American States and Cities*. W.E. Upjohn Institute for Employment Research, Kalamazoo, Michigan, 1998.

¹⁴ BMW Plant Background—South Carolina Economic Impact; <http://www.bmwusfactory.com>, accessed March 2002.

¹⁵ Charles F. Haywood, “A report on the significance of Toyota Motor Manufacturing Kentucky, Inc. to the Kentucky Economy,” Gatton College of Business and Economics, University of Kentucky, Unpublished paper, 1998; “Southern hospitality shown to Mercedes in Alabama,” *The Journal of Commerce*, March 30, 1994; Lindsay

Chappell, "Alabama's shocking bet was a winner," *The Journal of Commerce*, July 1, 2000; Rick Brooks, "Buying jobs: How big incentives won Alabama a piece of the auto industry," *The Wall Street Journal*, April 3, 2002; Jay Reeves, "Hyundai is latest to choose Alabama," Associated Press, April 3, 2002, republished at <http://www.auto.com>; "Hyundai to build Alabama plant," *The New York Times*, from the Associated Press, April 2, 2002; Ted Evanoff, "General Motors' Flint, Mich., plant to get \$107 million in public money," *The Detroit Free Press*, April 16, 1998; "Toyota picks Alabama site for engine plant; 350 jobs," Associated Press, February 7, 2001, accessed at <http://www.auto.com>; "Siegelman announces Toyota to locate in Alabama: \$220 million plant will employ 350 workers," Office of the Governor of the State of Alabama, February 6, 2001, Press Release, accessed at <http://www.governorpress.state.al.us>; "Siegelman announces economic impact of Mercedes expansion amounts to 5,900 jobs and at least \$275 million in earnings," Office of the Governor of the State of Alabama, August 30, 2000, Press Release, accessed at <http://www.governorpress.state.al.us>; "Siegelman and DaimlerChrysler officials announce Mercedes expansion in Alabama," Office of the Governor of the State of Alabama, August 28, 2000, Press Release, accessed at <http://www.governorpress.state.al.us>; Keith Bradsher, "Honda plans to build plant in Alabama for larger vehicles," *The New York Times*, May 7, 1999; Gina Holland, "Nissan formalizes Mississippi plant deal," Associated Press State and Local Wire, November 9, 2000; Personal communication with BMW Manufacturing Corp.

¹⁶ The State of South Carolina, Office of the Secretary of State, *Economic Development Incentives in South Carolina Handbook*. Columbia, S.C.: Office of the Secretary of State, 1993.

¹⁷ United Nations Committee on Trade and Development (UNCTAD), *Global Investment Report 2001: Promoting Linkages*, New York: UNCTAD, 2001, p. 209.

Appendix A
Economic Impact Methodology

Appendix A

Economic Impact Methodology

Input-output (I-O) analysis is the basis for economic impact models. Input-output country tables are found throughout the world.¹ Variants of the U.S. input-output table are available for all counties in the United States. They are constructed with data on detailed inter-industry flows throughout the local economy, and information on demand and total output. One of the major virtues of I-O is that industry, or sectoral impacts can be calculated (see Appendix B, Employment Impacts by Sector).

The employment and income multipliers that derive from input-output analysis are the basis for most economic impact analysis. But multiplier analysis is often misused or misunderstood. This appendix summarizes the methodology and explains how it is used in impact analysis.

The basis for multiplier analysis is the input-output table. An I-O table is an accounting relationship, with each industry represented as both a column and a row in a matrix. In simple terms, it is a set of recipes for production in a given economy. The table provides data on industry demands from all other industries (the backward linkages are depicted in the columns of the table for each industry) and suppliers to all other industries (depicted across the rows of the table for each industry). The table also includes final demands and total output for the economy.

To measure the total impact of a new project in an economy, changes in all demands from other industries (the upstream linkages) must be determined. For example, the construction of a \$10 million BMW expansion provides an initial impact of \$10 million on the local economy. This is an example of a direct impact. Clearly, the construction of the project will require concrete, steel, construction workers, and so forth. The money spent on these materials and services comprises the indirect expenditures, or the indirect impacts. The mechanism used to measure total indirect expenditures is the I-O table. Table A.1 gives a simplified, two-vector version of an input-output table.

Table A.1
Hypothetical Input - Output Table

	Construc- tion	Manu- facturing	Final Demand	Total Output	Construc- tion	Manu- facturing	Final Demand	Total Output
Construction	200	100	700	1000	Z_{11}	Z_{12}	F_1	X_1
Manufacturing	400	500	1100	2000	Z_{21}	Z_{22}	F_2	X_2

where Z_{ij} = interindustry flow from sector i to sector j
 F_i = final demand of industry i
 X_i = total output of industry i

Most input-output tables would have dozens, if not hundreds, of sectors, but in this simplified economy, only construction and manufacturing, using hypothetical data. In this example, the manufacturing sector delivers to final demand \$1,100 worth of goods. Final demand is the finished product that is used by a consumer. The interindustry flows are interpreted in the following manner: Manufacturing provides \$400 worth of goods to the construction sector and \$500 to itself. From the column of manufacturing data, we can see that to produce the \$1,100 of final goods, the manufacturing sector used \$500 worth of its own output and \$100 of output from the construction sector. These demands are termed intermediate demands, goods to be used in the production of other goods delivered to final demand. The total output of manufacturing is the row total, or \$2,000. The row entries are the inputs to the column sector.

Dividing the interindustry flows by the total output (from Table A.1) produces the technical coefficients matrix (Table A.2). This is the set of “recipes” for production. An illustrative interpretation of these technical coefficients shows that it takes \$.20 worth of construction output and \$.40 worth of manufacturing output to produce \$1.00 worth of construction output.

Table A.2
Direct Coefficients Table

	<i>Construction</i>	<i>Manufacturing</i>		<i>Construction</i>	<i>Manufacturing</i>		
	<u>200</u>	<u>100</u>					
<i>Construction</i>	1000	2000	=	.2	.05	=	a ₁₁ a ₁₂
	<u>400</u>	<u>500</u>					
<i>Manufacturing</i>	1000	2000		.4	.25		a ₂₁ a ₂₂

The process follows a general matrix algebra notation often used in multiplier analysis. The total output (**X**) from each sector is the sum of the intermediate demands and the final demands. For two sectors, like the example in Table A.2, we have:

$$\mathbf{X}_1 = \mathbf{Z}_{11} + \mathbf{Z}_{12} + \mathbf{F}_1$$

$$\mathbf{X}_2 = \mathbf{Z}_{21} + \mathbf{Z}_{22} + \mathbf{F}_2,$$

which can be put into a matrix form as $\mathbf{X} = \mathbf{Z} + \mathbf{F}$.

The direct coefficients table is used to calculate the multipliers for each industry. The multipliers are derived from the (Leontief) inverse of the direct coefficients in Table A.3. Table A.3 displays the inverse, or multipliers, given the data in Table A.2.

Table A.3
Leontief Inverse

$$[\mathbf{I}-\mathbf{A}]^{-1} = \begin{bmatrix} 1.2931 & 0.0862 \\ 0.6897 & 1.3793 \end{bmatrix}$$

This inverse matrix contains industry multipliers. The logic follows from the equations above. Since total output (\mathbf{X}) equals the sum of the inter-industry flows (\mathbf{Z}) and the final demand (\mathbf{F}), one can derive the following equation:

$$\mathbf{X} = \mathbf{Z} + \mathbf{F}, \text{ where } \mathbf{Z} = \mathbf{A}\mathbf{X}.$$

This may be solved as $\mathbf{X} = [\mathbf{I} - \mathbf{A}]^{-1} \mathbf{F}$.

The right side of the equation above is given in Table A.3. The term $[\mathbf{I} - \mathbf{A}]^{-1}$, called the Leontief inverse, provides a powerful tool in quantifying economic effects. The numerical result of $[\mathbf{I} - \mathbf{A}]^{-1}$ in our example is found in Table A.3.

To understand these numbers, consider what will happen to this economy should the demand for construction increase by \$100. Obviously, to meet this demand, the construction sector will have to produce an extra \$100 of output. Additionally, from the I-O table one can see that construction uses construction services in its own production process. From the \mathbf{A} matrix, we see that to produce \$1 worth of output, it takes \$.20 worth of construction production as an input. Thus, \$20 worth of construction will be needed as an input to increase output by \$100 and, to produce that \$20 worth, an additional amount given by $(.2 \times \$20)$ will be used as an input. Further, construction will demand $(0.4 \times \$100)$ from the manufacturing sector. The Leontief inverse is an effective tool for calculating the result of this round-by-round process. From the example in Figure 3.3, we see that a \$100 increase in the demand for construction output requires a total increase of about \$129 in construction output and an increase of \$69 in manufacturing output. Thus the $[\mathbf{I} - \mathbf{A}]^{-1}$ matrix contains all of the direct and indirect effects of a change in final demand. The total economic impact is given by the column sums of the Leontief inverse. In our example, we find that the total economic impact of a \$1 change in construction demand is \$1.98; that is, the \$1 gets multiplied by \$1.98.

The multiplier derived from this example of the I-O model incorporates both the direct and indirect impacts. By adding to this simple model a row for payments to labor by the firm (wages) and a column of expenditure patterns (the marginal propensity to consume each type of product), the multipliers derived from the Leontief inverse will incorporate the direct, indirect, and induced impacts. The induced impacts are additional expenditures resulting from increased earnings by local residents as a result of the increase in final demand.

By slight modifications of the above simple model, multipliers may be determined to analyze the total output impact, earnings impact, and jobs impact. Typically in impact analysis the analyst needs an I-O table generated by the governmental statistical office to determine the impact of changes in final demand.

The data from an I-O table also provide quantitative measures of upstream and downstream linkages. The terms upstream and downstream become intuitive when one looks at the I-O table. A change in output by the construction sector requires increased production by all of its suppliers. This is upstream linkage. On the other hand, increased output in the construction sector also means additional amounts of this product that are available to be used as inputs in other sectors. This is the downstream linkage. The upstream linkage measures the strength of the supplier relationship while the downstream linkage measures the strength of the market for selling the product as an input. Often the downstream linkage also includes the concept of marketing directly to the consumer in addition to sales to other firms as an input.

How can these economic impact analysis tools be used to understand a particular industry?

In the United States, as many countries, the federal government produces a detailed I-O table. Multipliers, as described above, are calculated from this table by IMPLAN so that it is fairly straightforward to estimate the impact of any change in final demand in the United States.

IMPLAN modeling software contains all the necessary information on sectoral linkages to estimate the total economic impact of a specified change in the final demand for the output of any given industry. This detailed information on the linkages between sectors is available at the national, state, and county levels. Overall, these data fully describe the relationships between 528 disaggregated sectors, covering manufacturing, services, retail trade, and so on.

Therefore, IMPLAN provides models that are well-suited to estimating the economic impacts of BMW's operations, given detailed information on BMW's level of employment, annual payroll, and pattern of in-state input purchases. This primary information is used in conjunction with the South Carolina-specific economic model provided by IMPLAN to estimate the ongoing employment, income, and output impacts of BMW's operations.

Fiscal Impacts

While IMPLAN provides the framework necessary to estimate the *economic* impacts (employment and income) of BMW's operations, it is not designed to reliably estimate the associated *fiscal* impacts. The Division of Research has developed a model tailored to South Carolina and the counties in the Upstate to estimate government benefits and costs. Overall, the fiscal impacts considered here include increased tax revenues accruing to the state in the form of sales and individual income tax revenues, tax revenues to counties and school district's via property taxes, state government education and development incentives costs costs, and local government costs in the form of county service provision costs and school district education costs.

At the state level, fiscal benefits will be realized through higher sales and individual income tax revenues. Specifically, these benefits will result from the personal income that is supported by BMW's operations via the direct, indirect, and induced income impacts. This income will be taxable directly via the income tax, the amount of which is estimated using state-specific tax information. The after-tax income will be used, in part, for spending on sales-taxable goods within the state. Using appropriate data on household consumption patterns, and sales tax information for South Carolina, the impact on sales tax revenue can be calculated. Meanwhile, the Division of Research's fiscal impact model estimates the increased education costs to state government, and the costs of the state's Enterprise Program Job Development Credits.

At the local level, it is important to consider not just the fiscal benefits but also the fiscal costs. In particular, the local costs examined in this study are driven entirely by the population associated with BMW's direct employment base. Given county-level demographic statistics on, for example, average household size and average number of school-age children per household, the total population impact of BMW's direct employment is estimated.

This population will place additional burdens on the local infrastructure. At the county-level, this population will need to be provided will a variety of services, including police, fire and emergency medical services. The school-age children of BMW's employees will place additional costs on the local school

systems. To estimate these various impacts, the Division of Research's fiscal impact model incorporates county and school district information on the costs of providing these services.

The county and school district benefits estimated in this study are the property tax revenues attributable to BMW's employees and BMW itself. That is, BMW's employees will own homes and cars on which they pay residential and personal property taxes, and BMW itself will pay the fee-in-lieu of property taxes discussed in the text. The fiscal impact model utilizes information on the local tax structure, as well as data on median home and automobile values to arrive at an estimate of the property tax revenues paid directly by BMW's employees. Meanwhile, actual nonresidential property tax payments from BMW are added to this to arrive at the total property tax revenues attributable to BMW and its workers.

Endnotes

¹ The approach used in I-O models may be traced to the French scholar Quesnay's *Tableau Economique* in 1758. In the 20th century, Wassily Leontief, the first to win a Nobel prize for an applied general equilibrium model, is credited with developing the analytical framework for I-O analysis, which is also termed interindustry analysis. I-O models have been used extensively in the analysis of both national and regional economies.

² For a detailed explanation of the mathematics involved in calculating these linkage measures, see R.E. Miller and P. D. Blair, *Input-Output Analysis: Foundations and Extensions*, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1985.

Appendix B
Employment Impacts by Sector

Appendix B Employment Impacts by Sector

The economic impacts of BMW's operations will reach far beyond just the manufacturing sector. For example, various service industries will supply directly to BMW and its suppliers. The economic activity generated via the induced impact (household expenditures) will have the largest impact on sectors in which firms sell directly to consumers. In fact, virtually all sectors of the South Carolina economy will see some additional activity due to the presence of BMW.

The following table provides a sectoral breakdown of the indirect and induced employment impacts.* From the table, it is apparent that the majority of indirect jobs are in manufacturing. This is reasonable as these jobs represent employment at firms that are supplying inputs to BMW. However, a large share of the indirect jobs is in fact located in the services sector. Looking at the induced employment impacts in the table, these jobs are primarily in the retail and wholesale trade and service sectors.

BMW has clearly played a key role in the revitalization of manufacturing in South Carolina and especially in the Upstate. However, this sectoral analysis of the employment impacts demonstrates that BMW is an important engine of job growth in the state's non-manufacturing sectors as well.

Employment Impacts by Sector

	<i>Indirect Impacts</i>	<i>Induced Impacts</i>
Agriculture	13	63
Mining	1	0
Construction	101	116
Manufacturing	3,217	198
TCPU	245	181
Trade	610	2,369
FIRE	141	448
Services	2,345	2,026
Government	40	75
Other	0	176
<i>Total</i>	<i>6,712</i>	<i>5,652</i>

* The direct employment impact, 4,327 jobs, lie fully within the manufacturing sector because these represent jobs directly at BMW.