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Micro-Dynamics of Business Location and Growth and its Effects on the Transportation Network and Congestion in Georgia and the Southeast Region

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MICRO-DYNAMICS OF BUSINESS LOCATION AND GROWTH AND
ITS EFFECTS ON THE TRANSPORTATION NETWORK AND CONGESTION IN GEORGIA AND THE SOUTHEAST REGION

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16. Abstract:
The project explored the linkages between industry dynamics and economic activity, and the macro-congestion aspects of freight transport. The Kia Motors manufacturing plant near West Point, Georgia was selected for case study. The principal study effort went into collecting data elements in sufficient detail to allow for in-depth empirical analysis. This included collecting economic activity and supply chain data associated with the growth in activities both within the plant and among the many parts suppliers that have moved into the area to serve it. Impact variables examined include those related to employment in a wide range of occupations, schooling, educational attainment, and population and migration patterns. A series of economic multipliers are reported, showing some significant differences between counties with component supplier activity and other counties in the region. The project also developed a detailed spatial mapping and explored the derivation of supply chain cost estimates associated with both domestic and international movements of auto industry inputs and outputs, involving individual and multimodal highway, rail, and waterway shipments.

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List of Abbreviations Used in This Report

3PL	Third Party Logistics operator/agency
ACS	American Community Survey
ATRI	American Transportation Research Institute
BNSF	Burlington Northern Santa Fe Railroad
CSCMP	Council of Supply Chain Management Professionals
CSX, CSXT	CSXT Railroad
FAF3	Freight Analysis Framework, Version 3
FHWA	Federal Highway Administration
GC	Georgia Central Railroad
GDOT	Georgia Department of Transportation
GDP	Gross Domestic Product
HOG	Heart of Georgia Railroad
JIT	Just-In-Time (delivery service)
KMMG	Kia Motors Manufacturing
MSA	Metropolitan Statistical Area
NODUS, SMILE, STAN	Freight network models
NS	Norfolk Southern
OEM	Original Equipment Manufacturer
OOIDA	Owner-Operator Independent Drivers Association
ORNL	Oak Ridge National Laboratory
STB	Surface Transportation Board
TEU	Twenty-foot equivalent unit (shipping container)
URCS	Uniform Rail Costing System
US DOT	United States Department of Transportation
VHSS	The Hamburg Shipbrokers' Association

Executive Summary

The research documented in this report set out to explore the little understood linkages between the micro-foundations of industry dynamics and economic activity, and the macro-congestion aspects of freight transportation. A major barrier to such understanding has been the difficulty of obtaining the necessary data for analysis purposes. Recognizing this, the principal study effort went into collecting and merging the necessary data elements, in sufficient detail to allow for in-depth empirical analysis.

For our case study, we used the location and rapid expansion of the Kia Motors Manufacturing (KMMG) plant in West Point, Georgia, as a natural experiment, to study the resulting economic and transportation effects of placing a large industrial plant in a little developed, semi-rural location. The KMMG plant started operations in 2008, with an initial production capacity of 250,000 vehicles per year. After subsequent expansions, the current production capacity of the plant stands at some 360,000 vehicles per year. Large automobile assembly plants like KMMG are known to generate significant economic multiplier effects on neighboring areas. The plant has also had significant effects on transportation flows, which arise from both the inward movement of automobile components, and the outward movement of finished automobiles.

First, to get a clear understanding of the industrial processes involved, we developed a taxonomy of the automobile supply chain, identifying its major component categories (Section 2). We identified the locations of the many component suppliers that have located in Georgia and in neighboring Alabama Counties, following the decision of Kia Motors to locate in West Point. For these component suppliers, we obtained information on the types of components they manufacture and supply to KMMG, as well as data on their employment and investment levels.

The location of these numerous component suppliers in areas close to the KMMG plant is found to provide a substantial boost to the overall economic activity in the region. Using the American Community Survey (ACS) database, we studied the economic impacts on counties surrounding the plant, by dividing them into core and non-core counties (Section 3). Core counties are defined as those where a meaningful number of component suppliers are located, whereas a non-core designation refers to neighboring counties with a lack of meaningful component suppliers. We examined a comprehensive set of variables, including those related to employment in a wide range of occupations, schooling, educational attainment, and population

and migration patterns. In our examination of these data and computation of multipliers, we found that in some categories of economic and business development the core counties show substantial differences compared to non-core counties, while in other areas differences are less clear. (The report includes numerous tables containing these multiplier effects, in Section 3 and in two Appendices).

To understand the inflow of components to the KMMG plant, and the outflow of finished automobiles, we identified the types of, and origination points for, those components obtained from suppliers outside the southeast, including outside the United States. We obtained detailed data on many of the individual shipments associated with the automobile manufacturing supply chain, and on its uses of local, regional, and national highway, rail and waterway (including seaport) networks and cargo transfer facilities (Section 4). This includes data on the freight flows associated with international, multimodal land-sea shipments, originating in both Asia and Europe. Data sources and software tools for costing the transport of both components and finished vehicles were then identified, and are described. In particular, we explored the nature of just-in-time transport costs and the value of on-time reliability, and assessed the availability of existing data sources for doing so. An interview and tour of the Kia facility indicated the considerable importance of reliable, on-time components delivery to its production process.

To allow the routing and mapping of product shipments, and to better model the door-to-door costs involved in individual freight movements, we enhanced an existing global truck-rail-trans-oceanic freight network database. A description of this model-supporting database is followed with a brief discussion of the potential for significant freight movement bottlenecks within the southeast region, based on an interpretation of recent highway and rail traffic forecasts for the next three decades. Brief reference is also made to the potential impacts of a capacity-expanded Panama Canal on the competitive advantage of different intercontinental land-sea routes, and the markets currently serving the KMMG plant and region. This is seen as a topic worth further exploration, using the sort of multimodal network-based analysis tool and data described in this report.

While more detailed analytical and econometric modeling is needed to better understand the exact magnitudes of the effects of the KMMG plant's decision to locate in central Georgia, the database constructed during the project represents an excellent starting point for such an effort. The project also demonstrates the level of effort needed to construct similar datasets for other manufacturing plant-based studies.

1. Introduction

The State of Georgia offered approximately $500 million in incentives to attract Kia Motors to locate its manufacturing assembly plant in Georgia. In March 2006, Kia President E.S. Chung and Georgia Governor Sonny Perdue signed the contracts for Kia to build its first North American automobile manufacturing facility on over 2,200 acres in West Point, Georgia. In November 2007, Kia Motors Manufacturing of Georgia (KMMG) announced that its first production vehicle would be the next generation Kia Sorento, and in February 2008, KMMG's first employment application process closed with an automotive industry benchmark-setting 43,013 applications received. By September 2010, KMMG had produced over 100,000 vehicles and in January 2012, they completed an expansion by increasing the plant's full production capacity to 360,000 vehicles annually. In July 2013, KMMG reached a landmark of 1,000,000th vehicle produced.[1] The scale of operations at KMMG is expansive, with significant growth from its inception to the current stage.

The objective of our study is to examine the impact of the KMMG plant's location on the region's economic and business development, and the resulting transportation flows and logistics. In sections 2 and 3, we lay out the framework for our study, describe the data we compiled, and present a broad overview of the economic and business development effects that can be attributed to the KMMG plant. In section 4, we examine the effects and implications for a broad range of transportation issues. These include demand for transportation, logistics, and traffic congestion effects on business performance, among others.

2. Framework for Analysis and Data

The town of West Point is located in Troup County, Georgia. In the 2000 Census, West Point had a population of about 3,400. There was no major industry located in West Point before Kia Motors started operations. Troup County as a whole had a population of about 58,800 in the 2000 Census. Troup County has no recent history of major manufacturing. In much earlier periods in the early-to-mid 1900s, Troup County had some presence in the textile industry along with agriculture. But these industries faded as the US lost much of its competitive advantage in textiles. Based on our examination of Troup County's history and the 2000 US Census and

[1] KMMG history and operations information are available at: http://www.kmmgusa.com/about-kmmg/our-history/

American Community Survey data before Kia located, Troup County is best described as semi-rural.

In an important respect, this allows for a relatively clean experiment for us to study. The KMMG advanced manufacturing plant is located in an area with no significant manufacturing, or other industry, present. This potentially allows us to cleanly track the economic and business development in Troup County and related areas in Georgia and Alabama before and after KMMG. To compile data to examine these effects, we considered several sources.

For the economic and business development effects, we first considered the US Census. Given that the KMMG plant investment and activities by component makers started in 2008, the relevant Censuses we could use would be 2000 and 2010. This choice posed several problems. The main one being that the year 2000 was considerably before 2008 and one could argue that much could have changed in the intervening 7-8 years before the KMMG plant startup. Given this, we explored using the American Community Survey (ACS) data, which provides County-level data at a higher frequency for many Counties. Our examination of the ACS data showed that we could use the 2005-2007 ACS for the pre-KMMG data, and the 2009-2011 for the post-KMMG data.

Being able to use the 2005-2007 and 2009-2011 ACS data solved a very important empirical identification problem as there was no overlapping period. The pre-KMMG and post-KMMG data were cleanly separated, allowing us to examine the effects of the KMMG location on a range of economic and business variables.

Overall, the combination of factors related to the location of the KMMG plant in Troup County and having access to economic data that can be separated as pre-and-post, allows us to study a clean natural experiment. Below, we describe these and other data in detail.

2.1. Component Suppliers Data

The ACS data are at the County level. After the KMMG plant location decision, many automotive component suppliers decided to locate in Troup County and other nearby areas. We compiled the list of component suppliers who located pursuant to the KMMG location decision.

Since Kia doesn't disclose their supplier list and no existing studies have provided a comprehensive list of Kia suppliers, we collected the component suppliers' information ourselves. We focused on collecting information of Kia's suppliers in Georgia and Alabama as the intention of the research is to study the local economic impact of Kia Motors Manufacturing Georgia (KMMG) assembly plant in West Point, GA, which is more related to the state of Georgia and Alabama. For the Alabama part, the Alabama Department of Commerce published a list of Kia's Suppliers in Alabama in 2013. Based on the company names on the list, we turned to the Alabama New & Expanding Industry Report composed and published by Alabama Development Office for detailed information about year, jobs, investment, and industry code. Then, we went to the companies' websites for their nationality and address information. For the companies that didn't give factory addresses on their websites, we obtained information on them by searching Google Maps and www.manta.com.

Regarding Georgia, because no State government departments appear to publish a specific list of Kia's suppliers in Georgia, we collected suppliers' names using different methods. First, in the report "2011 Automotive Manufacturing in Georgia" by Georgia Power Co., information on some of Kia's component suppliers in Georgia was listed. Then, we used key words searching (like "Kia supplier") to find news, reports and articles that mentioned Kia's suppliers on the Atlanta Journal-Constitution and Georgia Chamber of Commerce. Next, similar to the approach we took with Alabama, the companies' websites, Google Maps and www.manta.com were used to obtain the companies' nationality and address information. However, different from the Alabama list, which only includes existing suppliers, news articles that reported incoming future suppliers were also scanned and the information checked to verify that it was still up to date. As an example, an earlier article reported that DangNam Tech, a supplier of Kia, was about to come to Columbus, GA, investing $29 million and creating 350 jobs. However, later articles said that as the financial situation changed in 2009, the company would no longer come to Georgia.

Table A.1 in Appendix A provides a list of 117 component suppliers of KMMG West Point assembly plant (25 in Georgia, 92 in Alabama) with company names, supplying components and location information. As noted above, only information of suppliers in Georgia and Alabama was collected.

Next, in Tables A.2 and A.3, we provide information on employment and investments by the component suppliers located in Georgia and Alabama, respectively.

The Georgia data are from the news and articles on the Atlanta Journal Constitution and Georgia Chamber of Commerce website, and the 2011 and the 2013 Troup County Directory of Manufacturers. Address information, if not provided by the previous sources, are from company websites, Google Maps, or www.manta.com. For Georgia, with the exception of Yasufuku USA Inc., all the suppliers are newly established companies in Georgia. These companies came directly to supply the KMMG plant. Our meeting with the Kia management in late July of 2013 confirmed that the vast majority of the Kia suppliers are dedicated to the KMMG plant production. From 2011 to 2013, we can see most of the Kia suppliers have expanded, which is in accord with the expansion of KMMG production. The KMMG impact is still growing as we see many suppliers have exceeded the announced future employment, and there were still new suppliers coming in 2012.

The Alabama supplier names and components are from the 2013 Kia supplier list composed and provided by Alabama Department of Commerce and based on the Alabama Industrial Database. Address information, if not provided by the previous list, is again from company websites, Google Maps, or www.manta.com. As we observe from the data, most of the Alabama investments and employments are from expansion of current facilities, which is not the case of Georgia. This is because before KMMG came to Georgia, Hyundai (which took a controlling interest in Kia in 1998) had already built their assembly plant in Montgomery, AL, which has brought a number of suppliers to the state. Then, since Kia and Hyundai share many components, many Hyundai suppliers naturally also become suppliers of Kia, and have expanded because of the newly generated demand from the KMMG plant. So, the KMMG plant has also benefited these companies in Alabama.

2.2. Core versus Non-Core County Classification

The objective of the project is to be able to examine the changes in economic and business development across Counties that are the central beneficiaries of the KMMG plant's location, versus those that are not. We use the location of component suppliers to designate Counties as Core versus Non-Core. We assume that the Core counties are those with three or more component suppliers of KMMG. These counties are the ones that are assumed to have received the most economic impact from the KMMG plant. **Table 1.1** provides information on these Counties and the number of components suppliers who locate in each.

In our study, we compare the changes in the Core Counties with those in the Non-Core, as well as two broader averages related to State-wide and major metropolitan area. For example, we compare changes in the Core Troup County with Non-Core, as well as the Georgia average and Atlanta Metropolitan Statistical Area (MSA) average changes. These comparisons provide a clear picture of the effects in the Core Counties.

Table 1.1 Local Components (Auto Parts) Suppliers by County

State	County	Number of Kia Suppliers	Core
AL	Autauga	0	N
AL	Bullock	0	N
AL	Butler	4	Y
AL	Chambers	7	Y
AL	Crenshaw	2	N
AL	Elmore	3	Y
AL	Lee	14	Y
AL	Lowndes	2	N
AL	Macon	1	N
AL	Montgomery	11	Y
AL	Pike	1	N
AL	Randolph	2	N
AL	Russell	0	N
AL	Tallapoosa	3	Y
GA	Harris	2	N
GA	Heard	0	N
GA	Meriwether	2	N
GA	Talbot	0	N
GA	Troup	20	Y
GA	Upson	0	N
AL	AL Total	50	
GA	GA Total	24	
AL & GA	Total	74	

Notes: (1) Based on the component supplier information of Table A.1, numbers of Kia suppliers in each of the 20 counties of interest are counted. Among the total 115 identified component suppliers, 74 of them locate in the 20 counties surrounding the Hyundai Alabama and Kia Georgia assembly plants.(2) Core counties are the counties with three or more component suppliers of KMMG. These counties are the ones that are assumed to have received the most impact from the KMMG plant. See Figure 4.7 below for a mapping of these suppliers.

2.3. Economic and Business Development Data

Next, we used the Core v. Non-Core classification to examine various economic and business development indicators. Our objective here is to examine economic and business development in an encompassing manner.

To measure the local business and economic impact of the KMMG plant, we use the American Community Survey (**ACS**) data. The ACS is an ongoing survey that provides data every year – giving communities the current information they need to plan investments and services. The data are estimates based on the collected survey answers. For example, the ACS 3-year data, for 2005-2007, are based on the answers from the 2005, 2006 and 2007 surveys. In our study, we use the ACS 2005-2007 data to represent the economic situation before Kia started operating in 2008. Similarly, the ACS 2009-2011 data were used to represent the economic situation after Kia started operations.

The ACS provides more than 100 variables. In our study, we use specific variables that fit into broad categories such as: employment by occupations; schooling; educational attainment; population migration; and household income. For each variable, we examine the change going from ACS 2005-2007 which is centered in 2006, to ACS 2009-2011 which is centered in 2010. The actual data for our broad set of variables are presented in the tables in Appendix B. In the main body of the report, we discuss the percent changes in the variables, as well as a rough measure of the multipliers, which we discuss later.

We collected ACS state-level data for Georgia and Alabama and county-level data for 20 counties surrounding the Kia Georgia and Hyundai Alabama plant. The ACS 3-year data from five counties (Bullock, Crenshaw, Lowndes, Heard, Talbot) are not available because their populations are too small; the ACS 3-year data only report counties of populations larger than 20,000. A few variables for Meriwether and Butler Counties were also not available.

To compare the changes in the affected Counties with the Atlanta MSA, we collected the data for all counties located within the Atlanta MSA and aggregated the data to report the ACS variables for the entire MSA. Here we use a somewhat narrower definition of the Atlanta MSA, which is different from the official definition of Atlanta MSA consisting of 25 counties. For our study, the 25-county area is far too expansive and extends right to the border of the area neighboring the Kia plant. Instead of this overly expansive 25-county definition, we picked a slightly narrower 15-county the Atlanta MSA definition. In our view, these are the counties that very likely constitute the core of the Atlanta MSA and serve as the relevant benchmark to compare changes in the Kia activity related counties. The 15 counties we use as the Atlanta MSA definition are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale. This definition of Atlanta MSA is consistently used in our study and reported in the tables.

Overall, using the ACS data, we examine a wide range of indicators which fall under broadly defined categories such as employment by major occupational category, migration, education, schooling and household income. As noted earlier, we use the ACS 2005-2007 as the pre-KMMG data, and 2009-2011 as the post-KMMG data.

3. Examining the Economic and Business Development Effects

The underlying raw data on the changes in the various ACS variables are presented in Appendix B. In this section, we present the data and discuss changes in two forms. First, in Tables 2.1 to 2.5, we examine the percentage changes in the ACS variables going from pre-KMMG to post-KMMG. Second, in Tables 3.1 to 3.5, we provide a perspective on some basic multiplier effects. Our attempts to conduct more sophisticated multiplier calculations are constrained by the lack of availability of time-series data both pre-and-post KMMG location.

3.1. Changes in Key Economic Variables

Table 2.1 displays the data (as percentage changes) for employment in various major occupational categories made available by the ACS. Some of the key observations are as follows. First, in Georgia, the Core Troup County outperformed all the three counterparts (Georgia average, Atlanta MSA, and non-core counties) in retail trade, transportation and warehousing, and finance and insurance; it also outperformed the Georgia average, Atlanta MSA, but not the non-core counties in sales and office and wholesale trade; and it outperformed non-core counties in manufacturing. However, Troup County didn't show faster increases in the management, service, construction, and education and health care sectors. This shows that although the direct job creation effect of the KMMG plant is in the manufacturing sector, the increase of manufacturing jobs in this region is still weaker compared to other parts of Georgia. However, the induced job creation effect greatly benefited Troup County, mainly in sectors like retail trade, transportation and warehousing, and finance and insurance, which support the manufacturing factories and their workers. It is worth noticing that Harris County experienced significant growths in employment in management, wholesale trade, and education and health care. But these effects, from what we can infer, are due to other changes such as those in military establishments and are not related to KMMG. Second, the Alabama core counties had better

Table 2.1 Percentage Change in Employment by Industry

State	County	Core	Management	Service	Sales and office	Construction	Manufacturing	Whole sale trade	Retail trade	Transportation and warehousing	Finance and insurance	Education and health care
			06-10	06-10	06-10	06-10	06-10	06-10	06-10	06-10	06-10	06-10
AL	AL		5.18	10.32	-1.58	-13.86	-11.68	-22.22	-2.16	-3.12	-5.15	8.49
AL	Core Avg.		14.59	10.36	-5.26	-25.67	-18.17	-15.81	8.55	-2.00	-17.71	22.14
AL	Non-core Avg.		12.78	10.11	-1.96	-18.24	15.59	-37.17	-15.45	-1.33	-19.09	18.32
AL	Autauga	N	14.76	10.74	0.48	-31.19	-14.74	-14.77	5.71	48.87	9.09	30.51
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	N/A	N/A	N/A	-10.76	-46.48	26.83	14.65	12.06	-10.74	2.09
AL	Chambers	Y	9.57	-20.14	-11.92	-38.10	-36.25	-8.09	2.49	-25.89	3.59	8.64
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	37.94	39.53	2.14	-32.36	4.21	-7.90	13.42	-27.72	-4.49	60.83
AL	Lee	Y	7.25	16.99	-2.84	-21.37	-6.27	-34.97	2.99	17.82	-18.89	11.81
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	-24.52	12.08	-22.55	0.00	66.36	-63.48	-28.47	8.80	-77.44	-2.75
AL	Montgomery	Y	-1.74	15.23	0.51	-23.39	-10.29	-10.81	2.02	0.40	-14.40	6.21
AL	Pike	N	11.90	3.62	3.84	-14.81	20.41	-23.22	-16.44	-24.43	-24.39	15.30
AL	Randolph	N	28.07	-13.99	4.22	-32.07	0.29	-51.32	-39.17	-20.85	-17.75	14.03
AL	Russell	N	33.70	38.09	4.22	-13.13	5.63	-33.04	1.12	-19.04	15.03	34.53
AL	Tallapoosa	Y	19.93	0.17	-14.19	-28.05	-13.92	-59.89	15.72	11.36	-61.30	43.28
GA	GA		3.43	6.87	-5.45	-25.80	-10.55	-15.06	-1.20	-5.59	-12.85	10.64
GA	Core Avg.		-4.47	-3.56	0.51	-31.39	-10.36	-12.70	19.05	17.66	6.79	-1.17
GA	Non-core Avg.		8.65	4.13	3.46	-24.14	-20.08	20.57	7.17	-22.44	-40.05	31.29
GA	Atlanta MSA		1.36	7.45	-7.96	-27.54	-5.44	-15.39	-3.16	-5.97	-15.98	10.11
GA	Harris	N	28.81	2.91	1.16	-3.09	1.05	128.89	2.71	-7.86	-31.47	58.56
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	N/A	N/A	N/A	-34.52	-23.94	2.35	22.71	-35.41	-33.68	7.69
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	-4.47	-3.56	0.51	-31.39	-10.36	-12.70	19.05	17.66	6.79	-1.17
GA	Upson	N	-11.51	5.35	5.75	-34.80	-37.36	-69.54	-3.92	-24.05	-54.99	27.62

Notes: (1) Information on all the following tables are based on American Community Survey (ACS) data. The ACS is an ongoing survey that provides data every year-- giving communities the current information they need to plan investments and services. Data are estimates based on the collected survey answers. For example, ACS 3-year Estimates 2005-2007 are based on the answers of 2005, 2006 and 2007. These data are therefore treated as centered on the year 2006 (denoted by 06 above). Similarly, the ACS 3-year Estimates 2009-2011 are based on the answers of 2009, 2010 and 2011. These data are therefore treated as centered on the year 2010 (denoted by 10 above). The percentage difference data are calculated based on ACS 2005-2007, which is used to represent the socioeconomic situations before Kia came in 2008; and ACS 2009-2011, which is used to represent the socioeconomic situations after Kia came. 06-10 indicates that the centers of ACS 2005-2007 and ACS 2009-2011 are 2006 and 2010 respectively.. (2)ACS 3-year estimates of Heard, Talbot, Bullock, Lowndes, and Crenshaw and part of data of Butler and Meriwether are not available as the populations of those counties are too small and the ACS 3-year estimates only cover counties with population larger than 20,000. (3) The concept of Atlanta MSA is different from the official definition of Atlanta MSA which consists of 25 counties, because the 25 counties include many counties in the neighboring area of Kia plant, which we want to be separated from Atlanta. Instead, 15 counties are selected to create a smaller area of Atlanta MSA. Those counties are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale. The same definition of Atlanta MSA is used in every following table.

performance than the Alabama average and the Alabama non-core counties in management, wholesale trade, retail trade, and education and health care. Other sectors didn't seem to do better than other parts in Alabama. It is a little surprising that Chambers County, which has many newly established suppliers, didn't show significantly faster growth in any of the selected sectors. The reasons for this need further study.

Table 2.2 presents data on the percentage change in migration to the various counties. The migration data provided by the ACS allows broad identification of whether those that came to a particular county migrated from another State or from within the same State, or whether they came from overseas. It also provides information on the citizenship and whether US versus foreign born. The key findings from Table 2.2 are that Troup County experienced a huge inflow of foreign residents. Numbers in residents from abroad, foreign-born citizen, naturalized citizen, and non-citizens almost doubled. For example, non-citizen residents in Troup increased from 1,151 to 2,114. Also, there is a 335% increase in residents from abroad, which is the second highest among all the selected counties, after Pike County. However, from the data on actual number of immigrants, we know that the high growth rate of Pike County is because of its low starting level. From the list of new establishments of suppliers we have, we found that most are Korean companies, thus we infer that a large proportion of the immigrants to the region are Koreans, working in those Korean companies and accompanied by their families. In terms of residents from other states, Troup County decreased less than non-core counties and the Atlanta MSA, which indicates that a part of the decline is offset by the inflow of workers from other states. Under the categories of foreign-born citizen, naturalized citizen, and non-citizens, Alabama core counties are also much higher than non-core counties. Notice the huge increases of Chambers County, where more than 7 suppliers locate. But we can't see a clear trend of domestic migration to the core counties. The major cause of domestic migration in this area may involve some factors other than the arrival of the KMMG plant and its suppliers.

Changes in population dynamics, as noted in Table 2.2, will also result in changes in educational profile. Inflows of higher skilled production and services workers, along with management, are likely to alter the composition of educational attainment. **Table 2.3** presents these data. Some of the main observations from Table 2.3 are as follows. In Georgia, Troup County had a larger increase in population 25 years or older, population with high school

Table 2.2 Percentage Change in Migration

State	County	Core	Residents from other counties, but same state	Residents from other states	Residents from abroad	US born citizen	Foreign-born citizen	Naturalized citizen	Non-citizens
			06-10	06-10	06-10	06-10	06-10	06-10	06-10
AL	AL		-0.16	-14.70	-14.97	3.48	28.77	25.05	30.43
AL	Core Avg.		3.16	4.41	40.07	2.43	177.82	180.34	98.73
AL	Non-core Avg.		12.93	6.55	237.44	4.02	58.25	91.15	68.45
AL	Autauga	N	37.09	4.33	-49.62	11.93	31.07	-30.79	120.76
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	29.37	-21.98	N/A	2.41	565	N/A	N/A
AL	Chambers	Y	37.11	-38.80	136.67	-3.23	262.50	746.67	198.23
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	-25.46	-22.47	-19.07	4.50	39.79	-9.80	83.41
AL	Lee	Y	2.66	7.24	-18.63	8.98	41.00	3.41	57.86
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	22.47	-31.52	231.82	-6.40	21.91	425.00	-87.50
AL	Montgomery	Y	-2.50	3.83	-40.83	1.04	32.76	55.58	22.29
AL	Pike	N	-4.42	77.33	688.46	7.52	94.45	16.36	101.68
AL	Randolph	N	-32.69	-41.34	-12.96	0.14	161.54	78.57	192.11
AL	Russell	N	42.20	23.96	329.51	6.93	-17.73	-33.38	15.21
AL	Tallapoosa	Y	-22.25	98.62	142.22	0.87	125.89	105.83	131.88
GA	GA		-5.95	-26.10	-25.61	3.15	11.89	29.17	3.92
GA	Core Avg.		4.20	-28.74	335.09	4.56	92.27	116.92	83.67
GA	Non-core Avg.		22.19	-64.99	-59.29	3.30	-11.47	49.84	-26.59
GA	Atlanta MSA		-4.95	-33.54	-30.04	1.66	8.69	29.34	-0.71
GA	Harris	N	0.51	-71.79	12.12	14.24	-8.61	-1.35	-26.92
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	86.8	-69.41	-90.00	-2.96	-25.60	N/A	N/A
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	4.20	-28.74	335.09	4.56	92.27	116.92	83.67
GA	Upson	N	-20.75	-53.77	-100.00	-1.37	-0.21	101.03	-26.26

Notes: (1) Calculations are based on ACS 2005-2007 and ACS 2009-2011 data. (2) Unit of all the numbers are percentages. Data of Bullock, Crenshaw, Lowndes, Heard, and Talbot, and part of the data of Bulter and Meriwether are not available. (3) The 15 counties are selected to create a smaller area of Atlanta MSA. Those counties are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale.

education, and graduate degrees. In population with 9th to 12th grade education, Troup County increased by 13.91%, compared with -9.72 for Georgia average, -15.09 for non-core counties and -12.81 for Atlanta MSA. The number of people with some college education increased from 7,221 to 9,025. However, we observe a decline instead of increase in the number of people with associate or college degrees in Troup County. The combined results show that Troup County has been attracting people, but it is hard to conclude that the arrival of Kia and its suppliers has to date contributed to an accumulation of human capital within the local area. Also, we again observed a large increase in population in Harris County, which is the result of new military establishments.

Inward movement of population and workers is also likely to alter the profile of schooling. **Table 2.4** presents these data. In Troup County, compared with the Georgia average, Atlanta MSA, and non-core counties, we can see significant larger increases in schooling groups of preschool (27.38%), kindergarten (29.20%), and elementary school (10.03%). In contrast, the number of students in high schools and college or graduate schools didn't show a similarly large increase. This may be the results of workers of new companies bringing their children with them to Troup County. Given the fact that these children are mostly younger than high school age, we can conclude that the people arriving to work in the area's new businesses are mostly young to middle-age adults. Interestingly, Harris County's large increases are in nursery school students, high school students, and college students, which implies a different composition of employees at these military establishments. In Alabama, the two counties of Elmore County and Lee County show similar pattern to those in Troup County. But the reason is not clear why Pike County experienced the largest increase in student number among all the selected counties.

Finally, in **Table 2.5**, we examine changes in household income. While we do not conduct an exercise to assess the tax implications for the County or State, the changes in incomes are a direct signal of economic benefits. For Georgia, the household income of Troup County experienced a larger increase (6.52% in median household income and 10.30% in mean household income) compared to the Georgia average, to Meriwether County and to Upson County. In contrast, Harris County achieved a huge increase of more than 22.3%. As noted before, the increase in Harris County may be the result of its military establishments. Thus, we can still conclude that Kia and its suppliers had significant positive impact on household income in the local area. For Alabama, although the core counties of Elmore and Lee show similar pattern to

Troup County, the impact is unclear for other core counties in Alabama. This makes it unclear whether on average the newly generated jobs are higher paid than the previously existing jobs.

3.2. Calculating Multipliers

Many studies calculate the impact of State incentives by computing multipliers. Typically, these tend to be related to additional income generated, jobs created and tax revenues collected, among others. As noted above, we take an encompassing view of the effects of the KMMG plant location and operations, and examine a wide array of variables that inform us of the impact of the Kia plant.

In **Tables 2.1 to 2.5**, we displayed the percentage changes in the affected counties, and discussed the changes between core and non-core counties, and how the core county effects compared with the State-wide or Atlanta MSA averages. In this section, we compute some basic multipliers to take a different look at the data. The starting point is the State of Georgia offering approximately $500 million in incentives. Next, the Kia plant locates and begins operations. The Kia plant has a direct employment of approximately 2,500 workers, and a capital investment of $1,200 million. This implies that the $500 million offered in State incentives results in an initial investment of $1,200 million and annual employment of 2,500 workers. These form the narrowest and most direct multipliers.

To examine the totality of the effects, we need to consider that the location of the Kia plant resulted in: (1) numerous component suppliers moving to the area; and (2) various counties experiencing broader economic and business development, as manifested by changes in (a) employment in multiple occupations to support the activities of Kia and their suppliers, (b) inward movement of workers and their families with resulting effects on educational attainment and schooling, (c) intra-US and foreign migration patterns, and (d) income changes, among others. In other words, the full effect relates to the overall development of the economic and business ecosystem. As there is no single index we can meaningfully construct to measure this effect, we display the multipliers for each of the variables we consider, compare the multipliers for the core versus non-core counties, and also compare the multipliers for the core counties to State-wide and Atlanta MSA averages.

Table 2.3 Percentage Change in Education

State	County	Core	Population 25 years and over	Less than 9th grade	9th to 12th grade, no diploma	High school graduate (includes equivalency)	Some college, no degree	Associate degree	Bachelor degree	Graduate or professional degree
			06-10	06-10	06-10	06-10	06-10	06-10	06-10	06-10
AL	AL		5.07	-4.23	-8.22	0.97	15.59	14.55	10.74	8.11
AL	Core Avg.		5.15	-13.89	-5.33	3.91	14.68	6.25	14.93	21.56
AL	Non-core Avg.		4.75	-10.59	-1.91	2.93	21.3	9.97	23.37	-6.93
AL	Autauga	N	11.75	7.68	5.95	7.12	21.54	18.21	15.59	3.24
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	5.08	-0.74	6.47	1.71	14.37	-13.97	4.03	55.9
AL	Chambers	Y	-1.61	-15.22	-0.45	-4.53	10.16	-21.62	3.04	26.93
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	8.26	-30.3	-16.49	-6.31	32.52	37.61	24.47	46.77
AL	Lee	Y	11.99	-23.41	12.7	16.97	13.81	9.89	17.4	7.41
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	-3.14	-21.62	-1.68	10.17	13.65	-24.55	-28.36	-3.71
AL	Montgomery	Y	4.69	9.19	-15.25	4.23	14.12	1.07	14.77	-3.6
AL	Pike	N	5.75	-43.12	-18.84	11.32	33.02	4.96	32.7	-2.24
AL	Randolph	N	4.12	17.68	11.06	-8.97	32.28	-5.22	27.42	-35.07
AL	Russell	N	5.25	-13.56	-6.02	-4.97	5.99	56.46	69.48	3.14
AL	Tallapoosa	Y	2.49	-22.88	-18.94	11.37	3.11	24.49	25.84	-4.06
GA	GA		5.01	-2.48	-9.72	1.23	15.85	9.88	6.98	11.33
GA	Core Avg.		7.09	-11.08	13.91	4.8	24.98	-5.56	-3.41	10.25
GA	Non-core Avg.		4.54	-8.78	-15.09	-1.01	30.2	-3.7	8.98	7.81
GA	Atlanta MSA		3.02	1.9	-12.81	-3.85	11.88	8.34	4.3	9.45
GA	Harris	N	17.25	-24.67	-17.82	6.3	28.52	22.09	38.41	45.68
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	-2.82	5.85	1.26	-4.85	13.7	-38.99	6.13	-40.05
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	7.09	-11.08	13.91	4.8	24.98	-5.56	-3.41	10.25
GA	Upson	N	-0.81	-7.52	-28.72	-4.48	48.37	5.8	-17.59	17.81

Notes: (1) The calculations are based on ACS 2005-2007 and ACS 2009-2011 data. (2) Unit of all the numbers are percentages. Data of Bullock, Crenshaw, Lowndes, Heard, and Talbot are not available. (3). 15 counties are selected to create a smaller area of Atlanta MSA. Those counties are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale.

Table 2.4 Percentage Change in Schooling

State	County	Core	Population 3 years and over enrolled in school	Nursery school, preschool	Kindergarten	Elementary school (grades 1-8)	High school (grades 9-12)	College or graduate school
			06-10	06-10	06-10	06-10	06-10	06-10
AL	AL		5.75	-2.37	4.78	2.78	2.3	16.19
AL	Core Avg.		3.65	7.41	6.50	-0.18	-3.38	23.18
AL	Non-core Avg.		11.25	3.94	-2.06	-2.01	11.09	39.37
AL	Autauga	N	21.77	-17.71	43.2	12.1	25.59	51.62
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	8.44	-9.96	-38.53	7.97	0.25	50.74
AL	Chambers	Y	-3.11	19.47	-4.25	-7.1	-14.7	16.26
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	5.02	65.23	57.3	-6.46	2.45	9.01
AL	Lee	Y	9.02	29.84	48.57	4.4	-3.19	10.91
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	-17.09	20.3	-36.68	-32.27	11.03	-17.97
AL	Montgomery	Y	2.88	-14.77	-0.29	3.1	-5.13	13.63
AL	Pike	N	35.72	78.41	18.08	2.46	3.06	71.68
AL	Randolph	N	-12.86	-55.8	-54.45	4.25	-11.8	-23.68
AL	Russell	N	28.7	-5.51	19.56	3.41	27.55	115.21
AL	Tallapoosa	Y	-0.37	-45.35	-23.78	-2.96	0.04	38.52
GA	GA		7.92	-3.68	7.23	4.07	2.74	23.4
GA	Core Avg.		7.62	27.38	29.20	10.03	-8.15	7.48
GA	Non-core Avg.		5.39	-2.33	-35.92	-3.36	24.05	30.92
GA	Atlanta MSA		9.86	-2.45	7.38	4.58	6.94	27.39
GA	Harris	N	20.28	26.42	4.38	4.42	39.65	37.93
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	-11.92	-3.24	-55.56	-20.04	12.97	-0.81
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	7.62	27.38	29.2	10.03	-8.15	7.48
GA	Upson	N	7.81	-30.18	-56.59	5.53	19.52	55.64

Notes: (1) Calculations are based on the ACS 2005-2007 and ACS 2009-2011 data. (2) Unit of all the numbers are percentages. Data of Bullock, Crenshaw, Lowndes, Heard, and Talbot are not available.(3) 15 counties are selected to create a smaller area of Atlanta MSA. Those counties are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale.

Table 2.5. Percentage Change in Household Income

State	County	Core	Median Household Income	Mean Household Income
			10-Jun	10-Jun
AL	AL		4.8	5.93
AL	Core Avg.		2.32	2.73
AL	Non-core Avg.		11.29	9.64
AL	Autauga	N	11.28	10.81
AL	Bullock	Y	N/A	N/A
AL	Butler	Y	-7.9	-3.63
AL	Chambers	Y	-7.25	2.73
AL	Crenshaw	N	N/A	N/A
AL	Elmore	Y	6.71	10.11
AL	Lee	Y	6.13	8.97
AL	Lowndes	N	N/A	N/A
AL	Macon	N	6.58	-5.55
AL	Montgomery	Y	4.76	-0.94
AL	Pike	N	28.09	11.77
AL	Randolph	N	-1.16	15.12
AL	Russell	N	11.64	16.04
AL	Tallapoosa	Y	11.46	-0.85
GA	GA		-1.75	0.08
GA	Core Avg.		6.52	10.3
GA	Non-core Avg.		8.83	5.32
GA	Atlanta MSA		N/A	N/A
GA	Harris	N	22.3	22.36
GA	Heard	N	N/A	N/A
GA	Meriwether	N	5.65	-0.18
GA	Talbot	N	N/A	N/A
GA	Troup	Y	6.52	10.3
GA	Upson	N	-1.46	-6.23

Notes (1) Calculations are based on the ACS 2005-2007 and ACS 2009-2011 data. (2) Unit of all the numbers are percentages. Data of Bullock, Crenshaw, Lowndes, Heard, Talbot, and Atlanta MSA are not available. (3) 15 counties are selected to create a smaller area of Atlanta MSA. Those counties are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale.

Our presentation of the multipliers related to the Kia facility is based on computing the following two ratios:

(1) The actual change (pre-Kia to post-Kia) in the specific variable relative to Kia direct employment. We label this MuE. For example, if the actual change in a core county employment was 5,000 workers, then MuE is equal to 2.0 (that is, 5,000 divided by the Kia direct employment of 2,500); and

(2) The actual change in the specific variable relative to Kia capital investment. We label this MuCI. For example, if the actual change in a core county employment was 5,000 workers, then MuCI is equal to 4.17 (that is, 5,000 divided by the Kia investment of 1,200).

These multipliers are reported in Tables 3.1 to 3.5.

In **Table 3.1**, we report the employment by occupation related multipliers. In Georgia, the core county, Troup County, outperformed its counterparts in the non-core counties in retail trade (0.265 additional jobs per Kia employment, 0.553 jobs per million Kia investments), in transportation and warehousing (0.092 additional jobs per Kia employment, 0.191 jobs per million Kia investments) and in finance and insurance (0.041 additional jobs per Kia employment, 0.085 jobs per million Kia investments). Troup County out-performed the non-core counties in sales and office and services, and was about the same in wholesale trade. In some categories, Troup County did worse than non-core counties; these include, for example, the industry categories of management, construction, and manufacturing. This shows that although the direct job creation effect of the KMMG plant is in the manufacturing sector, the increase of manufacturing jobs in this region is still weaker than in some other parts of Georgia. However, the induced job creation effect greatly benefited Troup County, mainly in retail trade, transportation and warehousing, and finance and insurance, all of which support the manufacturing factories and their workers. It is worth noting that during the analysis period, Harris County experienced significant growth in employment in the management sector, in wholesale trade, and in education and health care, but these are due to the recent arrival of military establishments. For Alabama, the core counties had better performance than non-core counties in the industry categories related to management, service, retail trade, and education and health care. In the other categories, the core counties did not do better than non-core counties. It is a little surprising that that Chambers County, which has many newly established suppliers, didn’t show significantly faster growth in any of the selected sectors.

The dispersion of the employment results across the core and non-core are perhaps not surprising as many businesses tend to locate in neighboring counties. The precise dynamics of the location of the complementary and supporting businesses can only be addressed in a more detailed study.

The effects related to migration are presented in **Table 3.2**. Troup County experienced a huge inflow of foreign residents. The multipliers for residents from abroad (ranging 0.15 to 0.32), foreign-born citizen (ranging from 0.57 to 1.19), naturalized citizen (ranging from 0.19 to 0.39, and non-citizens (ranging from 0.39 to 0.80) are all relatively large multipliers, and considerably greater than the corresponding numbers for the non-core counties. From the list of new supplier establishments, we found that most of them are Korean companies, and we infer from this that a large proportion of the immigrants are Korean workers and their families. In terms of residents from other states, Troup County decreased less than non-core counties, which indicates that part of the decline is offset by the inflow of workers from other states. For US-born residents, the multipliers for the core and non-core countries are large, and approximately the same. Perhaps the most interesting overall observation relates to the large movement of populations into Troup County that fall under the categories of residents from abroad, foreign-born citizens, naturalized citizens, and non-citizens.

For the Alabama core counties, the multipliers for foreign-born citizen (ranging from 2.34 to 4.87), naturalized citizen (ranging from 0.58 to 1.21), and non-citizens (ranging from 1.71 to 3.56) are significantly higher than that state's non-core counties. However, in contrast to the Georgia core v. non-core counties, the Alabama core counties also have much larger multipliers for the US born citizen category (AL range 6.46 to 13.46 versus GA range of 1.11 to 2.32) This leads us to infer that the major cause of domestic migration into the Alabama areas may involve factors other than the arrival of the KMMG plant and its suppliers. This is not surprising as Alabama had been successful in attracting numerous prominent manufacturing facilities, in automobiles (e.g., Honda, Nissan, Hyundai, Toyota, and Daimler) and in other manufacturing (e.g., ThyssenKrupp, Airbus).

Table 3.3 presents a transformation in educational attainment. In Georgia, Troup County had larger multipliers in categories related to 9th-12th grade (ranging from 0.29 to 0.60) and high school graduate (ranging from 0.27 to 0.57). For population 25+ and schooling less than 9th grade, Troup County multipliers were about the same as non-core counties. For categories related to some college, associate degrees and bachelor degrees, the multipliers for Troup County were either marginally or considerably lower than non-core. The combined results show that Troup County has been attracting people, but it is hard to conclude that the coming of Kia and its suppliers contribute to an overall accumulation of human capital in that county. This is perhaps not surprising as many workers often tend to stay in adjacent counties, and not necessarily in the county they work in.

In Alabama, the core county multipliers are greater than non-core counties in all the educational categories apart from less than 9th grade, and 9th to 12th grade. Overall, there is a significant measured effect on population with higher educational degrees.

For the effects related to schooling, the multipliers are presented in **Table 3.4**. In Troup County, the multipliers are higher in all categories apart from high school, and college or graduate school. This implies that most of the effects are at the lower end of the schooling distribution. This may be the result of workers of new companies bringing their children with them to Troup County. Given the fact that these children are mostly younger than high school age, we can conclude that the people coming to work in the new businesses are mostly young to middle-age adults. Interestingly, Harris County has a somewhat different pattern, which may indicate a different composition of employees at the military establishments in that county. In Alabama, the core counties have systematically higher multipliers than non-core counties, except for the high school category. The population, educational and schooling patterns in the core versus non-core are complicated and difficult to provide a clean interpretation. This is largely due to the fact that workers need not stay in the same county as their work.

Finally, in **Table 3.5**, we present the multipliers related to household income. For Georgia, we can see how the Kia plant has affected the household income of residents in Troup County versus the non-core counties (Meriwether and Upson) in Georgia. Aside from Harris County, the multipliers for Troup County are larger than the other non-core counties. The Harris County numbers are influenced by the military establishments. The Troup County households experienced a larger increase compared to Meriwether County and Upson County (every job brought into the Kia plant brings a $1 increase in the county's median household income and $2 in mean household income; one million dollars of investment in the Kia plant brings a $2 increase in median household income and a $4 in mean household income). Thus, we can still conclude that the Kia location boosted household income in the local area. For Alabama, although the core counties of Elmore and Lee show a somewhat similar pattern of income gains (multipliers) as those in Troup County, the impact of the Kia plant on the incomes in the other core counties in Alabama is unclear. This also makes it unclear whether, on average, the newly generated jobs are higher paid than the existing jobs. Having said this, the Alabama results are more complicated and difficult to interpret due to the location of numerous other automobile and manufacturing plants.

In summary, we see tangible evidence that the location of the Kia plant has affected population, schooling, educational and income dynamics in the affected (core) and non-core counties. Since many workers live and work in different counties, it is often difficult to pin down the precise effects in a particular county. But the overall picture is clear, that the location of the Kia plant has had a wide range of effects across the core and no-core counties in Georgia. The Alabama effects are more difficult to interpret due to the location of numerous other automobile and other manufacturing plants in that state.

Table 3.1 Multipliers of Employment by Industry

State	County	Core	Management		Service		Sales and office		Construction		Manufacturing	
			MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI
AL	Core Counties		2.174	4.529	2.084	4.342	-0.426	-0.888	-1.845	-3.844	-1.418	-2.955
AL	Non-core Counties		1.127	2.348	0.686	1.430	-0.042	-0.088	-0.496	-1.033	0.161	0.336
AL	Autauga	N	0.374	0.779	0.150	0.313	0.012	0.026	-0.260	-0.542	-0.213	-0.444
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	N/A	N/A	N/A	N/A	N/A	N/A	-0.023	-0.048	-0.494	-1.028
AL	Chambers	Y	0.113	0.235	-0.172	-0.358	-0.171	-0.356	-0.224	-0.466	-0.632	-1.316
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	1.331	2.773	0.638	1.330	0.071	0.148	-0.436	-0.908	0.068	0.142
AL	Lee	Y	0.615	1.282	0.603	1.256	-0.172	-0.359	-0.406	-0.845	-0.185	-0.386
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	-0.220	-0.458	0.084	0.176	-0.228	-0.474	0.000	0.000	0.146	0.304
AL	Montgomery	Y	-0.247	-0.514	1.012	2.109	0.052	0.108	-0.596	-1.242	-0.431	-0.898
AL	Pike	N	0.171	0.356	0.036	0.076	0.054	0.113	-0.050	-0.105	0.169	0.353
AL	Randolph	N	0.215	0.448	-0.071	-0.148	0.028	0.058	-0.094	-0.197	0.003	0.006
AL	Russell	N	0.587	1.223	0.486	1.013	0.091	0.190	-0.091	-0.189	0.056	0.118
AL	Tallapoosa	Y	0.362	0.754	0.002	0.004	-0.206	-0.428	-0.184	-0.383	-0.238	-0.497
GA	Core County		-0.140	-0.292	-0.069	-0.143	0.014	0.029	-0.236	-0.493	-0.257	-0.536
GA	Non-core Counties		0.414	0.863	-1.085	-2.261	-0.098	-0.205	-0.074	-0.154	-0.143	-0.298
GA	Harris	N	0.613	1.278	0.018	0.038	0.017	0.036	-0.012	-0.025	0.005	0.011
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	N/A	N/A	N/A	N/A	N/A	N/A	-0.112	-0.234	-0.199	-0.414
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	-0.140	-0.292	-0.069	-0.143	0.014	0.029	-0.236	-0.493	-0.257	-0.536
GA	Upson	N	-0.199	-0.414	-1.104	-2.299	-0.116	-0.241	0.050	0.105	0.050	0.105
	Total		3.576	7.449	1.616	3.368	-0.553	-1.152	-2.651	-5.523	-1.658	-3.453

Notes: (1) The table is constructed based on the data in Table B.1. (2) MuE stands for Multiplier for Kia Employment and MuCI stands for Multiplier of Kia Capital Investment. MuE= Change in variable/Kia direct employment; MuCI= Change in variable/Kia capital investment. Kia direct employment is about 2,500 workers and Kia capital investment is $1,200 million. (3) For example, the multipliers under Management for Alabama core counties mean 1 employment in Kia plant on average brings 2.174 management jobs in Alabama core counties and 1 million capital investments in Kia plant on average brings 4.529 jobs in Alabama core counties. (4) By definition, the multipliers of AL core are the sums of the multipliers of the AL core counties; AL non-core, GA core, and GA non-core are calculated in similar ways. The “Total” row is calculated as the sum of all the county multipliers. (5) There exist negative multipliers as the employment in certain categories decrease from ACS 2005-2007 to ACS 2009-2011. (6) Data of Bullock, Crenshaw, Lowndes, Heard, Talbot, and part of the data for Butler and Meriwether are not available.

Table 3.1. Multipliers of Employment by Industry … Cont'd

State	County	Core	Wholesale trade		Retail trade		Transportation and warehousing		Finance and insurance		Education and health care	
			MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI
AL	Core Counties		-0.449	-0.936	0.520	1.084	-0.114	-0.237	-1.045	-2.178	3.068	6.391
AL	Non-core Counties		-0.252	-0.526	-0.350	-0.730	-0.027	-0.057	-0.091	-0.190	1.188	2.475
AL	Autauga	N	-0.052	-0.109	0.066	0.137	0.190	0.395	0.047	0.098	0.429	0.893
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	0.013	0.028	0.058	0.120	0.016	0.034	-0.013	-0.027	0.012	0.025
AL	Chambers	Y	-0.008	-0.016	0.015	0.031	-0.088	-0.183	0.009	0.018	0.082	0.171
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	-0.027	-0.057	0.178	0.370	-0.208	-0.433	-0.037	-0.077	1.118	2.328
AL	Lee	Y	-0.180	-0.374	0.090	0.187	0.131	0.273	-0.316	-0.658	0.741	1.543
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	-0.045	-0.094	-0.117	-0.244	0.009	0.018	-0.165	-0.343	-0.032	-0.067
AL	Montgomery	Y	-0.112	-0.234	0.094	0.195	0.006	0.013	-0.424	-0.883	0.495	1.032
AL	Pike	N	-0.040	-0.084	-0.126	-0.262	-0.112	-0.233	-0.064	-0.133	0.199	0.414
AL	Randolph	N	-0.054	-0.113	-0.184	-0.384	-0.049	-0.102	-0.016	-0.034	0.093	0.193
AL	Russell	N	-0.060	-0.125	0.011	0.023	-0.065	-0.136	0.107	0.223	0.500	1.041
AL	Tallapoosa	Y	-0.136	-0.283	0.087	0.182	0.028	0.059	-0.265	-0.552	0.620	1.292
GA	Core County		-0.035	-0.073	0.265	0.553	0.092	0.191	0.041	0.085	-0.027	-0.057
GA	Non-core Counties		-0.036	-0.075	-0.295	-0.614	-0.177	-0.369	-0.325	-0.677	0.630	1.313
GA	Harris	N	0.139	0.290	0.017	0.036	-0.016	-0.033	-0.228	-0.475	0.654	1.363
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	0.002	0.004	0.081	0.169	-0.107	-0.223	-0.077	-0.160	0.047	0.098
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	-0.035	-0.073	0.265	0.553	0.092	0.191	0.041	0.085	-0.027	-0.057
GA	Upson	N	-0.177	-0.369	-0.393	-0.819	-0.055	-0.114	-0.020	-0.042	-0.071	-0.148
	Total		**-0.772**	**-1.609**	**0.140**	**0.293**	**-0.226**	**-0.472**	**-1.420**	**-2.959**	**4.859**	**10.123**

Table 3.2. Multipliers of Migration

County	Core	Residents from other counties		Residents from other states		Residents from abroad		US born citizen		Foreign-born citizen		Naturalized citizen		Non-citizens	
		MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI
Core Counties		-0.860	-1.793	0.138	0.288	-0.325	-0.677	6.459	13.457	2.335	4.865	0.580	1.209	1.710	3.562
Non-core Counties		0.307	0.639	0.138	0.288	0.367	0.765	3.920	8.168	0.397	0.828	0.008	0.016	0.390	0.812
Autauga	N	0.237	0.493	0.036	0.074	-0.026	-0.054	2.265	4.718	0.088	0.183	-0.052	-0.108	0.140	0.291
Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Butler	Y	0.030	0.062	-0.016	-0.033	0.021	0.044	0.194	0.405	0.045	0.094	0.000	0.000	0.000	0.000
Chambers	Y	0.080	0.167	-0.215	-0.448	0.016	0.034	-0.449	-0.935	0.134	0.280	0.045	0.093	0.090	0.187
Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Elmore	Y	-0.808	-1.683	-0.159	-0.332	-0.015	-0.031	1.328	2.767	0.184	0.383	-0.021	-0.044	0.205	0.428
Lee	Y	0.087	0.181	0.207	0.431	-0.090	-0.188	4.354	9.072	0.824	1.717	0.021	0.044	0.803	1.673
Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Macon	N	0.049	0.102	-0.218	-0.454	0.020	0.043	-0.566	-1.178	0.031	0.065	0.129	0.269	-0.098	-0.204
Montgomery	Y	-0.075	-0.156	0.122	0.253	-0.283	-0.590	0.892	1.859	0.922	1.921	0.492	1.025	0.430	0.896
Pike	N	-0.038	-0.080	0.236	0.492	0.215	0.448	0.876	1.826	0.245	0.511	0.004	0.008	0.242	0.503
Randolph	N	-0.088	-0.183	-0.175	-0.364	-0.003	-0.006	0.013	0.027	0.101	0.210	0.013	0.028	0.088	0.183
Russell	N	0.147	0.307	0.259	0.540	0.161	0.335	1.332	2.775	-0.068	-0.142	-0.087	-0.181	0.019	0.039
Tallapoosa	Y	-0.174	-0.363	0.200	0.417	0.026	0.053	0.139	0.289	0.226	0.470	0.044	0.091	0.182	0.379
Core County		0.043	0.090	-0.276	-0.575	0.153	0.318	1.112	2.317	0.573	1.194	0.188	0.392	0.385	0.803
Non-core Counties		0.210	0.437	-0.474	-0.988	-0.057	-0.118	1.120	2.333	-0.054	-0.113	0.036	0.075	-0.165	-0.343
Harris	N	0.004	0.008	-0.258	-0.537	0.002	0.003	1.534	3.195	-0.028	-0.059	-0.003	-0.007	-0.025	-0.053
Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Meriwether	N	0.316	0.658	-0.108	-0.225	-0.022	-0.045	-0.266	-0.553	-0.026	-0.053	0.000	0.000	-0.100	-0.208
Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Troup	Y	0.043	0.090	-0.276	-0.575	0.153	0.318	1.112	2.317	0.573	1.194	0.188	0.392	0.385	0.803
Upson	N	-0.110	-0.229	-0.108	-0.226	-0.037	-0.077	-0.148	-0.308	0.000	-0.001	0.039	0.082	-0.040	-0.083
Total		**-0.301**	**-0.627**	**-0.474**	**-0.987**	**0.138**	**0.288**	**12.612**	**26.274**	**3.251**	**6.773**	**0.812**	**1.692**	**2.320**	**4.833**

Notes: (1) This table is constructed based on the data in Table B.2. (2) MuE stands for Multiplier for Kia Employment and MuCI stands for Multiplier of Kia Capital Investment. MuE= Change in variable/Kia direct employment; MuCI= Change in variable/Kia capital investment. Kia direct employment is about 2,500 workers and Kia capital investment is $1,200 million. (3) Data of Bullock, AL, Crenshaw, AL, Lowndes, AL, Heard, GA, Talbot, GA, and part of the data for Butler, AL and Meriwether, GA are not available. (4) By definition, the multipliers of AL core are the sums of the multipliers of the AL-core counties; AL non-core, GA core, and GA non-core are calculated in similar ways. The total row is calculated as the sum of all the county multipliers.

Table 3.3. Multipliers of Education

State	County	Core	Population 25 years and over		Less than 9th grade		9th to 12th grade, no diploma		High school graduate (includes equivalency)	
			MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI
AL	Core Counties		8.056	16.784	-0.831	-1.731	-1.437	-2.993	1.726	3.596
AL	Non-core Counties		2.67	5.562	-0.366	-0.763	-0.212	-0.441	0.27	0.563
AL	Autauga	N	1.482	3.088	0.048	0.099	0.078	0.163	0.322	0.67
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	0.271	0.564	-0.003	-0.007	0.058	0.122	0.034	0.071
AL	Chambers	Y	-0.154	-0.321	-0.128	-0.268	-0.008	-0.018	-0.154	-0.321
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	1.624	3.384	-0.344	-0.718	-0.425	-0.885	-0.457	-0.952
AL	Lee	Y	3.409	7.102	-0.354	-0.737	0.372	0.774	1.254	2.612
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	-0.167	-0.348	-0.111	-0.231	-0.013	-0.027	0.134	0.279
AL	Montgomery	Y	2.625	5.468	0.249	0.518	-1.048	-2.184	0.649	1.353
AL	Pike	N	0.415	0.864	-0.267	-0.556	-0.253	-0.527	0.27	0.563
AL	Randolph	N	0.247	0.515	0.114	0.238	0.107	0.223	-0.214	-0.446
AL	Russell	N	0.692	1.443	-0.15	-0.313	-0.131	-0.273	-0.241	-0.503
AL	Tallapoosa	Y	0.282	0.587	-0.25	-0.521	-0.385	-0.803	0.4	0.833
GA	Core County		1.13	2.354	-0.143	-0.298	0.288	0.599	0.273	0.568
GA	Non-core Counties		1.073	2.236	-0.125	-0.26	-0.538	-1.122	-0.11	-0.228
GA	Harris	N	1.302	2.713	-0.104	-0.217	-0.125	-0.261	0.143	0.298
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	-0.17	-0.353	0.03	0.062	0.013	0.028	-0.124	-0.258
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	1.13	2.354	-0.143	-0.298	0.288	0.599	0.273	0.568
GA	Upson	N	-0.06	-0.124	-0.05	-0.105	-0.426	-0.888	-0.129	-0.268
	Total		**12.929**	**26.936**	**-1.464**	**-3.051**	**-1.899**	**-3.957**	**2.16**	**4.499**

Notes: (1) This table is constructed based on the data in Table B.3. (2) MuE stands for Multiplier for Kia Employment and MuCI stands for Multiplier of Kia Capital Investment. MuE= Change in variable/Kia direct employment; MuCI= Change in variable/Kia capital investment. Kia direct employment is about 2,500 workers and Kia capital investment is $1,200 million.(3) Data of Bullock, AL, Crenshaw, AL, Lowndes, AL, Heard, GA, and Talbot, GA are not available. (4) By definition, the multipliers of AL core are the sums of the multipliers of the AL core counties; AL non-core, GA core, and GA non-core are calculated in similar ways. The total row is calculated as the sum of all the county multipliers.

Table 3.3. Multipliers of Education … Cont'd

State	County	Core	Some college, no degree		Associate's degree		Bachelor's degree		Graduate or professional degree	
			MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI
AL	Core Counties		4.015	8.365	0.674	1.404	3.218	6.704	0.691	1.439
AL	Non-core Counties		1.571	3.273	0.472	0.983	1.046	2.180	-0.112	-0.234
AL	Autauga	N	0.579	1.206	0.160	0.333	0.268	0.558	0.029	0.060
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	0.130	0.271	-0.063	-0.131	0.020	0.041	0.095	0.198
AL	Chambers	Y	0.185	0.385	-0.151	-0.314	0.020	0.043	0.082	0.172
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	1.277	2.660	0.454	0.945	0.604	1.258	0.516	1.075
AL	Lee	Y	0.791	1.648	0.211	0.440	0.847	1.765	0.288	0.599
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	0.144	0.301	-0.114	-0.238	-0.187	-0.390	-0.020	-0.043
AL	Montgomery	Y	1.568	3.267	0.032	0.067	1.437	2.994	-0.262	-0.546
AL	Pike	N	0.384	0.799	0.012	0.024	0.283	0.589	-0.014	-0.028
AL	Randolph	N	0.291	0.606	-0.021	-0.043	0.094	0.196	-0.124	-0.258
AL	Russell	N	0.174	0.362	0.435	0.907	0.589	1.228	0.017	0.035
AL	Tallapoosa	Y	0.064	0.134	0.191	0.398	0.290	0.603	-0.028	-0.058
GA	Core County		0.722	1.503	-0.054	-0.113	-0.066	-0.138	0.112	0.233
GA	Non-core Counties		1.142	2.379	0.049	0.103	0.392	0.818	0.262	0.547
GA	Harris	N	0.447	0.931	0.145	0.303	0.462	0.963	0.334	0.697
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	0.131	0.273	-0.118	-0.245	0.022	0.045	-0.124	-0.258
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	0.722	1.503	-0.054	-0.113	-0.066	-0.138	0.112	0.233
GA	Upson	N	0.564	1.175	0.022	0.045	-0.092	-0.191	0.052	0.108
	Total		**7.450**	**15.521**	**1.140**	**2.376**	**4.590**	**9.563**	**0.952**	**1.984**

Notes**:** (1) This table is constructed based on the data in Table B.3 Cont'd. (2) MuE stands for Multiplier for Kia Employment and MuCI stands for Multiplier of Kia Capital Investment. MuE= Change in variable/Kia direct employment; MuCI= Change in variable/Kia capital investment. Kia direct employment is about 2,500 workers and Kia capital investment is $1,200 million. (3) Data of Bullock, AL, Crenshaw, AL, Lowndes, AL, Heard, GA, and Talbot, GA are not available. (4) By definition, the multipliers of AL core are the sums of the multipliers of the AL core counties; AL non-core, GA core, and GA non-core are calculated in similar ways. The total row is calculated as the sum of all the county multipliers.

Table 3.4. Multipliers of Schooling

State	County	Core	Population 3 years and over enrolled in school		Nursery school, preschool		Kindergarten		Elementary school (grades 1-8)		High school (grades 9-12)		College or graduate school	
			MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI	MuE	MuCI
AL	Core Counties		2.906	6.054	0.102	0.213	0.342	0.713	0.232	0.484	-0.415	-0.865	2.645	5.510
AL	Non-core Counties		2.845	5.927	-0.062	-0.128	0.071	0.148	0.122	0.253	0.609	1.269	2.104	4.384
AL	Autauga	N	1.113	2.319	-0.056	-0.118	0.100	0.209	0.296	0.617	0.313	0.653	0.460	0.958
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	0.162	0.338	-0.010	-0.020	-0.052	-0.109	0.072	0.149	0.001	0.003	0.151	0.315
AL	Chambers	Y	-0.100	-0.208	0.038	0.080	-0.008	-0.017	-0.107	-0.223	-0.113	-0.235	0.090	0.187
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	0.377	0.785	0.224	0.466	0.209	0.435	-0.224	-0.466	0.050	0.103	0.118	0.247
AL	Lee	Y	1.748	3.642	0.233	0.486	0.258	0.537	0.232	0.483	-0.084	-0.174	1.109	2.310
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	-0.574	-1.197	0.027	0.057	-0.034	-0.070	-0.321	-0.668	0.052	0.109	-0.300	-0.624
AL	Montgomery	Y	0.733	1.527	-0.270	-0.563	-0.004	-0.008	0.309	0.643	-0.270	-0.563	0.968	2.017
AL	Pike	N	1.297	2.702	0.083	0.173	0.020	0.041	0.030	0.062	0.019	0.039	1.146	2.388
AL	Randolph	N	-0.287	-0.598	-0.100	-0.208	-0.061	-0.128	0.042	0.088	-0.057	-0.118	-0.111	-0.231
AL	Russell	N	1.296	2.700	-0.015	-0.032	0.046	0.096	0.075	0.156	0.282	0.587	0.909	1.893
AL	Tallapoosa	Y	-0.014	-0.028	-0.113	-0.236	-0.060	-0.126	-0.049	-0.103	0.000	0.001	0.209	0.435
GA	Core County		0.515	1.073	0.134	0.278	0.116	0.242	0.293	0.610	-0.130	-0.270	0.102	0.213
GA	Non-core Counties		0.506	1.054	-0.033	-0.069	-0.206	-0.430	-0.094	-0.195	0.438	0.912	0.402	0.837
GA	Harris	N	0.577	1.202	0.048	0.101	0.008	0.018	0.056	0.118	0.254	0.530	0.209	0.436
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	-0.272	-0.568	-0.006	-0.013	-0.110	-0.229	-0.215	-0.448	0.062	0.128	-0.003	-0.006
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	0.515	1.073	0.134	0.278	0.116	0.242	0.293	0.610	-0.130	-0.270	0.102	0.213
GA	Upson	N	0.202	0.420	-0.075	-0.157	-0.105	-0.218	0.065	0.135	0.122	0.253	0.195	0.407
	Total		**6.772**	**14.108**	**0.141**	**0.293**	**0.323**	**0.673**	**0.553**	**1.153**	**0.502**	**1.046**	**5.253**	**10.943**

Notes (1) This table is constructed based on the data in Table B.4. (2) MuE stands for Multiplier for Kia Employment and MuCI stands for Multiplier of Kia Capital Investment. MuE= Change in variable/Kia direct employment; MuCI= Change in variable/Kia capital investment. Kia direct employment is about 2,500 workers and Kia capital investment is $1,200 million. (3) Data of Bullock, AL, Crenshaw, AL, Lowndes, AL, Heard, GA, and Talbot, GA are not available. (4) By definition, the multipliers of AL core are the sums of the multipliers of the AL core counties; AL non-core, GA core, and GA non-core are calculated in similar ways. The total row is calculated as the sum of all the county multipliers.

Table 3.5. Multipliers of Household Income

State	County	Core	Median Household Income		Mean Household Income	
			MuE	MuCI	MuE	MuCI
AL	Core Counties		2.749	5.728	3.714	7.737
AL	Non-core Counties		6.954	14.488	8.914	18.571
AL	Autauga	N	2.168	4.516	2.529	5.268
AL	Bullock	Y	N/A	N/A	N/A	N/A
AL	Butler	Y	-1.006	-2.097	-0.600	-1.249
AL	Chambers	Y	-0.973	-2.028	0.450	0.937
AL	Crenshaw	N	N/A	N/A	N/A	N/A
AL	Elmore	Y	1.360	2.833	2.434	5.072
AL	Lee	Y	0.953	1.985	1.840	3.834
AL	Lowndes	N	N/A	N/A	N/A	N/A
AL	Macon	N	0.702	1.462	-0.946	-1.970
AL	Montgomery	Y	0.800	1.666	-0.229	-0.478
AL	Pike	N	2.792	5.817	1.936	4.034
AL	Randolph	N	-0.162	-0.338	2.824	5.883
AL	Russell	N	1.455	3.032	2.570	5.355
AL	Tallapoosa	Y	1.616	3.368	-0.182	-0.379
GA	Core County		1.025	2.135	2.005	4.177
GA	Non-core Counties		5.779	12.039	6.627	13.806
GA	Harris	N	5.088	10.599	6.444	13.426
GA	Heard	N	N/A	N/A	N/A	N/A
GA	Meriwether	N	0.804	1.674	-0.033	-0.068
GA	Talbot	N	N/A	N/A	N/A	N/A
GA	Troup	Y	1.025	2.135	2.005	4.177
GA	Upson	N	-0.112	-0.234	0.215	0.448
	Total		**16.507**	**34.390**	**21.259**	**44.290**

Notes (1) This table is constructed based on the data in Table B.5. (2) MuE stands for Multiplier for Kia Employment and MuCI stands for Multiplier of Kia Capital Investment. MuE= Change in variable/Kia direct employment; MuCI= Change in variable/Kia capital investment. Kia direct employment is 2,500 and Kia capital investment is $1,200 million. (3) Data of Bullock, AL, Crenshaw, AL, Lowndes, AL, Heard, GA, Talbot, GA, and Atlanta MSA are not available. (4) By definition, the multipliers of AL core are the sums of the multipliers of the core counties; AL non-core, GA core, and GA non-core are calculated in similar ways. The total row is calculated as the sum of all the county multipliers.

4. Supply Chains: Components and Final Product Flows

This section of the report focuses on the various freight flows associated with the automobile manufacturing supply chain, and its uses of local, regional and national highway, rail and waterway (including seaport) networks and cargo transfer facilities.

4.1 Introduction

When companies such as Kia Motors move their operations into a new region, they have put a good deal of thought and research into the benefits of doing so. One important consideration is the ability to operate a highly efficient and consistently reliable just-in-time (JIT) materials and parts delivery process, as well as a similarly time sensitive and cost efficient finished products (i.e. finished automobiles) delivery process. This means operating an effective product supply chain that involves a number of sequential, including inter-modal freight movements that are now integral to, and a significant cost component of, the overall production process. Today, a key supply chain requirement is therefore an accessible, reliable, and high capacity global, as well as regional, transportation network. The public sector role in this process includes maintaining and, where necessary, facilitating the expansion of such networks. For States, this public sector role has become a key component in both attracting and retaining large manufacturing facilities, such as Kia's West Point automobile manufacturing plant, and one that deals increasingly with the issue of ensuring that disruptions to the transport of goods into and out of such sites are kept to a minimum. This includes traffic bottlenecks that result from either specific, non-recurring events (crashes, bad weather, roadway damage, necessary network rehabilitation) or that emerge over time from the continued growth in both freight and passenger traffic volumes. [2] As Weisbrod and Fitzroy (2011)[3] put it:

"From the public perspective, there is a need to make investment, financing and policy decisions based on an understanding of public infrastructure needs, costs and broader economic stakes

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[2] Cambridge Systematics Inc. and Texas Transportation Institute (2005) Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation. Report to the Federal Highway Administration, Washington, D.C.

[3] Weisbrod, G. and Fitzroy, S. (2011) Traffic congestion effects on supply chains: accounting for behavioral elements in planning and economic impact models. Chapter 16 in Supply Chain Management – New Perspectives, Renko, S. (Ed.) www.intechopen.com

involved. From the perspective of shippers and carriers, there are the day-to-day cost implications of delay and reliability as it affects supply chain management, as well as a longer-range need to assess opportunities, risks and returns associated with location, production and distribution decisions. Both perspectives need to be recognized when considering the full range of impacts that traffic congestion can have on the economy."

Bringing these two perspectives together in a productive manner presents a significant challenge, and one that requires, among other things, that public agency transportation planners expand their current efforts beyond traditional measurement of in-vehicle travel times and monetary costs, to broader considerations of industry sector specific production processes. As Holl (2006, page 11)[4] puts it, in one of the very few papers to address the role of regional transportation infrastructure investments from the individual firm perspective:

"*New patterns of production and distribution are emerging that are increasingly dependent on high-quality transportation. In an increasingly time-based competitive environment, access to the higher order road network and issues of reliability and frequency are becoming more important than just pecuniary transport costs*."

That is, such benefits can go beyond the usual estimates of in-vehicle transit travel time and cost savings, notably by providing opportunities to benefit from logistical reorganization, from market area expansion, and from wider supplier access. She also concludes that "micro-level knowledge" of firm operations is important for correct public sector evaluation of such transportation (infrastructure investment) projects.

The trend towards low-inventory JIT ordering and delivery systems in manufacturing industries such as automobile production places a considerable additional burden on the consistent, on-time supply of product inputs. In a summer 2013 interview at Kia Motors as part of this project's activities, the authors were told that a production stoppage to the automated assembly of automobiles of as little as one hour could prove to be very costly. They also learned that dealership orders based on specific vehicle specifications are often met within the south-eastern region by dispatching auto-carriers to fulfill such orders, often covering a considerable travel distance over the highway system. A similar on-time imperative has increasingly become the norm in other industries where the delivery of finished products is concerned. Often termed a

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[4] Holl, A. (20 06) A Review of the Firm-Level Role of Transport Infrastructure with Implications for Transport Project Evaluation. *Journal of Planning Literature 21.1*: 3-14.

"pull" supply chain in which the receiver/final customer determines the delivery schedule, this puts pressure on the manufacturer to maintain reliable transportation services. Solutions to this problem include locating suppliers near to, and sometimes within, a manufacturing plant. Another option is to integrate the manufacture and delivery of components within different branches of the Original Equipment Manufacturer's (OEM's) own company: a movement that is at odds with the vertical disintegration of the production process that has led many manufacturing companies to outsource the creation of sub-components of the firm's core end product. Whatever the "production and delivery model" adopted, transportation costs need to be treated as one component in a series of increasingly interdependent product delivery costs.

The rest of this section of the report is used to explore the nature and monetary value of such JIT-based transportation costs, and to assess the availability of existing data sources for doing so. We begin in Section 4.2 with a review of the recent literature on traffic congestion, its recent and projected growth in the south-eastern United States, and its various direct and indirect effects on a manufacturing firm's production costs, examined from the single firm's perspective. This in effect becomes an examination of how we quantify the costs of delays to freight pickups and deliveries. In doing so, and in the context of expected strong and continued growth in overall freight traffic volumes across the south-eastern region[5], we identify a number of potentially significant freight movement bottlenecks that may affect future movement efficiencies at the firm as well as broader regional level of operation. Sections 4.3 and 4.4 describe our efforts to construct a database of both the flows and costs respectively associated with moving freight inputs and outputs through the case study-based automotive industry supply chain. Section 4.5 then describes a method for bringing these flows and costs into a modeling framework for both identifying and computing the monetary costs of freight movement delays within JIT manufacturing supply chains.

4.2 Measuring the Effects of Congestion-Induced Delays on Firm Transaction Costs

4.2.1 Current and Forecast Congestion in the South-East and Nationally

The growing costs of traffic congestion have attracted a good deal of interest over the past decade, notably highway congestion and the efforts of state and regional planners to deal

[5] Georgia Statewide Freight and Logistics Plan, 2010-2050. Task 4. Economic Evaluation and Projections. Office of Planning, Georgia DOT.

with mixed passenger and freight mobility and place accessibility issues. Both federally and regionally sponsored studies of traffic growth and its impacts in the south-east contain forecasts of freight movement activity that will put a great deal of stress on current transportation networks, including water (seaport) [6] and rail [7] as well as highway [8] travel supporting infrastructure. A recent study by the American Transportation Research Institute [9] estimates that highway congestion cost trucking firms over $9.2 billion in additional operating costs and 141 million hours of lost productivity in 2013: with the Atlanta region rated the 10th most impacted metro area in the country.

Based on the manufacturing supply chain data collected and described in Sections 4.3 and 4.4 below, congestion is expected to impact large manufacturing establishments such as the Kia Motors plant principally at three different geographic scales, each of which is also dominated by a specific mode or modal combination:

- highway congestion both locally and within the south-eastern US
- congestion on the region's and the nation's rail network, and
- congestion at both foreign and US seaports associated with the inter-continental transport of waterborne (containerized) freight

Highway Congestion

Figure 4.1 shows the regional highway traffic forecasts for the year 2040, based on the mixed passenger and truck traffic volumes forecast by the US DOT's Freight Analysis Framework (Version 3: FHWA, 2010). The "VCR40" shown in the map key refers to the forecast traffic volume/roadway capacity (v/c) ratio in 2040, based on the assumption that no significant additional highway capacity has been added to the network. Many links have v/c ratios much higher than 1.2, with many of these links reaching this stage of heavy delay-inducing congestion well before 2040. Based on these ratios, the yellow colored links on this map indicate an average (space mean) speed reduction of over 25% between 2007 and 2040, the blue colored

[6] Volpe (2009) Assessment of the Marine Transportation System (MTS) Challenges. Summary Report to the U.S. Army Corps of Engineers by the Volpe Transportation Research Center, Cambridge, MA.

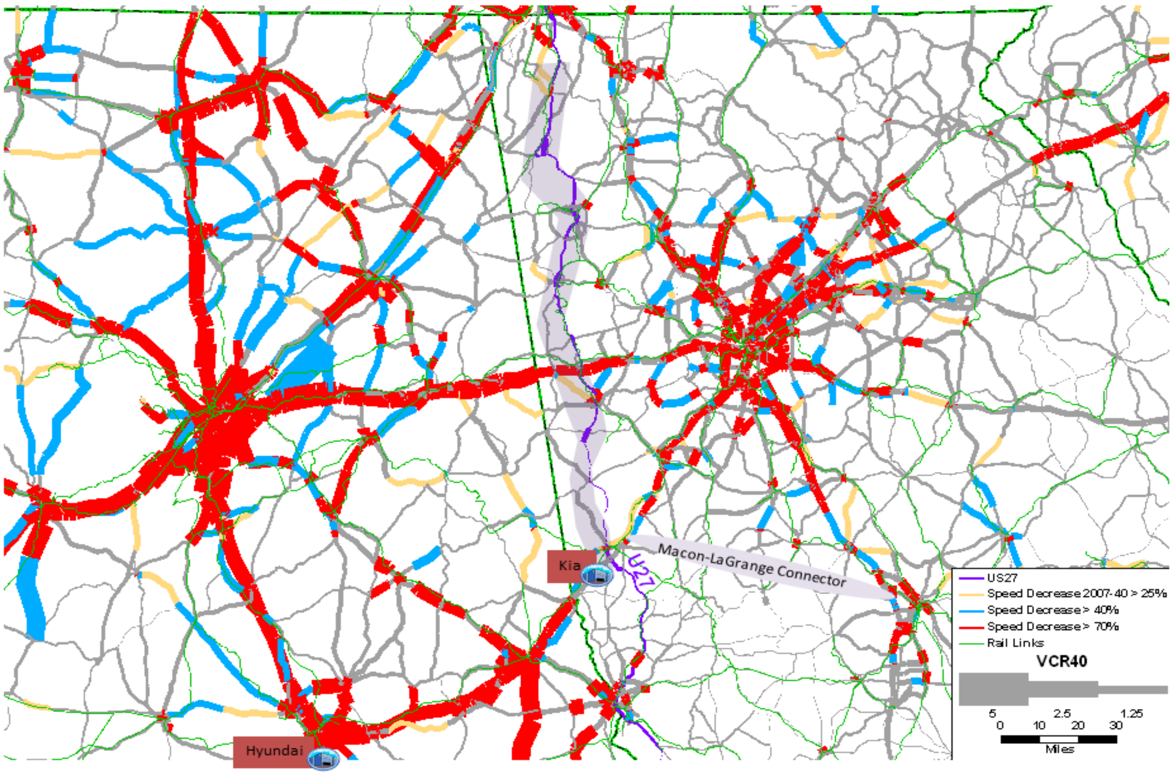
[7] Cambridge Systematics Inc. (2007) National Rail Freight Infrastructure Capacity and Investment Study. Chapter 5: Capacity and Performance Analysis. Report to the American Association of Railroads. September, 2007.

[8] FAF3 Freight Traffic Analysis (2011) Report to Oak Ridge National Laboratory by Battelle, Columbus, OH. http://faf.ornl.gov/fafweb/Data/Freight_Traffic_Analysis/index.htm

[9] Pierce, D. and Murray, D. (2014) Costs of congestion to the trucking industry American Transportation Research Institute, Arlington, VA. http://atri-online.org/

links indicate a greater than 40% reduction, and the red links a decrease of more than 70% in link speeds over the same period.

Figure 4.1 Regional Highway Congestion Forecast for 2040*



* Data source: See footnote 8.

Recognizing the traffic growth potential of the region, the Georgia DOT's Freight and Logistics Plan for 2010-50 (GDOT, 2013)[10] analyzed a number of potential network upgrades. These include upgrading both the north-south U.S 27 corridor and east-west Macon-Lagrange Bypass. Both of these corridors are shown in Figure 4.1, and each would offer additional capacity to the highway network in the vicinity of the Kia Motors plant. Figure 4.2 shows the full national picture of this 2040 traffic forecast, highlighting the fact that the south-eastern states including Alabama, Florida, Georgia, Tennessee, and the Carolinas are expected to see a good deal of traffic congestion, comparable to similar slow-downs in between as well as within metropolitan area traffic flows in the north-east, mid-west, Texas, and southern California.

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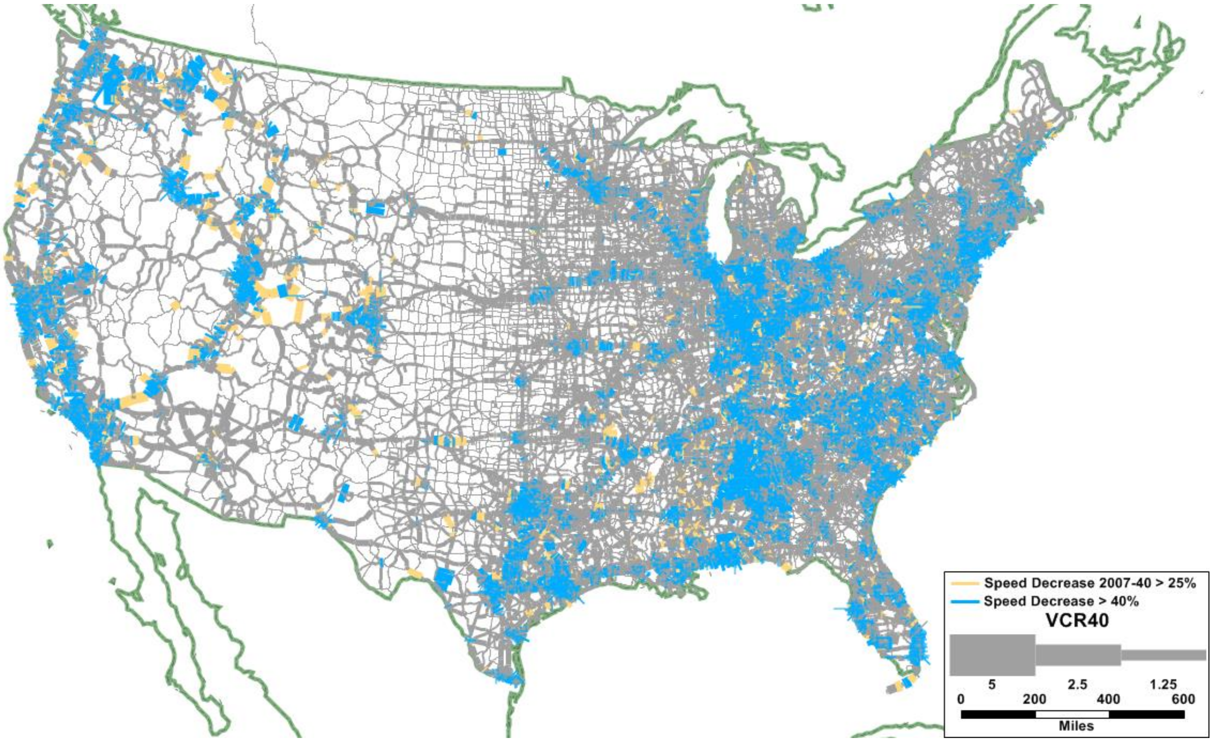
[10] *Georgia Statewide Freight and Logistics Action Plan.* Georgia DOT. http://www.dot.ga.gov/Projects/programs/georgiafreight/Pages/default.aspx

Figure 4.2 National Highway Congestion Forecast for 2040*



* Data source: See footnote 8.

Rail Congestion

Similar to the nation's major highways, significant traffic congestion is also expected on many mainline railroads by 2035, failing significant investment in network carrying capacities.[11] With only 5% of its Class 1 rail mileage double tracked, and both weight restrictions and bridge clearance issues associated with some shortlines, bottlenecks are already beginning to impact railroad delivery times within Georgia.[12] Both Georgia's Rail Plan[13] and its more recent Freight and Logistics Plan for 2010-50 recognize this network investment challenge. One potentially positive step forward here is the December 2011 opening of the Cordele Intermodal Center, which might help to link the Kia Motors plant and places to the West to the Port of Savannah's Garden City terminal via CSXT and the Heart of Georgia (HOG) and Georgia Central (GC)

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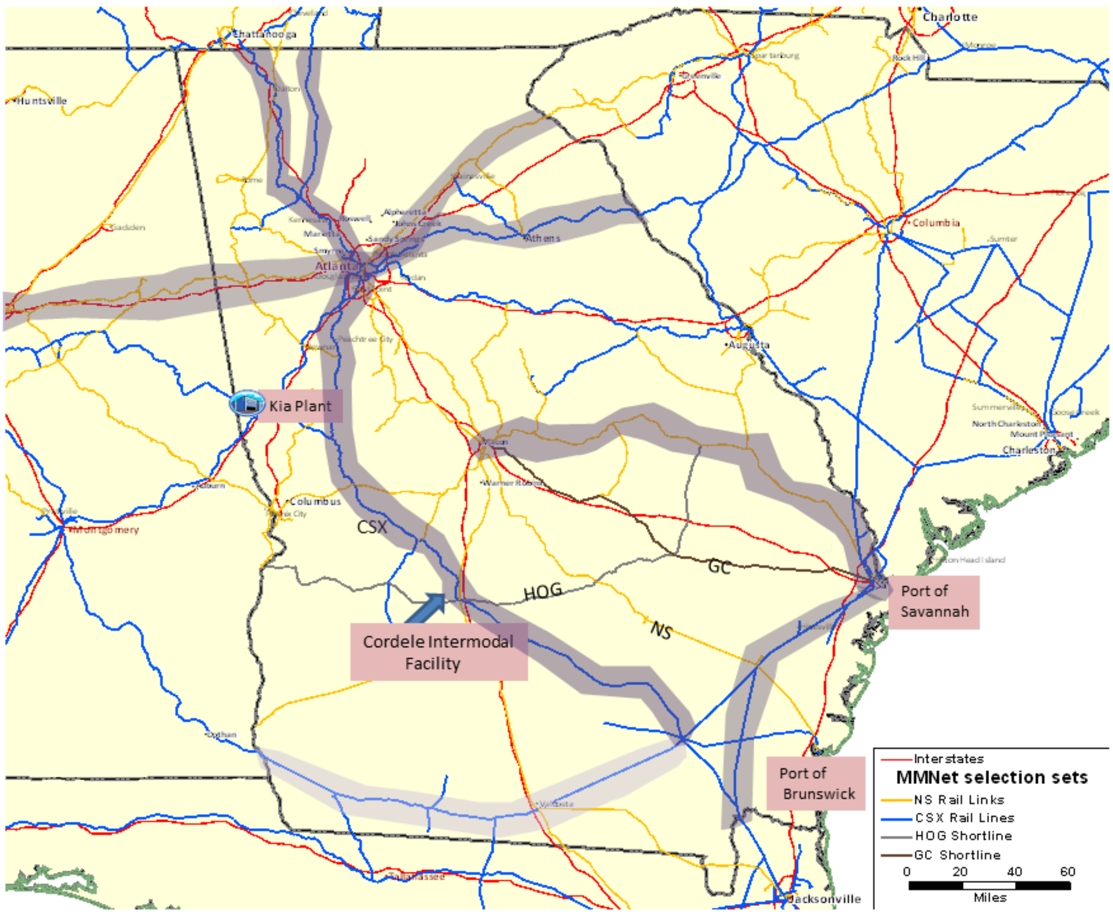
[11] See FHWA's on-line *Freight Story 2008* report and associated national rail network forecast maps at http://ops.fhwa.dot.gov/freight/freight_analysis/freight_story/congestion.htm#railroad (based on reference in footnote 6 above)

[12] See footnote 10.

[13] See Footnote 10, as well as Georgia DOT (2009) *State Rail Plan.* http://www.dot.ga.gov/travelingingeorgia/rail/Pages/StateRailPlan.aspx

shortline railroads. Figure 4.3 shows the State's major rail lines, the location of this Cordele intermodal facility, and the State's two seaports with respect to the Kia plant. Also highlighted (in grey) are the rail corridors classified by GDOT's Statewide Freight and Logistics Plan as already experiencing bottleneck conditions: with "significant growth" in rail traffic expected along all but one of these rail lines.

Figure 4.3 Major Rail Lines and Current Congestion Levels in Georgia*



* Data source: See footnote 7.

Seaport Congestion

A key question for Georgia and the rest of the east coast states with major seaports is how cost-competitive the impending opening of the newly expanded Panama Canal channel will be.[14] From a geographic perspective, the Port of Savannah seems to be well placed to benefit from the

[14] MARAD (2013) The Panama Expansion Study. Phase 1 Report. Developments in Trade and National and Global Economies. Maritime Administration, US Department of Transportation, Washington, D.C.

‘Canal’s expanded capacity and the economies of scale it will offer to much larger capacity “Post-Panamax” container ships[15], once the port’s scheduled harbor deepening is completed. Competition with current land-bridge traffic, using the southern Californian San Pedro Bay ports of Los Angeles and Long Beach to drop off cargo that is shipped by rail or truck to south-eastern states, is anticipated: trading off improved vessel economies of scale and intermodal transfer cost savings against the additional ocean miles required per voyage. And still further competition for cargos may also come from the introduction of even larger trans-Atlantic container vessels with the ability carry more than 13,000 TEU’s on board, taking advantage of the soon to be operational and much wider Suez Canal (see Section 4.3.3 below).

4.2.2 Quantifying the Monetary Costs of Freight Network Congestion

As noted by a number of authors (see the review by Gong et al, 2012),[16] putting a monetary value on the cost of delay due to disruptions to the movement of goods is a conceptual as well as technical challenge. In particular, it depends on the importance of on-time deliveries to the customer in question, especially where that customer is going to be using the goods delivered to produce its own products (such as finished automobiles), and upon just how much JIT operations are a key feature of the production process. Based on both a literature review and their own interviews with manufacturing and wholesale sector shippers and, most notably, with receivers of goods in Texas and Wisconsin, Gong et al (2010)[17] found that traffic congestion and associated late product delivery resulted in the following, firm-level operational impacts:

- Additional fuel, oil, and truck operating costs.
- Extra in-transit inventory holding costs.
- A large volume of on-site safety stock and high inventory holding costs.
- Interrupted work flows at unloading bays.
- A disturbed production schedule and lower productivity.
- Dissatisfied customers and potential lost sales.
- Potential loss of the opportunity to consolidate multiple outbound shipments.

[15] Vessels transporting from 5,001 – 13,000 container TEUs.
[16] Gong et al (2012) Assessing public benefits and costs of freight transportation projects: measuring shippers’ value of delay on the freight system. UTCM Project 11-00-65.CFIRE Project 04-14 Texas Transportation Institute, College Station, Texas.
[17] Gong, Q. et al (2012) ibid.

- Lost business markets and reduced agglomeration economies.

Of these cost elements, until quite recently, only those costs listed in the first three bullets have usually found their way into public agency transportation planning studies: with an emphasis on the over the road vehicle operating costs in the first bullet. And also as a result of this partial coverage, the most reliable statistical data comes from a survey of freight carriers, such as the trucker surveys by the American Transportation Research Institute (ATRI: see Section 4.4.1) and the railroads' reporting to the Surface Transportation Board (STB: section 4.4.2). That is, shippers, and especially receivers of goods are rarely surveyed in a way that leads to robust statistical estimation. Until very recently, most state-based long range transportation planning and infrastructure investment studies also paid limited attention to the cargo handling and storage costs associated with on-site activities at either end of freight deliveries or during en-route terminal based transfers of freight between two different modes. This situation has begun to change, moving studies of benefits versus costs of such public investments to consider what is often now referred to as the total logistics costs of managing (e.g. scheduling), handling, moving, and storing of goods.

Efficiencies on total logistics costs matter a good deal to US manufacturing industry. According to the Council of Supply Chain Management Professionals 23rd Annual State of Logistics Report annual report (CSCMP, 2013), these costs accounted for 8.5% of US Gross Domestic Product (GDP) by value in 2011 (of which 5.4% comes from 'transportation" or moving the goods between places). Significantly, this is down from 10.1% in 2000 and 16.2% of GDP in 1981: showing both the importance of and potential for monetary gains from more effective logistics. A major future barrier to such continued cost savings will be increased levels of network (including over-the- road /rail/ waterway as well as within-terminal) traffic congestion. A 2005 study by Macrosys Research and Technology[18] for FHWA's Freight Management and Operations Office, made use of Council of Supply Chain Management Professionals (CSCMP) other datasets to estimate an approximate economy-wide, all modes breakdown of total business logistics costs into 63% transportation, 43% inventory carrying, and

[18] Macrosys (2005) Logistics Costs and U.S. Gross Domestic Product. Report to the Federal Highway Administration, Washington, D.C.
http://ops.fhwa.dot.gov/FREIGHT/freight_analysis/econ_methods/lcdp_rep/index.htm#Toc112735360

4% administrative logistics costs: with these inventory-carrying costs broken down further into taxes, depreciation, insurance and obsolescence (63%), warehousing (26%) and interest (8%).
It remains a challenge to bring these various freight logistics costs into benefit-cost calculations that can in turn inform transportation system investment decisions at the public agency level. A few studies have begun to shed light on this process, however. In NCHRP Report 436, Weisbrod, Vary and Treyz (2001)[19] have extended traditional analysis of congestion costs (i.e. extra travel time and vehicle operating costs) to include additional productivity costs associated with travel time variability, worker time availability, freight inventory and logistics/scheduling, just-in-time production processes, and economies of market access: while noting the lack of prior freight costing studies at that time, but seeing a growing concern for congestion's effect on, in particular, JIT business practices.

A more recent survey of businesses in Portland, OR (EDR, 2005[20]) identified the following direct business costs associated with congestion-induced delays:

- costs for additional drivers and trucks due to longer travel times;
- costly "rescue drivers" to avoid missed deliveries due to unexpected delays
- loss of productivity due to missed deliveries;
- shift changes to allow earlier production cut off;
- reduced market areas;
- increased inventories; and
- costs for additional crews and decentralized operations to serve the same market area.
- reduced access to specialized labor and materials.

Drawing on information from their own business interviews as well as prior studies, Weisbrod and Fitzroy (2011) describe 26 different elements of business impact and response to traffic congestion growth, grouped into the following seven broad classes, in their effort to understand the economic consequences that "can only be addressed through more detailed micro-level analysis of business processes and business decision-making": market and fleet size

[19] Weisbrod, G., Vary, D. and Treyz, G. (2001) Economic Implications of Congestion. *NCHRP 436*. Transportation Research Board, Washington, D.C.
[20] EDR (2005) *The Cost of Congestion to the Economy of the Portland Region*. Economic Development Research Group . Portland, Oregon.

impacts, business and delivery schedules, inventory management, use of intermodal connections, worker travel, business relocation, and localized interactions with other activities.

Based on these and other studies, Figure 4.4 summarizes the principal reported impacts of traffic congestion-induced delays on business costs. For the purposes of further analysis, and eventual model development, these costs are grouped into three classes according to the speed with which they typically manifest themselves. Both congestion-induced en route travel time delays and arrival time variability are listed as causal factors in increasing freight movement costs. Arrival time variability here implies less reliable on-time service, raising an important measurement issue discussed further in Section 4.3 below. Note that the freight cost modeling efforts of interest to this current research effort fall under “Immediate Impacts” and “Short Term Impacts”, as they apply to an existing manufacturing plant and its current parts supplier and finished goods distribution center (e.g. autorack rail-to-truck transfer terminal) locations.

All of the impacts shown in Figure 4.4 can lead to higher per unit (e.g. per finished vehicle) production costs, which if sufficiently damaging may in turn lead to reduced sales with an eventual effect on reduced economies of production, and hence potentially higher transportation and logistics costs. Finally, changes in production costs, may at some point lead ton changes in the volumes and types of vehicle makes and models offered. Conversely, speedier and more reliable transportation service supports the opposite effects, leading to potentially less costly finished vehicles, lower (and hence more competitive) finished product costs, and increases in vehicle-demand induced production.

4.3 Product Flows in the Automotive Industry Supply Chain

4.3.1 Supply Chain Overview

This section focuses on identifying the commodity specific components of the case study industry’s supply chain, including the movement of commodities both into and out of the manufacturing plant, from parts sourcing to finished product (i.e. automobile) delivery. Figure 4.5 lists the principal products required to construct today’s automobiles, organized into six broad component categories. Automobiles are complex machines requiring a wide variety of pre-manufactured parts, from nuts and bolts to sophisticated electronic devices that have their own assembly issues. In this research, the focus is placed on the movement of parts from what are commonly termed “Tier 1” suppliers: those companies that deliver their finished products directly to the original equipment manufacturer, or OEM (in our case study, to the Kia Motors plant in West Point, Georgia).

Figure 4.4 Business Costs of Traffic Congestion

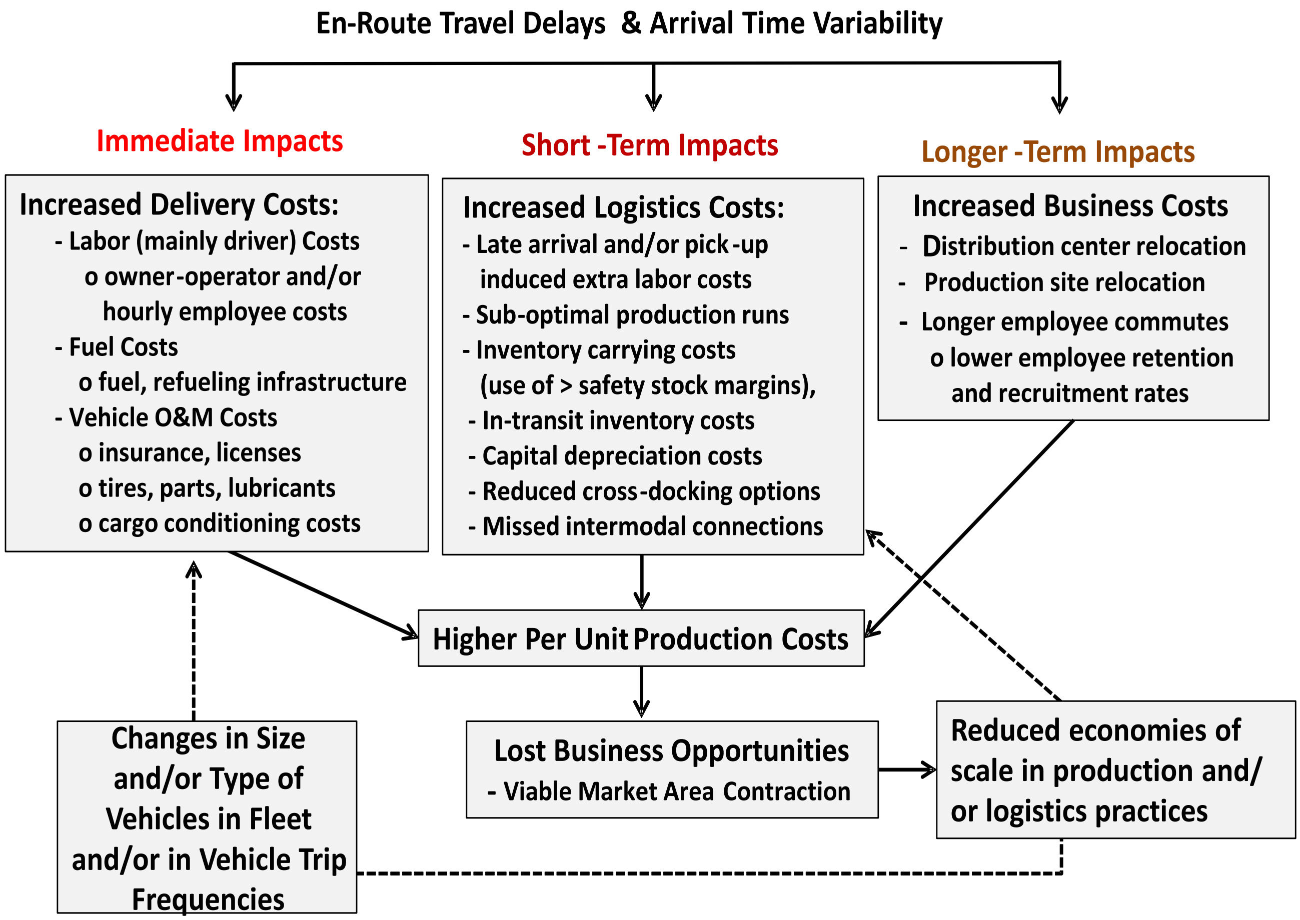


Figure 4.6 shows the major generic freight delivery steps associated with supplying these components. The present research looked at the connections between the activities in the colored boxes, that is, at Tier 1 supplier to OEM and OEM to retail dealer steps. An effort was made to find out what types, volumes, transport modes and shipment distances are involved in moving these various automobile parts, as well how finished automobiles are moved from the OEM to auto dealerships both within and outside the south-eastern region. The transport of replacement parts and the fate of used vehicles and parts were not pursued in this present research effort.

Figure 4.5 Principal Components of Automobile Manufacturing Supply Chains

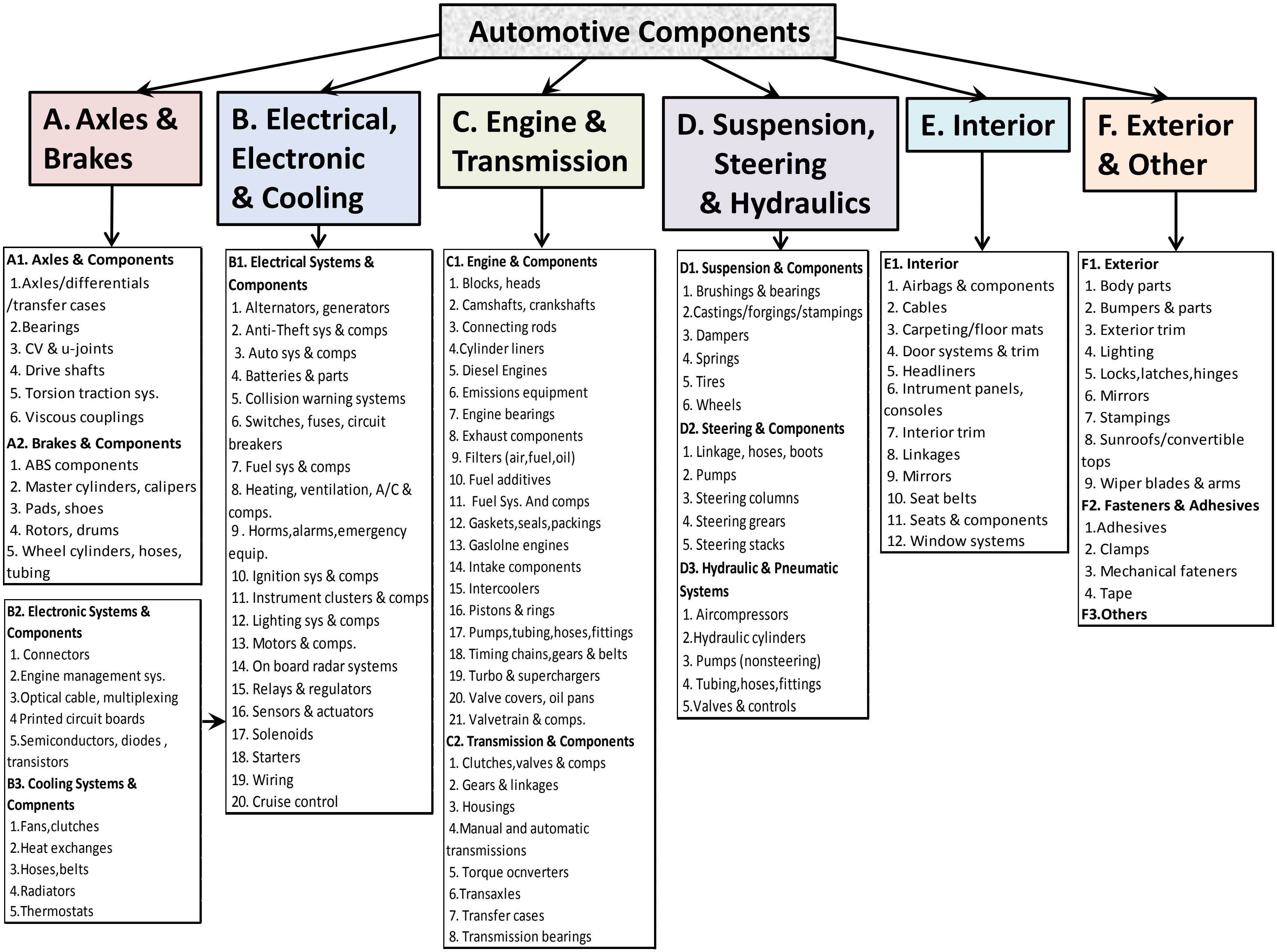
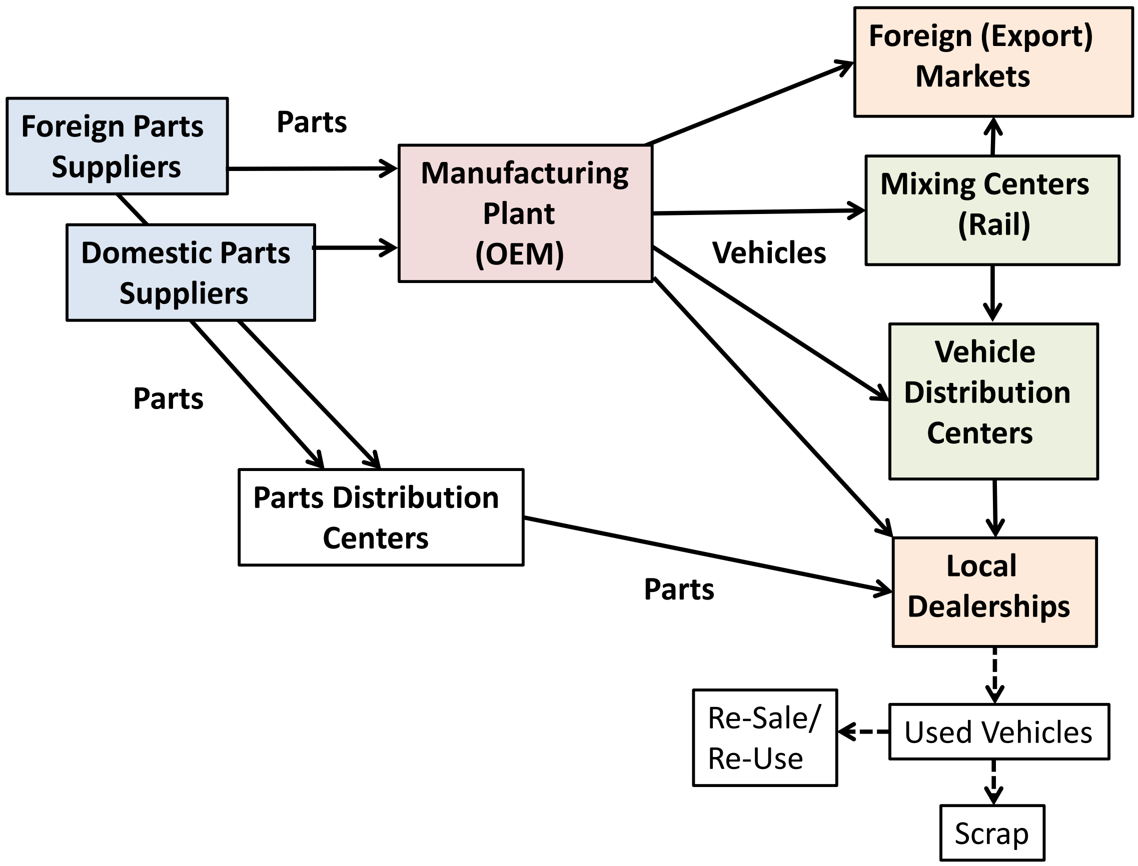


Figure 4.6 Transportation Links in an Automotive Industry Supply Chain (Generic)



4.3.2 Local and Regional Components Suppliers and Their Shipments

Many components are delivered to the KMMG plant from local and US based suppliers. These local area suppliers have in this instance come into being for the purposes of supplying parts to the KMMG plant (cf. Table 1.1 above). Unfortunately, much of the information on exactly what and how many parts are supplied to the KMMG plant is private and we do not have any database that tracks these flows. **Table A.1** in Appendix A contains a list of these 117 component suppliers of KMMG West Point assembly plant (25 in Georgia, 92 in Alabama) with company names, supplying components and location information, based on combining data from a number of different sources (see notes below table). Figure 4.7 shows the result of translating these addresses into longitudes/latitudes for mapping and highway trip routing purposes, showing the locations of auto parts suppliers in Georgia and Alabama along with the locations of the Kia and Hyundai auto plants. (A version of this file containing the locations of suppliers outside Georgia and Alabama was also created, based on the locations of suppliers in the foreign imports dataset).

Figure 4.7 Map of Georgia and Alabama Automotive Parts (Component) Supplier Locations

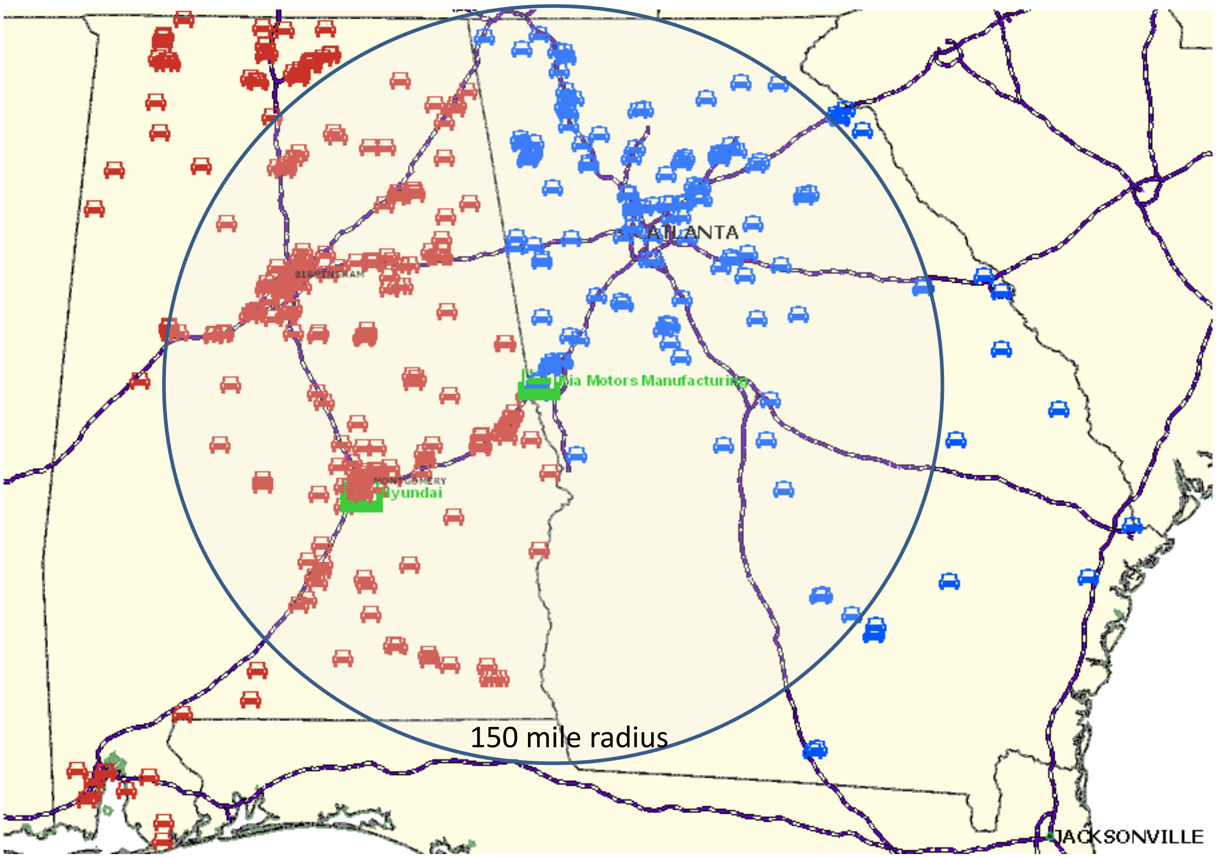


Table 4.1 lists the data elements in the geo-coded supplier locations database.

Table 4.1 Automobile Parts (Component) Supplier Locations Data File

ID	Record ID #
Long	Longitude
Lat	Latitude
Hnode	Highway Node #
SIC	Standard Industrial Classification Code (4-digit)
Emp	Number of Employees
Tier	Placeholder (only used to identify OEM locations currently)
Zip	5-digit-zip code
County	US County Name
Product Class	SIC Description
Firm	Company Name
Address	Company Address
OEM	OEM served, if known
Fnode	Other Network Node (NOT CURENTLY USED)
State	2-Digit State Abbreviation in US
City	City Name

4.3.3 Foreign Supplier Shipments – US Imports Data

Kia being part of Hyundai, and a major multinational company, has deep ties to component suppliers from the Asia-Pacific region. Using US customs related databases, we are able to track these shipments. A number of commercial data sources provide data on the foreign imports of vehicle parts. Upon review, the Panjiva (2013)[21] dataset was selected for project use. Shipment data from Panjiva.com are used to analyze the origin and destination port of the shipments coming to the KMMG plant. By searching final destination of Kia Georgia plant, we found 4,253 shipment records in Panjiva for the period 7/7/2008 to 4/25/2013. Each shipment record also contains the type, weight and number of items of commodity shipped, the name and location of the shipper, as well as the foreign port of lading (loading), the US domestic port of unlading, and the final US port of destination. To allow mapping, each of these locations was geo-coded and the results combined to produce the data elements shown in Table 4.2.

In the aggregate, Figure 4.8 shows the growth in imports at each unlading port as a percentage of each year's contribution to that port's total mid-2008 through 2012 import totals, based on both annual number of shipments and annual tonnage shipped. The results are shown for the dominant US ports of unlading, i.e. for Savannah, GA and a combined total for the San Pedro Bay ports of Los Angeles and Long Beach, CA; and also (the green bars) for all US ports of lading in the dataset. The final destination of all shipments is the Kia auto plant.

Between them, Savannah and Los Angeles/Long Beach accounted for some 98% of all imports during this start-up period, with Savannah accounting for over 60% by tonnage and 50% by number of individually reported shipments (of various sizes and counts). What Figure 4.8 shows is the increased activity levels through Savannah post-2010, when the port is estimated to have accounted for 66% of all imported parts by tonnage (estimated at some 186,000 metric tons from July 2008 through April 2013) and over 55% (over 2,000 bills of lading) by shipment count. Much smaller volumes also entered the US over this four and a half year period including shipments via the ports of Mobile AL, Charleston SC, Jacksonville and Port Everglades FL, New York NY and New Jersey NJ, and Seattle and Tacoma, WA. Most of these imports come from South Korea, via the port of Busan (aka Pusan), with over 82% of shipments by count and over 92% of shipments by weight associated with this foreign port of lading. Other ports of lading include 8 ports in China (including Hong Kong), 3 each in Japan and Panama, 2 each in Germany and Vietnam, and one in France, Guatemala,

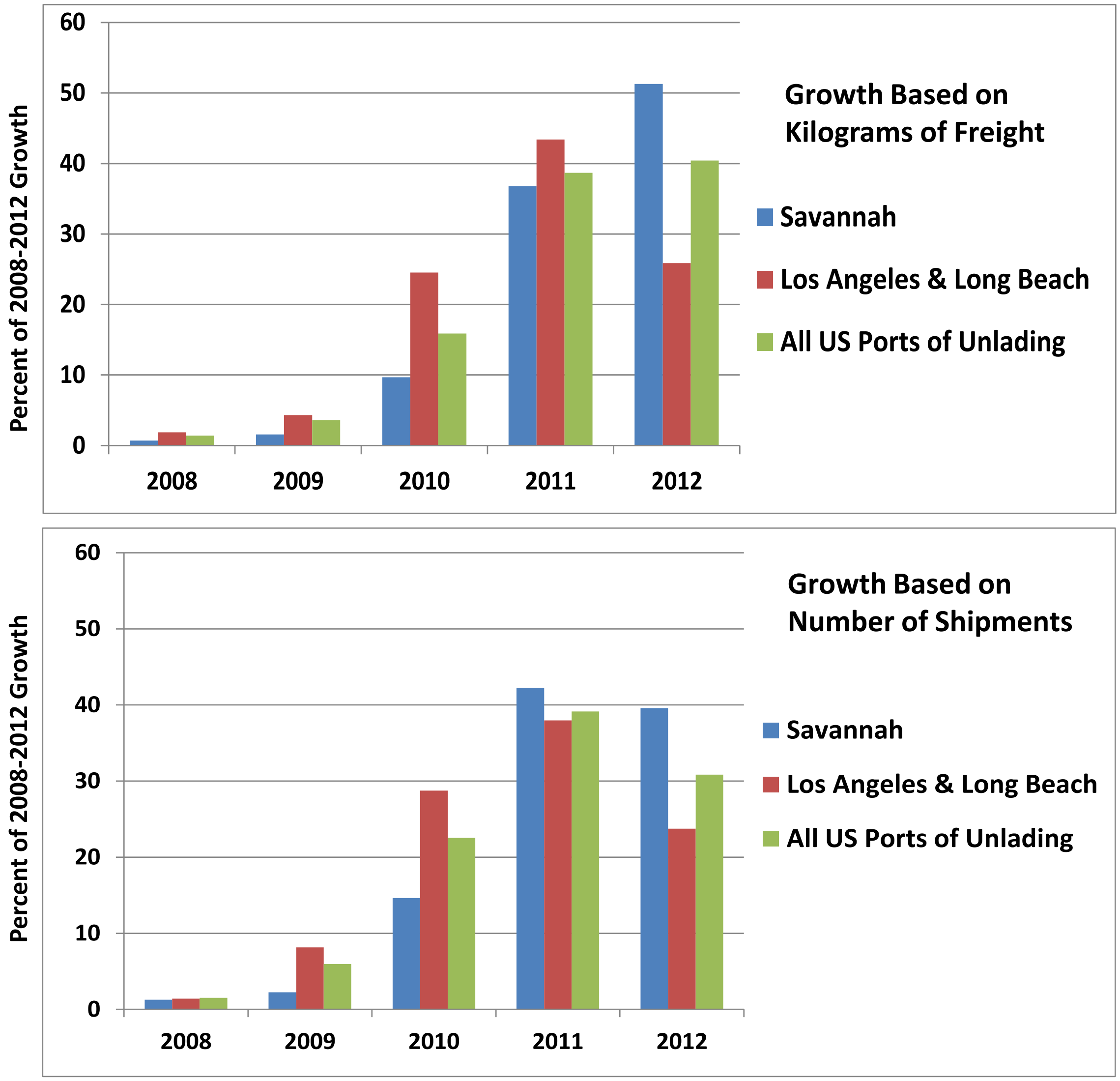
[21] Panjiva (2013) *Investigate Companies, Shipments, and Trade Trends* http://panjiva.com/

Jamaica, Malaysia, the Netherlands, Singapore, South Korea and Taiwan during the start-up period (see Figure 4.9).

Table 4.2 Geocoded Foreign Import Shipments Data File

ID	Record ID #	Analyst Computed
O	Origin (O) Port of Lading Highway Node	Analyst Computed
D	Final Destination (D) Highway Node	Analyst Computed
NP	Number of Long/Lat Points (=4)	Analyst Computed
Long1	Longitude of Shipment Origination City	Analyst Computed
Lat1	Latitude of Shipment Origiantion City	Analyst Computed
Long2	Longitude of Sforeign Port of Lading	Analyst Computed
Lat2	Latittude of Foreign Port of Lading	Analyst Computed
Long3	Longitude of US Port of Unlading	Analyst Computed
Lat3	Latitude oi US Port of Unlading	Analyst Computed
Long4	Longitude of Final Shipment Destination (OEM)	Analyst Computed
Lat4	Latitude of Final Shipment Destiantion (OEM)	Analyst Computed
Dist1	Estimated distance to Foreign Port of Lading (Miles)	Analyst Computed
Seadist	Estimated Seaborne Shipment Distance	Analyst Computed
LandDist	Estimated within US Land Shipment Distance	Analyst Computed
	(US Port of Unlading to OEM)	Analyst Computed
TotMiles	Estimated Land + Sea Miles from Shipment O to Shipment D	Analyst Computed
SeaMTon-MI	Metric Tons Shipped x Sea Miles	Analyst Computed
LandMTon-MI	Metric Tons Shipped x Sea Miles	Analyst Computed
TOTMTon-MI	Total Metric Ton-Miles Shipped	Analyst Computed
Supplier	Name of Supplier (NOT USED)	Original Data Item
Country of Origin	Country of Origin	Original Data Item
Place of Receipt	Foreign City (May Differ from Country of Origin)	Original Data Item
Foreign Port of Lading	Usually the Start of Seaborne Shipment Leg (not always)	Original Data Item
US Port of Unlading	End of Seaborne Shipment Leg	Original Data Item
US Destination Port	US Destination Port (may be Atlanta)	Original Data Item
Voyage Number	NOT USED except to esnure correct record ID	Original Data Item
Bill of Lading Number	NOT USED	Original Data Item
Shipper Name	NOT USED	Original Data Item
Consignee Name	NOT USED (mostly the OEM)	Original Data Item
Date (Day/Month/Yr)	When Shipped	Original Data Item
Year	2008 (partial), 2009-2012, 2013 (partial)	Original Data Item
Weight	NOT USED	Original Data Item
Weight Unit	LB, KG	Original Data Item
Weight in KG	Weight in Kilograms	Original Data Item
Quantity	# of units	Original Data Item
Quantity Unit	Package, Case, Box,...	Original Data Item
Measure	NOT USED	Original Data Item
Measure Unit	NOT USED	Original Data Item
Piececount	NOT USED	Original Data Item
Commodity	Detailed Description of Commodity Shipped	Original Data Item

Figure 4.8 Rate of Growth in Imported Auto Parts from 2008-2012 by Selected US Ports of Unlading

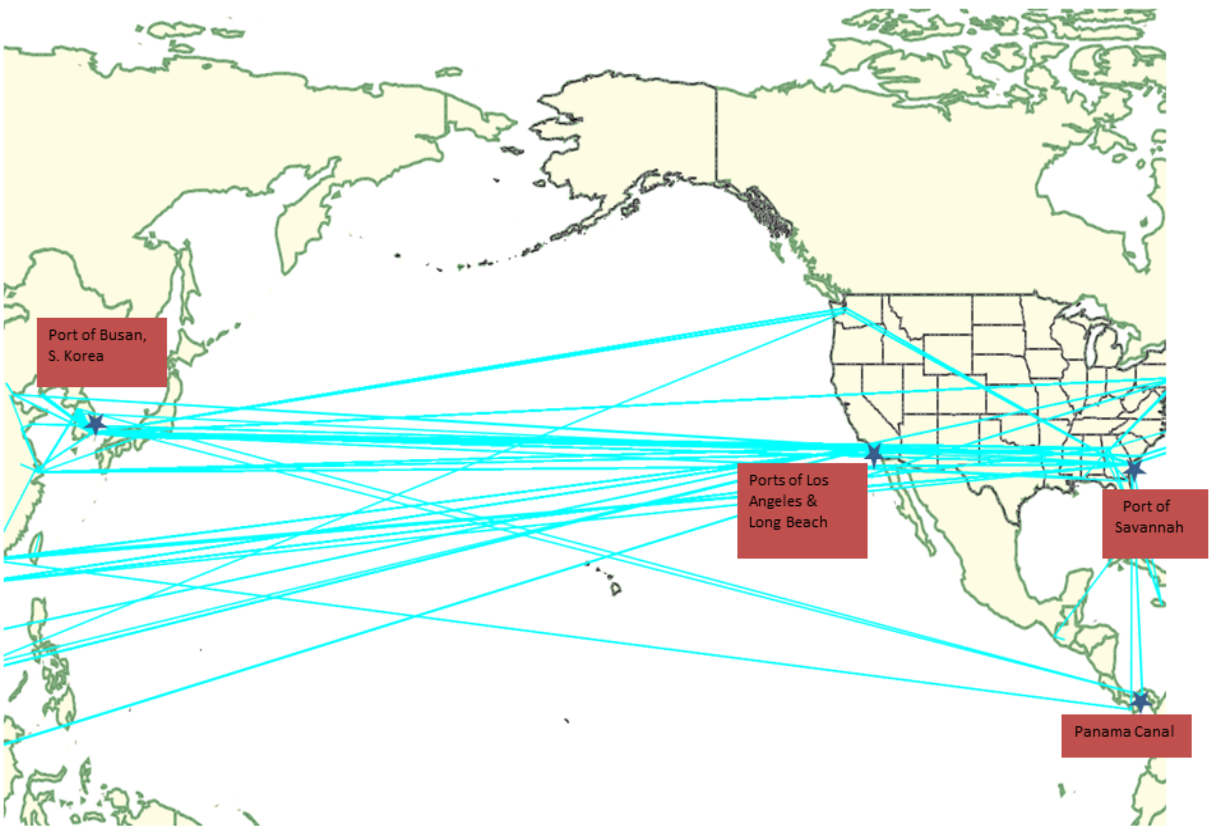


A major gap in the data on freight movements of all kinds within the United States is our limited knowledge of how US imports move inland, once they have been delivered at a US seaport. Perhaps surprisingly, given the considerable and growing importance of foreign imports into the United States, no government data source or combination of available sources exists from which to extract this modal information.[22] While all auto parts currently arrive at the plant by truck, an unknown percentage of the foreign and longer distance within-US cargos may travel overland by rail.

[22] Detailed railcar waybills data could tell us a good deal about how much non-container freight moved from ports such as Savannah and Los Angeles/Long Beach to intermodal terminals in close proximity to the Kia Motors plant: but this data was not available to the present study. Containerized data is more difficult to track, while offloading at intermodal truck-rail terminals designed for the purpose. Even the federal government's Freight Analysis Framework (FAF) database must estimate these modal percentages.

Railroad-operated on-line search sites such as CSXT's ShipCSX [23] and Norfolk Southern (NS) Railroad's Intermodal [24] services sites provide details of intermodal container train schedules originating or terminating in close proximity to the Kia Motors plant: notably the Fairburn CSX intermodal truck-rail terminal a few miles north-east of the Kia Motors plant along I-85 in Fulton County, Atlanta (CSXT also operates the Hulsey intermodal container terminal within Atlanta); and the NS-operated Austell intermodal terminal in Cobb County in north-west Atlanta.

Figure 4.9 Example Trans-Pacific Parts Shipment Routes.



4.3.4 Transportation of Finished Automobiles (to Customers/Dealerships)

Production and sales data can be obtained from the KIA Motors website, www.kmcir.com. On the website, Kia gives detailed monthly production by model and sales by country statistics of all of its factories around the world. The KMMG data were available starting January, 2010.

[23] http://shipcsx.com/public/ec.shipcsxpublic/Main?module=public.ischedule

[24] http://www.nscorp.com/content/nscorp/en/ship-with-norfolk-southern/shipping-options/intermodal/terminals-and-schedules.html

Kia's annual production and sales, and by model type data are presented in **Table 4.3** and T**able 4.4**, respectively. The KMMG plant began operations with two shifts and about 250,000 vehicles per year. With increase in market demand, especially for Kia Optima, they increased to three shifts and reached the designed maximum capacity of 360,000 vehicles per year. From the sales data, we can see that most of the sales are for the US market with some Kia Sorento being sold in Canada, and a few Kia Optima and Sorento being sold in Latin America.

Table 4.3 KMMG Production Statistics

	2010	2011	2012	2013	2014(Jan.-Apr.)
Optima/K5		35,132	128,536	133,946	49,703
Sorento	138,071	146,017	131,572	129,590	44,687
Kia Total	**138,071**	**181,149**	**260,108**	**263,536**	**94,390**
Santa Fe	29,051	91,155	98,091	105,969	35,885
Total	167,122	272,304	358,199	369,505	130,275

Notes: Data are from KIA Motors.

Table 4.4 KMMG Sales Statistics

		2010	2011	2012	2013	2014(Jan.-Apr.)
Optima/K5	US		21,505	126,797	124,598	42,945
	Latin America		225	344	340	88
Sorento	US	108,202	130,235	119,597	105,649	31,542
	Canada	10,207	15,105	14,031	14,542	3,845
	Latin America	710	1,194	1,512	1,295	241
Total		**119,119**	**168,264**	**262,281**	**246,424**	**78,661**

Notes: Data from KIA Motors.

In addition to a discussion with Kia staff, a number of sources were searched in order to both understand and quantify to some degree the level of transportation activity involved in getting finished vehicles from the KIA manufacturing plant to its dealers. While local, including some quite long intra-regional transport of finished cars takes place over the highway (an essential mode for short term order fulfillment), between 40% and 60% of the vehicles Kia produces are now transported from the plant to other parts of the US and Canada by rail. Kia opened its railcar loading facility early 2010 with an initial 36 railcar capacity, which has since been expanded to handle some 90 multi-level autorack railcars[25], with plans for further expansion from an initial 80-railcar to 400- railcar

[25] Bi-level autorack railcars may carry up to 15 vehicles, while some of the largest autoracks in use may carry as many as 20 or 22 vehicles. For example (only), at 60 carloads x 15 vehicles per car x 250 weekdays per year would = 225,000 vehicles shipped per year.

holding capacity.[26] By 2014, it is estimated that up to 60 railcars per day will leave the West Point plant for delivery to Kia dealerships.

CSX Transportation provided the project with some general information on its railcar-loadings with agreement not to report specific volumes. The data show deliveries to Canada, the Mid-Atlantic, Midwest, North-Eastern, South-Western and West Coast states, and smaller but still significant shipment volumes to the Pacific North West and Mountain West regions of the country. In contrast, South-Eastern states are served largely by truck. Trains heading West need to interline with western- serving railroads at locations such as Birmingham, Memphis, Chicago and Toledo. Kia's westbound vehicles are shipped using a combination of CSX and BNSF Railway, and CSX and Union Pacific Railroad. An on-line 2010 news article in Automotive Supply Chain reported finished vehicles from Kia's West Point manufacturing plant moving on bi-level railcars, each holding ten vehicles, for a total loading capacity at a single time of 1,500 vehicles.[27] Some 1,100 spaces were also reported to be available (in 2010) for plant-side truck pickups, using 10-car auto-transporters to distribute Kia vehicles around the south-east.[28] Both truck and rail options are considered for delivering vehicles to locations in the states of Maryland, West Virginia, Ohio, Indiana, Illinois, Missouri, Kansas, and New Mexico. This same article also reported these railcars being loaded either the same day or the day after the vehicles' release from the plant, with loaded railcars prepared several times a day for CSX nighttime pickups. Information technology is then applied to let truckers at the other end of a rail haul know when the railcars are due to arrive at their rail destination (i.e. offloading) ramps.

The location of CSX Corporation (via its Total Distribution Services Inc. subsidiary) automobile-_distribution facilities and storage locations, overlaid on a mapping of the CSX rail network can be found on-line at:

http://www.csx.com/index.cfm/customers/other-services-partners/tdsi/mapslocations/

Kia Car Dealership locations (addresses) can be found on-line at:

http://find.mapmuse.com/brand/hyundai-dealers (with on-line mapping) and

http://www.edmunds.com/dealerships/Kia/

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[26] http://www.transdevelopment.com/?p=243#

[27] http://www.automotivesupplychain.org/features/3/71/news/

[28] Up to 10 vehicles may be carried at one time, and it was reported that some carriers may also be moving Hyundai produced vehicles from the Montgomery, Alabama plant if this is a cost-effective use of the trucker's resource, with Kia (via its Glovis America logistics provider) paying for transport on a per-vehicle basis.

4.4 Estimation of Modal and Intermodal Transportation Costs

Freight rates are shipment distance and travel time sensitive, and require a sufficiently detailed and accurate source of such data for each of the transportation modes used within both automobile component and finished product links in the supply chain. While published freight rates exist and quotes are often accessible on-line, statistically reliable rate data is in general either hard to come by or expensive to purchase. And for forecasting purposes, it is also important to understand the elements of cost that go into creating such rates, both now and in the future. With this in mind, and given the project's ultimate interest in generating data for use in public sector planning, it was decided to assess the ability of current data sources to produce estimates of such shipment cost elements directly. The focus in the present case study is therefore on estimating truck, rail, and ocean-vessel transportation costs (air freight was not considered due to its comparatively limited current use, based on information obtained during OEM interview).

The following paragraphs summarize the latest literature on freight cost estimation methods, taking one mode at a time. Section 4.5 then describes how these various mode specific cost formulas can be used, along with a method for estimating shipment distances and associated origin-to-destination travel times, in order to compute dollar based fuel, labor, and other per hour or per mile vehicle or vessel operating, maintenance and cargo handling costs: including the cargo handling costs associated with inter-modal transfers.

4.4.1 Trucking (Highway) Costs

A recent TRB –sponsored review of the needs for and availability of specific freight cost data elements for public agency decision-making concluded (Holguin-Veras et al, 2013, page 56):[29]

"*In the trucking sector, a large assortment of data sources provide bits and pieces of data of various degrees of usefulness and quality, but fail to provide a comprehensive and coherent picture*."

Elements of Trucking Costs

A number of truck operating cost models and supporting software tools have been developed in recent years, usually with a bias towards a specific trucking sector or industrial sector operations. Among the more adaptable models are those by Berwick and Farooq's (2003) Truck Load Analysis

[29] Holguín-Veras, J. et al (2013) Freight Data Cost Elements. NCFRP Report 22. Transportation Research Board, Washington, D.C.

Model software[30], the Owner-Operator Independent Drivers Association's (OOIDA's) per mile truck cost of operation calculator[31], and the cost formulas developed by Hussein and Petering (2009)[32] who also provide a useful review of some past studies. The American Transportation Research Institute (ATRI)[33] also puts out an annual update of truck operating costs, based on survey responses from operators of over 40,000 truckload, less-than-truckload and specialized service trucks. Marginal expenses for motor carriers were divided into vehicle- and driver-based costs. These costs include average costs estimates for each of the following items:

Vehicle-based costs:

- Fuel and engine oil
- Truck/trailer lease or purchase payments
- Repair and maintenance
- Truck insurance premiums
- Tires
- Permits
- Tolls

Driver-based costs:

- Wages
- Benefits

Hussein and Petering (2009)[34] use a similar set of cost elements, which they term respectively fuel, labor, depreciation (straight-line depreciation less capital recovery), maintenance, loading and unloading, insurance (of both truck and cargo), overhead (including management and administration staff, property taxes, utilities, advertising, communication equipment, rental of facilities, insurance of facilities, etc)., and extra (highway user and licensing fees and additional costs for transporting hazardous cargo). They provide detailed formulas for each of these cost elements. Also of note, one of their numerical examples is the computation of an auto parts shipment.

What this literature makes clear is the considerable number of variables that can affect trucking costs for any given trip or shipment distance. And some of these variables have a

[30] Berwick, M., & Farooq, M. (2003). *Truck costing model for transportation managers*. Upper Great Plains Transportation Institute, North Dakota State University, Fargo, ND.
[31] http://www.ooida.com/EducationTools/Tools/costpermile.asp
[32] Hussein, M.I. and Petering, M. E.H. (2009) A policy-oriented cost model for shipping commodities by truck. CFIRE Paper No. 94-4. University of Wisconsin, Madison.
[33] http://atri-online.org/
[34] Hussein, M., & Petering, M. (2009). Ibid.

considerable influence on the final dollar cost of per cargo unit or per vehicle movement. The latest, 2012-based estimates from ATRI (Fender and Pierce, 2013)[35] report average carrier costs of just over $1.63 per mile, and $65.3 per hour: with different rates also reported for truckload (TL), less-than-truckload (LTL) and specialized trucking services as well as by region of the country. Of note, fuel costs accounted for some 39% of total operating costs in 2012, with driver costs at 33% of the total.

Operating costs are, however, known to vary a good deal in practice, depending on vehicle configuration and age, type of delivery service, and trip distance, among other factors. Hussein and Petering (2009) and Wheeler (2010)[36] provide recent reviews, reporting a rather large range of values: from as low as $10 per vehicle operating hour, to over $190 per hour associated with time delays due to traffic congestion.

What these studies also show, however, is a generally consistent treatment of the major cost elements involved, which we can summarize here as fuel, labor, operation and maintenance (with or without a vehicle depreciation and other indirect costs, depending on application) and cargo handling (= loading/unloading) costs.

To these, we can also add a fifth cost element, storage costs. These can occur whenever a pickup or delivery is late, and in some cases can be quite expensive if special cargo storage conditions (e.g. refrigeration) are required. These delays can occur at both ends of a trip, and however the cargo delivery payments occur between producers, consumers and carriers, any time that is lost due to significant variability in on-time arrivals can prove costly. Pulling these five different cost elements together (i.e. fuel, labor, O&M, loading and storage costs), Figure 4.10 shows how each is a function of not only the type of commodity and type of truck used, but also of an O-D trip's over the highway travel distance and time. Of note, travel speeds can be seen to play a key role in total O-D trip costs. In addition to direct impacts of such speeds on trip travel times, and hence labor (driver) costs, speed also impacts fuel consumption rate and therefore fuel costs.

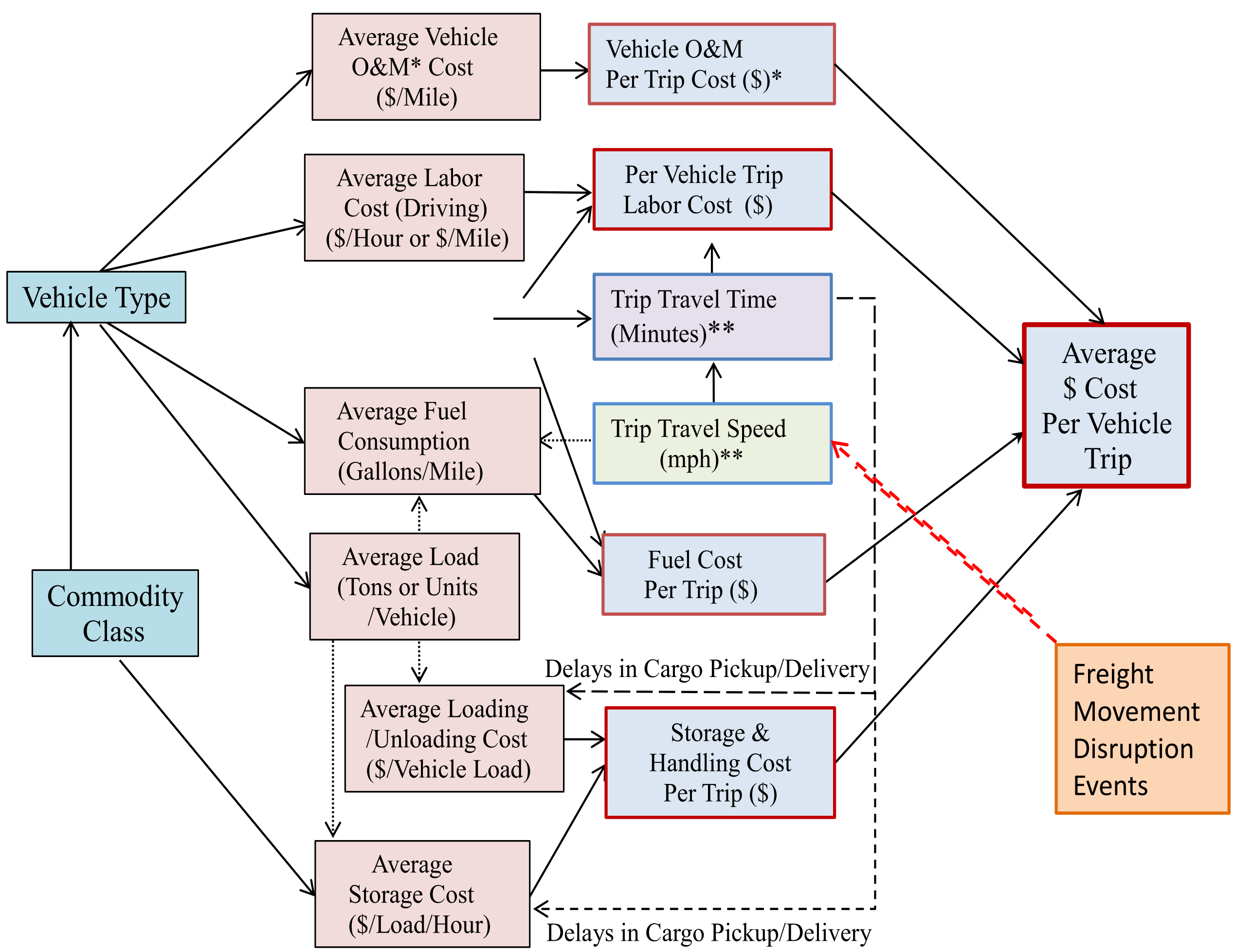
Particularly costly are in-transit delays that result in late cargo pickup or delivery where these result in extra cargo storage costs as well as possible additional labor costs associated with re-scheduled cargo loading/unloading activity at a trip's origin or destination. These linkages are labeled as Delays in Cargo Pickup/Delivery in Figure 4.10. These include the impacts on in transit speeds

[35] Fender and Pierce (2013) *An Analysis of The Operational Costs of Trucking: A 2013 Update.* American Transportation Research Institute, Alexandria, VA. September, 2013.

[36] Wheeler, N.M. (2010) *Multi-Criteria Trucking Freeway Performance Measure for Congested Corridors*. Master of Science Thesis, Civil and Environmental Engineering, Portland State University, Portland, OR.

caused by freight movement disruption events such as major highway accidents, severe weather, road damage and closures, and severe traffic congestion due to mixed passenger and freight traffic volumes exceeding roadway design capacities (see below). The greater the frequency of such events and the lower the percentage of on-time cargo deliveries, the more expensive are the delays incurred. And depending on the type of contract between shipper, receiver and carrier, one or more of these may need to absorb these additional costs, which can be expected, one way or another, to find their way back to the final consumer if they occur with sufficient frequency.

Figure 4.10 Elements of Truck-Trip Based Freight Transportation and Logistics Costs



** From Assignment Algorithm

* Vehicle O&M cost includes costs associated with tires, oil, parts maintenance and replacement, insurance and licenses.

Measuring the Costs of Poor On-Time Reliability

Recognition of the importance of this on-time reliability issue to freight shippers and receivers has led to a significant effort by the US DOT and the Transportation Research Board (TRB), among others, to quantify both the magnitude and costs associated with such travel time uncertainty. In particular, TRB's Strategic Highway Research Program 2 (SHRP2) has devoted a good deal of effort to measuring what it terms travel time reliability measures for the purposes of planning and programming studies.[37] A literature review by De Maeyer and Pauwels (2003)[38] on the role of quality of service attributes and their monetary valuation, as derived by a number of different freight demand models, confirms the importance of service reliability to mode selection, often placed ahead of the value of shipment cost itself. Fowkes et al's (2004) stated preference interviews of 40 shippers, carriers and third party logistics operators (3PLs) identified similar concerns over on-time delivery reliability, especially where JIT deliveries were concerned; placing a higher value on reliability and predictability in delivery times was emphasized as the most important transportation service attribute by industry respondents, more so than minimizing average lead times. [39] However, while a good deal has been written over the past five years about how to measure such reliability for planning purposes, including the use of such measures in the Highway Capacity manual, [40] comparatively little research has been published on how to assign monetary values, or the implied costs, to such reliability measures.

Where freight movements are concerned, reliability is recognized as one of the principal variables that affects the choice of both mode and shipment size. Reliability is valued by FHWA's Intermodal Transportation and Inventory Cost Model – State Tool (ITIC-ST)[41] by measuring the effects of variability in the shipment ordering lead-time. Lead-time here includes the time required for the shipper to receive the order from the customer, to pick the order from his inventory, to arrange for transportation, to wait for a vehicle to arrive at the shipping dock, load the shipment, and finally to move the freight from the shipping point to the customer's destination. The more reliable the

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[37] http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/SHRP2ResearchReports.aspx
[38] De Maeyer, J. and Pauwels, T (2003) Modal choice modelling: a literature review on the role of Quality of Service attributes and their monetary valuation in freight demand models. Department of Transport and Regional Economics, University of Antwerp, Belgium.
[39] Fowkes, A.S. et al (2004) How highly does the freight transport industry value journey time reliability—and for what reasons? *International Journal of Logistics: Research and Applications 7(1):33-43.*
[40] Kittelson, P.E. and Vandehey. M., et al (2013) Incorporation of travel time reliability into the HCM. *SHRP 2 Reliability Project – L08.* Transportation Research Board, Washington D.C.
[41] Federal Highway Administration (2011). Intermodal Transportation and Inventory Cost Model State Tool. https://www.fhwa.dot.gov/policy/otps/061012/iticst_info.htm

delivery schedule, the less safety stock the customer must keep on hand in order to ensure that a stock-out (i.e. the customer runs out of stock) does not occur, noting that safety stock "is typically a larger component of total logistics cost than many of the other costs (with the possible exception of transportation charges) because it must be carried continuously".

The method ITIC-ST uses to capture this (un)reliability of on-time service effect is a two parameter Gamma function based on the mean and the standard deviation of the shipment transit time. Treating the mean re-ordering lead-time as equal to the mean in-transit time, the model user inputs a coefficient of variation (COV) equal to the standard deviation of in-transit time for a given mode (truck or intermodal rail in this case) divided by this mean in-transit time. For further technical details, see FHWA (2006).[42] Default model parameters are provided.

In considering how to quantify travel time variability costs incurred on sections of US freeways (by general traffic), notably as a result of non-recurring incidents, Cohen and Southworth (1999)[43] present two different approaches to assigning a user benefit (cost) to more (less) reliable travel times. In the first approach, an additional cost of travel is assigned directly to a measure of trip time variability, i.e.

$$C = a1*T + a2*Var(T) + a3*M \tag{4.1}$$

where C equals the expected cost of a trip, and $a1$, $a2$, and $a3$ are parameters that reflect travelers' relative dislike of, respectively, trip time T, a measure of trip time variability $Var(T)$ (in practice, the standard deviation, SD, was again used), and a monetary travel cost, M. The ratio of ($a2/a1$) provides a useful measure of the relative importance of changes in travel time variability versus changes in total trip time. The ratio of ($a2/a3$), often termed a *reliability ratio*, allows a monetary cost to be assigned to the importance of such variability, i.e.

Reliability Ratio (Travel Time) = Value of SD of Travel Time / Value of Travel Time (4.2)

With a variation on this idea devoted to late arrivals:

Reliability Ratio (Lateness) = Value of SD of Lateness / Value of Lateness (4.3)

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[42] FHWA (2006) ITIC-ST Version 1.0. Intermodal Transportation and Inventory Cost Model**.** A Tool for States**.** Technical Documentation. Federal Highway Administration, Washington, D.C.

[43] Cohen, H. and Southworth, F. (1999) On the measurement and valuation of travel time variability due to incidents on freeways. *Journal of Transportation and Statistics 2.2*. 123-131.

where “SD’ in both equations (4.2) and (4.3) is short for the standard deviation.

A partial review of past studies, in both passenger and freight movement, is provided in a draft 2012 SHRP2 workshop report by Cambridge Systematics and ICF.[44] Of the seven freight value of travel time reliability studies cited, none are from North America. Most are from Europe. An earlier review of work on the topic of measuring travel time reliability in the United States, the European Union, and elsewhere, by Grant-Muller and Laird (2006)[45] notes that:

“*At this point in time there is still uncertainty as to what the value of reliability is for both personal and freight related travel. However, there can be no doubt, given the qualitative and increasing quantitative evidence, that these values can be significant and large*.”

This situation still applies today: although a recent US study by Gong et al (2012)[46] does begin to shed some light on this topic. Recognizing the difficulty of the task, these authors tried three different approaches to determining the value of fright shipment delay to shippers and receivers. Using a small number of in-depth interviews, along with a larger survey of manufacturers and wholesalers in Texas and Wisconsin, they also develop an analytic approach based on inventory management theory. Using an Analytic Hierarch Process (AHP) and Willingness To Pay approach to their survey instrument, they produce a number of example estimates of the cost of congestion-induced delay. Taken over their entire survey, they suggest a value of $56 per hour for shippers' travel time. They also compute a travel time reliability cost of $0.40 per each percentage of additional delay, where such a percentage represents the hypothetical delay time divided by the normal (average, expected) travel time for a given trip. Based on a series of experiments based on different inventory stock-out policies, different order lead times, and different demand frequency profiles, they found that freight receivers are more likely to find increases in the variability of O-D trip times to be more costly than increases in the means of such O-D travel times: sometimes costing more than twice as much in trucking plus in-transit and warehouse inventory carrying costs. (And of

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[44] Cambridge Systematics and ICF (2012) Value of travel time reliability. SHRP-2 Workshop Working Paper and Synthesis Report. April 2012. DRAFT.

[45] Grant-Muller, S. and Laird, J. (2006) Costs of congestion: literature based review of methodologies and analytical approaches. Report Prepared by the Institute for Transport Studies, University of Leeds, England for the Scottish Executive Social Research agency. http://www.scotland.gov.uk/Publications/2006/11/01103351/0

[46] Gong et al (2012) Assessing public benefits and costs of freight transportation projects: measuring shippers' value of delay on the freight system. UTCM Project 11-00-65.CFIRE Project 04-14 Texas Transportation Institute, College Station, Texas.

note, the values they obtained from their test respondents recorded higher than average delay valuations for those involved in moving automobile parts).

An additional wrinkle to Figure 4.10 is the way in which labor costs are determined. Specifically, truck drivers may be paid by the hour or by the mile. If by the latter, then speed of travel will be an especially important factor in a trucking company's revenues (subject to hours of service and other regulations and practices meant to ensure safe driving: see ATRI, 2013[47]). It also again leads to a trade-off between added fuel consumption and time saved.

Based on the above literature, the following per vehicle-trip cost formula suggests itself for use in planning studies, allowing the various right-hand-side costs to vary both by commodity carried and vehicle class:

Truck Trip Cost = Fuel Cost + Labor (Vehicle) Cost + O&M Cost+ Cargo Handling Costs (4.4)

and where cargo handling includes both cargo loading/unloading costs as well as any factory, warehouse or terminal based in-transit storage costs involved, including traffic congestion-induced delay costs.[48] An additional term, possibly in the form of a multiplication factor, can also be added as an approximation to the effects of on-time service (un)reliability on overall per trip dollar costs. Finally, truck trip rates should also include a profit margin, for which limited direct information exists in the public domain.

4.4.2 Rail Costs

While there are fewer studies of rail cost models and their data sources in the open literature than there are for trucking (Holguin-Veras et al, 2013), two publicly available cost estimation models exist: the Uniform Rail Costing System (URCS)[49] and the Intermodal Transportation and Inventory Cost Model – State Tool (ITIC-ST)[50]. Of these, Surface Transportation Board's (STB) URCS software offers the most generally useful, annually updated and at the same time, statistically robust railcar costing option. URCS uses average wage rates and other data from its annually collected,

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[47] Ibid.
[48] Loss of cargo value due to within-truck transit delays is considered here to be comparatively small compared to time costs due to extended on-site storage at shipment origin, destination or during intermodal terminal transfer. See Gong et al (2012) ibid.
[49] http://www.stb.dot.gov/stb/industry/urcs.html
[50] Ibid.

nationwide sample of railcar waybills to calculate the cost of shipping commodities by a specific railroad and origin-to-destination distance. These freight rates take into account the type of freight and being shipped (e.g. automobiles, or Standard Transportation Commodity Code 37111), the type of train (single or multiple railcar or unit train) and number and type of railcars in the train, whether or not these railcars are railroad or privately owned, and what type of backhauls (returning of empty or loaded railcars) will take place.

Figure 4.11 Example Initial Input Screen for Rail Costing Program

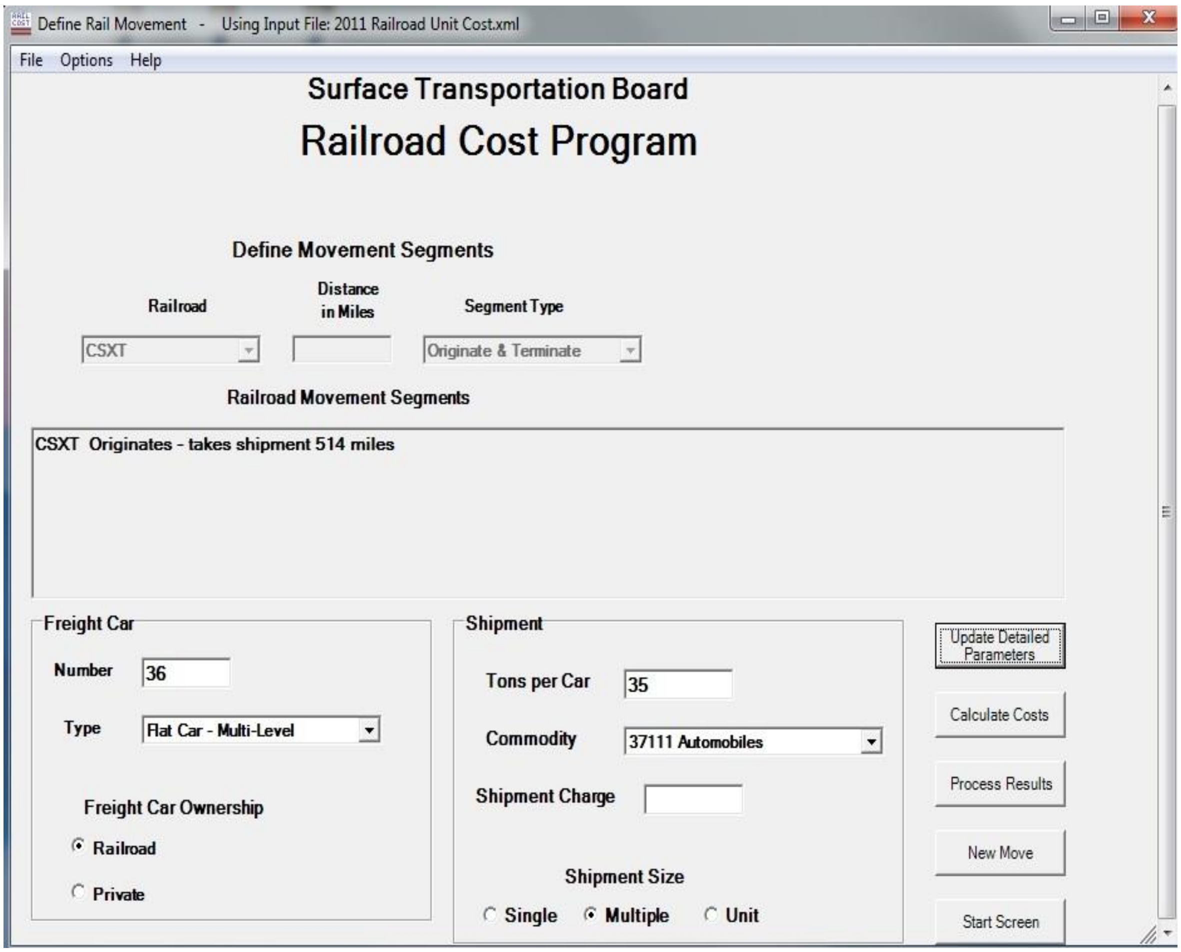


Figure 4.11 shows the initial data input screen for the URCS when applied to a specific shipment. Default settings can also be used to fix the circuity of the route in which the railcars will travel, the unloaded (tare) weight of the specific type of railcar (e.g. a multi-level flatcar) and a general overhead ratio which allocates administrative and other indirect expenses to variable car-mile and car-day costs for the specific railroad service in question. Using the URCS software, it is

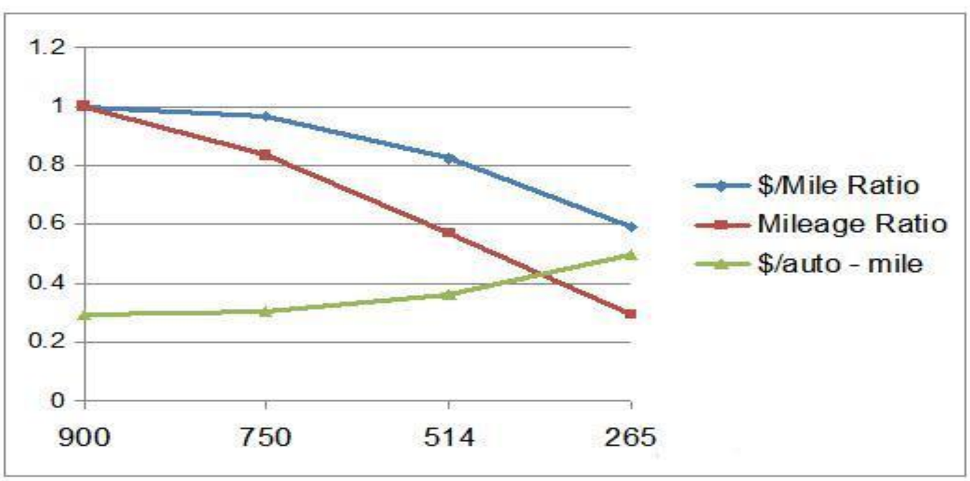
possible to estimate the cost of shipping not only parts but also finished automobiles, the latter by multi-level autorack trains.

Table 4.5 and Figures 4.12 and 4.13 provide example calculations for four different O-to-D rail distances from the OEM's railcar loading site to destinations whose network mileages are computable using the *railroad specific* sub-network contained in the ORNL multimodal freight transportation network database (see section 4.5.2 below). In this project, this means using the CSXT railroad sub-network out of the KIA West Point plant. While we DO NOT know the rates charged per vehicle transported from this plant, the URCS software does allow us to compute an approximate transportation rate and cost per destination city, and to do so for a range of cost-impacting factors. The number of railcars per train is set here at 36. Other input parameters are 20 autos per railcar, a weight of 1.75 tons per automobile (for example, the Kia Optima has a curb weight of around 3,200 lbs and the Kia Sorento SUV a curb weight around 3,800 lbs).[51]

Table 4.5 Privately-Owned Railcars Cost Breakdown by Selected O-D Rail Distances

Privately-Owned Railcars	265 miles	514 miles	750 miles	900 miles
Cost per shipment	45600	71669	88835	99726
Cost per auto moved	63.3	99.5	123.4	138.5
Cost per auto moved-mile	0.239	0.194	0.165	0.154

Figure 4.12 Results from Rail Costing Scenario Using Railroad-Owned Railcars



[51] http://www.edmunds.com/kia/optima/2013/features-specs.html and http://www.edmunds.com/kia/sorento/2013/features-specs.html?style=101424381

Figure 4.13 Results from Rail Costing Scenario Using Privately-Owned Railcars

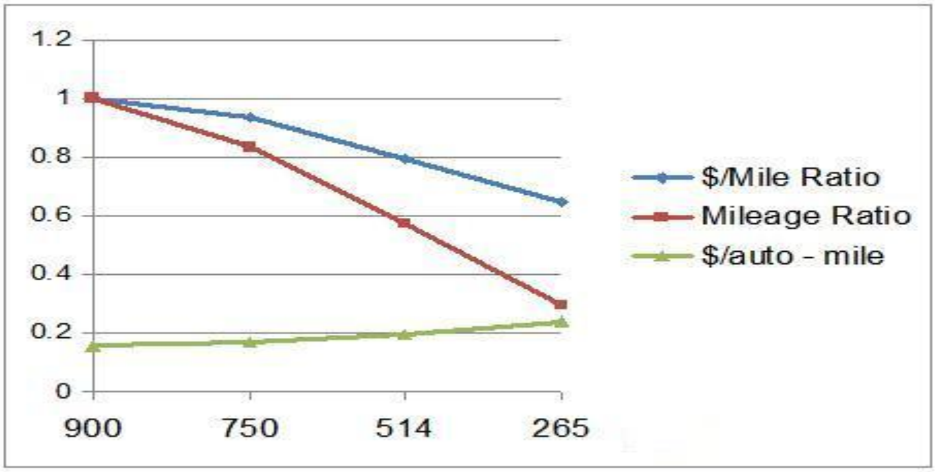
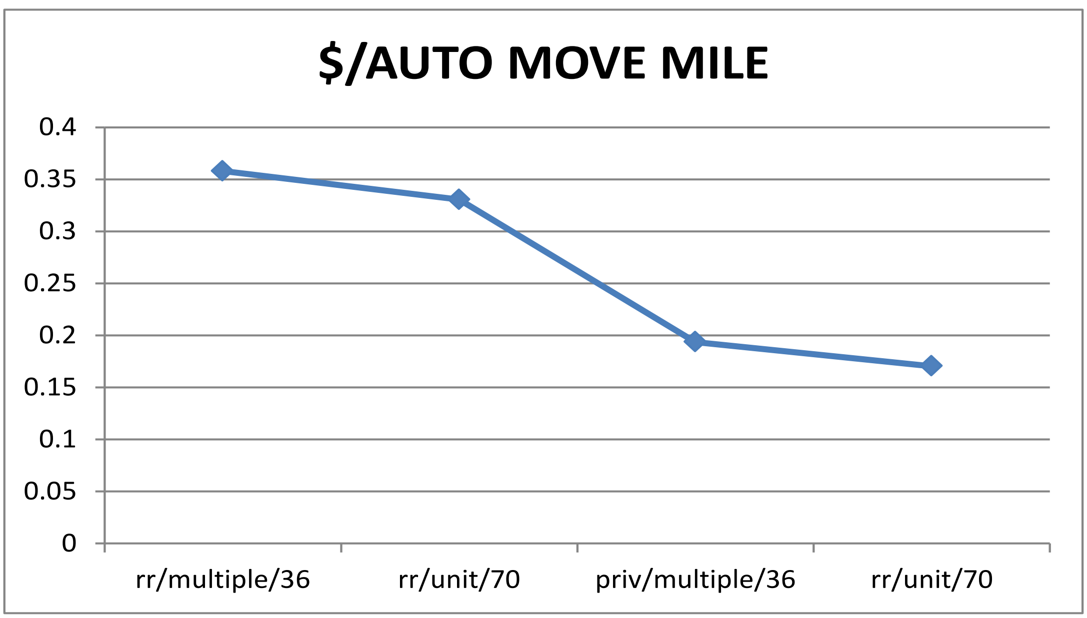


Figure 4.14 shows an example of the effect on cost per mile per automobile shipped by moving from a 36 railcar train to a unit train made up of 70 railcars, again for both privately owned ("priv") versus railroad owned ("rr") railcars.

Figure 4.14 Effect of Number of Railcars Per Train on Shipment Rate per Automobile (for a shipment distance of 514 miles)



4.4.3 Trans-Ocean Shipping Costs

With a good deal of auto-parts movement into the US auto manufacturing plants from both Eastern Asia and also Northern Europe, global shipping rates are of considerable interest to cost effective supply chains: for both parts supply and also for finished vehicles. The present project's focus is on the former, since most of the finished vehicles of interest are currently bound for US markets, with some deliveries also into Eastern Canada. Most of these parts are now transported by container ships. With nearly all parts now shipped in steel containers, and with more than 50% of all US seaborne trade by value now moved in containers (UNCTAD , 2013[52]), data on container transport costs are key inputs to supply chain assessments.

Gkonis, et al (2009)[53] provide a review of liner shipping costs. Psaraftis (2009)[54] describes the following container shipping cost model:

Container Shipping Cost = Fuel Cost +Time Charter Costs + Cargo Inventory Costs (4.5)

These cost elements are very similar to those reported as equation (4.4) above, with fuel costs for the trans-oceanic portion of a given O-D cargo shipment estimated by the following formula (for example, after Psaraftis, 2009):

$$\text{Fuel Cost} = \text{Fuel Price/Gallon} * (\text{O-D Distance}/V) * (a + b * V^{n}) * \text{Delta}^{\lambda} \quad (4.6)$$

where V = average ship speed in nautical miles/day; Delta = ship's displacement or loaded ("laden") weight; and a, b, n and λ are empirically derived model parameters.

Charter costs are proportional to O-D travel time, while cargo inventory costs are similar to the O&M costs used in the trucking formula. Per unit volume or unit time cargo delay costs here include two elements, or cargo delay rates: one for cargo waiting to be picked up at a port, and a second cost associated with the time a cargo remains within the ship before off-loading.

52 UNCTAD (2013). *Review of Maritime Transport 2013.* United Nations Conference of Trade and Development, New York and Geneva.
53 Gkonis, K.G. et al (2009) Liner shipping costs and logistics: a literature survey and taxonomy of Problems. Laboratory for Marine Transport, National Technical University of Athens. Greece.
54 Psaraftis, H. (2009) A ship pickup and delivery model with multiple commodities, variable speeds, cargo inventory costs and freight rates. Laboratory for Marine Transport, National Technical University of Athens. Greece.

Two useful sources of shipping rates data, including time charter costs, are the following:
i) In addition to selling shipping rate information, *Searates.com*[55] provides measures of shipment distances and transit times between major seaports around the world, reported in days and hours.
For example, a trans-Pacific vessel transit between the Port of Busan, South Korea and the Port of Los Angeles in southern California represents a roughly 6,100 mile trip, taking some 14.7 days. Continuing overland from Los Angeles to Atlanta, GA increases the trip to around 8,300 miles and 19 days in duration. In comparison, a shipment from Busan to Atlanta via the Panama Canal and the US Port of Savannah covers over 11,300 combined sea plus land miles, with an expected 29 days to complete.
ii) VHSS (The Hamburg Shipbrokers' Association)[56] reports representative charter shipping rates based on its connections to a Germany shipping industry that owns over half of the container ships on the sea: through its New ConTex and its Hamburg Indices (Containership Time-Charter-Rates) for a range of vessel sizes (based on the twenty-foot equivalent unit, or TEU carrying capacity). Example container shipping rates to the USA are also published by the World Bank for the years 1980 through 2013.[57]

As with trucking costs, vehicle/vessel speed plays an important role in all three major cost elements: positively in terms of charter time cost savings and negatively in terms of fuel and cargo inventory costs. Fuel costs have fluctuated a great deal over the past decade and a half, in part due to rising and falling per gallon bunker fuel prices, and also to the rapid increases in vessel capacity. While the latter can reduce per cargo unit delivered fuel costs, the increasing costs of handling cargo in the larger vessels once they arrive in port may offset these gains to some extent, notably for long-distance shipping of high value commodities.

Complicating the matter, the (spot) price of the goods being shipped may change a good deal during the multi-day course of such trans-oceanic shipments, while containership time charter rates have also been on something of a roller-coaster ride over the past decade and a half[58]: resulting in either the shipper, ship owner or charterer bearing any extra costs due to in-transit delays. Whoever pays, there is potentially a costly trade-off between fuel, charter time, and also, for long-distance high valued shipments, the cargo inventory carrying costs. One response to the considerable fluctuation in

[55] http://www.searates.com/reference/portdistance/
[56] http://www.vhss.de/company
[57] http://data.worldbank.org/indicator/IC.IMP.COST.CD
[58] see *Container Intelligence Monthly*. Also *Review of Maritime Transport* (UNCTAD, 2013 ibid).

fuel as well as commodity spot market and charter prices in recent years has been fuel cost savings based on "slow streaming".[59]

Of particular interest to a study concerned with in-transit congestion, the late arrival of such large ships at seaports (of either embarkation or debarkation) may lead to costly delays in port/terminal transfers, impacting the schedules, and hence costs associated with the use of land- as well as sea-side modal assets. This is a topic that has been visited now by a number of studies, with liner shipping agents seeking to deploy their assets so as to maximize economies of scale associated with time at sea while minimizing any diseconomies of scale associated with time in port.[60,61,62] Hsu and Hsieh (2005) estimate late cargo pickup costs as "inventory costs" that are positively correlated with cargo volume, cargo value, and the length of in-transit shipping and at-source or in–port storage time. The ability to handle the much larger Post-Panamax vessels at the Port of Savannah also implies a greater potential for increased cargo inventory costs should delays at ports occur. Such delay costs can be significant should a significant port disruption, such as may occur due to a severe weather event.[63]

4.4.4 Intermodal and Within-Terminal Transfer Costs

A significant component of multi-modal "door-to-door" supply chain costs involves freight inter-modal terminals. These costs are often the reason for using trucks to transport some parts, and also to transport finished automobiles significant distances, in order to fulfill limited size and time-sensitive orders for specific vehicles. Unfortunately for public agency analysis, the recently published TRB-funded review of freight data sources found that (Holguin-Veras et al, 2013, page 50)[64]:

" *there are no regularly published data sources that provide sufficient data on freight terminal costs*."

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[59] See UNCTAD, 2013 ibid. Also Wang, S. and Meng, Q. (2012) Sailing speed optimization for container ships in a liner shipping network. *Transportation Research E 48*: 701–714

[60] Cullinane, K. and Khanna, M. (1999) Economies of scale in large container ships. Journal of Transportation Economics and Policy 33(2): 198-208.

[61] Payne, B. (2013) Economies of scale, economies of scope and potential diseconomies of scale. AAPA Presentation , September 2010. NYK Line (North America).

[62]Hsu, C-I, and Hsieh, Y.P. (2005) Shipping economic analysis for ultra-large container ships. Journal of the Eastern Asia Society for Transportation Studies 6: 936 – 951.

[63] F. Southworth, J. Hayes, S. McLeod and A Strauss-Wieder (2014) *Enhancing U.S. Port Resiliency as Part of Extended Intermodal Supply Chains. NCFRP Report 37*. Transportation Research Board, Washington, D.C

[64] Holguín-Veras, J. et al (2013) Freight Data Cost Elements. NCFRP Report 22. Transportation Research Board, Washington, D.C.

Based on their review, Holguin-Veras et al (2013) suggest that a useful general model for terminal activity costing includes the following five activities:

- administrative processing of cargo/vehicle/vessel entry/exit;
- internal (within-terminal) movements,
- cargo loading/unloading activities[65];
- storage area organization and sorting; and,
- ancillary functions (including insurance, security, electricity, administration and other costs of terminal operation).

According to Hussein and Petering (2009, page 30), truck drivers are "usually not responsible for loading their vehicles. They may, however, participate in unloading at the destination. Unloading palletized cargo using a forklift costs about $40 per truck and it consumes about 20 minutes. Unloading non-palletized cargo by hand consumes 2-3 hrs and is far more costly." However, such values appear to be illustrative only, rather than statistically grounded.

Port or terminal specific tariff publications are suggested as a possible source of information, while noting that commodity and mode specific economies of scale among other aspects of cargo movement (some 119 unique cost elements are identified as potentially influencing such rates) may render such estimates at best approximate. However, according to The Tioga Group, Inc.'s review of marine container terminal operations (2010, page 86)[66]:

"Both ports and marine terminal operators compete on cost, and do not want their costs accessible to either competitors or customers. Negotiated charges to ocean carriers are confidential and sensitive. Labor man-hours and costs are doubly sensitive."

Since the present project could not afford to generate such a database from scratch, it was decided to incorporate (and enhance) an existing network data model to allow for such costs to be captured within the shipment source-to-destination routing process (see Section 4.5 below), should suitable sources of data emerge. Consistent with the recently published NCFRP 22 Report on such freight cost elements, this is seen as an important topic for attention, by compiling either a large body of port/terminal on-line cargo handling rates, and/or by modeling each of the above five terminal processing cost elements in some detail. A useful start is offered by the work done on the publicly

[65] According to Hussein and Petering (2009) (ibid.), loading and unloading refers to the services of transferring cargo between the inside of a truck's trailer and "any place or point of rest on a wharf or terminal".

[66] The Tioga Group, Inc. (2010) Improving marine container terminal productivity: development of productivity measures, proposed sources of data, and initial collection of data from proposed sources. Report to the Cargo Handling Cooperative Program. Maritime Administration, Washington, D.C.

available Intermodal Transportation and Inventory Cost (ITIC-ST) modeling software (FHWA, 2006).[67] Developed in MS Excel for the purpose of truck and rail freight diversion modeling, ITIC-ST contains spreadsheets for estimating the following components of a shipper's total logistics cost function:

- ordering cost
- capital carrying cost in transit
- capital carrying cost in inventory
- warehousing cost
- loading and unloading cost
- safety stock carrying cost
- cost of loss and damage claims

with cargo handling and storage costs broken down by the different types of expenses associated with bulk, dry, open, or temperature controlled commodities.

4.5 Global Supply Chain Modeling: Putting Freight Costs on Intermodal Networks

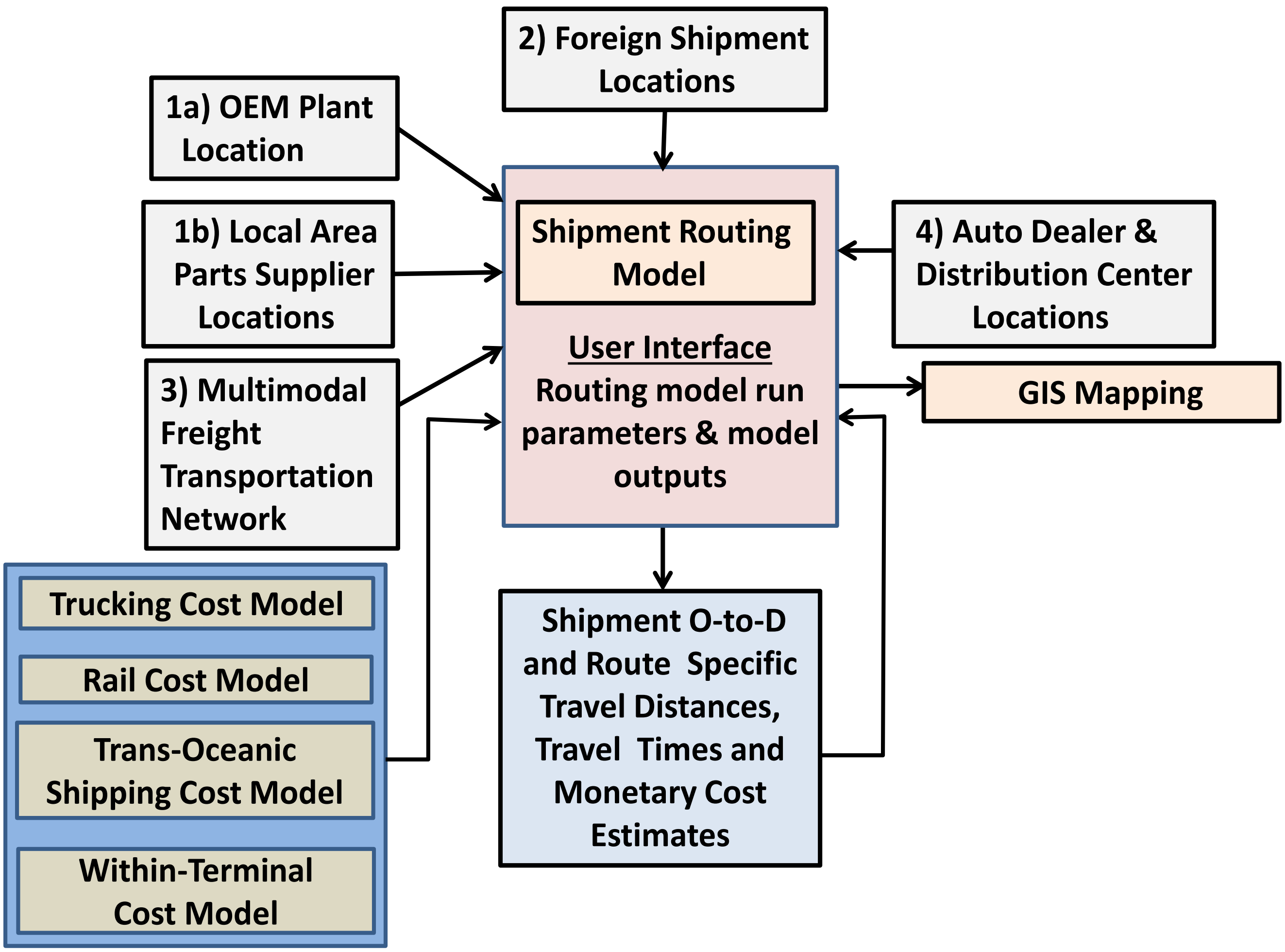
4.5.1 Supply Chain Routing

In order to compute the transportation costs associated with specific supply chains, or specific components of them, the above modal cost formulas have to be applied to specific origin-destination-commodity shipments. This means bringing together the sort of geo-location based data on both product inputs and outputs described in Section 4.3 above with the shipping cost formulas described in Section 4.4. While the development of a software tool was not a part of the current research project, an early prototype was constructed in order to test the usefulness of the data collected. Figure 4.15 shows this idea, for what is currently an in-progress software development activity, drawing together the various flow and cost data elements and sub-models, and accessing data via a user interface that allows the analyst to select an appropriate mode of transportation (or tell the program to find the best mode, or mode-combination) in order to ship the goods to be moved. The idea behind this software is for a user to either select default travel speeds as well as per hour cargo holding and intermodal transfer costs, or derive them based on detailed, mode specific cost modeling formulas (based on the four sub-models shown in the blue box) at the bottom left corner of Figure 4.15.

[67] ibid

Figure 4.16 shows an example of the current user interface (currently coded in MS Excel). These data are then sent to a least cost path-finding algorithm that operates on the global, multimodal link-node freight database described in Section 4.5 below, and computes over-the-network least cost paths based on either O-to-D travel times or distances. The resulting multi-link freight routings are

Figure 4.15 Freight Data and Modeling Components of Automobile Manufacturing Supply Chains: Flows and Costs Modeling



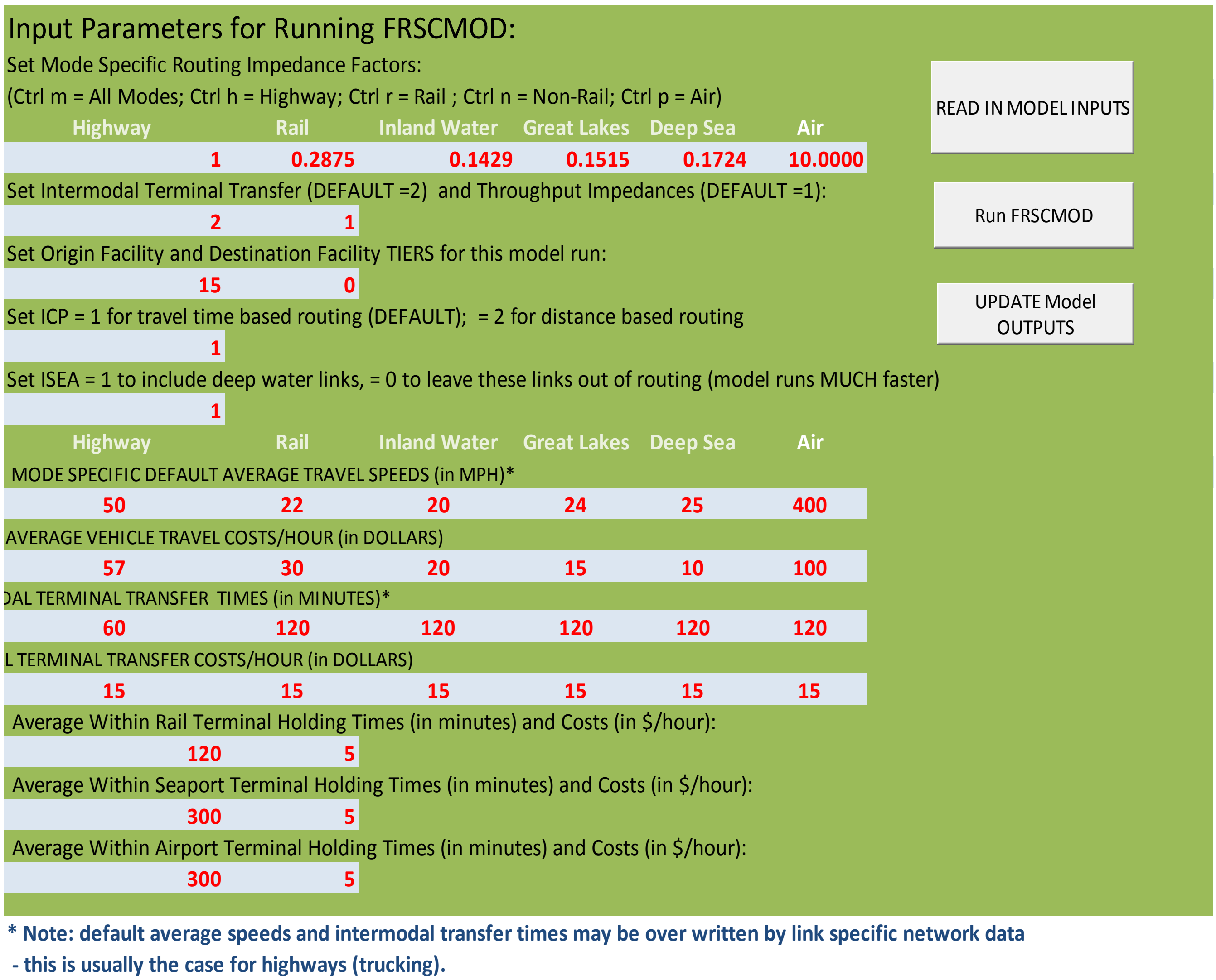
then output for use in dollar valued modal costs formulas such as those described in Section 4.4 above, and in a form that is also suitable for geographic information system (GIS) mapping (Caliper's Maptitude/TransCAD[68] software is currently used for this).

[68] http://www.caliper.com/

4.5.2 Intermodal Freight Network Data Model

To date, only a handful of multimodal freight network models have been developed that span entire countries or international shipments. The most widely reported of these freight network modeling efforts are the following:

Figure 4.16 Prototype Supply Chain Routing Model Interface



- STAN (Strategic Planning of National and Regional Freight Transportation) network model, developed by Canadian researchers (Guelat, Florian and Crainic, 1990;[69] see also Lubis, et al, 2003[70]);

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[69] Guelat, J., Florian, M., Crainic, T.G. (1990) A Multimode Multiproduct Network Assignment Model for Strategic Planning of Freight Flows, *Transportation Science*, *Vol.24.1*:25-39.

- NODUS (Geerts and Jourquin, 2000; Beuthe et al, 2001[71]; Jourquin and Beuthe, 2003[72]. 2006[73]), developed in Europe;

- SMILE (Tavasszy et al, 1998;[74] Bovernkerk, 2005 [75]) also developed in Europe; and

- ORNL: Oak Ridge National Laboratory's North American multimodal/inter-modal freight transportation network database (Southworth and Peterson, 2000[76]; ORNL, 2013 [77]).

The ORNL database has been used extensively in recent years to compute hundreds of thousands of inter-modal shipment distances for the US Commodity Flow Surveys and to estimate ton-mileage statistics for US DOT's Freight Analysis Framework and provides a very useful starting point for the development of a set of global, including truck, rail, inland water and trans-oceanic shipment routes. Fortunately, a recent version of this carefully documented network database is available in the public domain, and so was selected for use in this present study.

Figure 4.17 shows the major modes included in this transportation network database, as well as the structure of the link-node "data model" adopted. An important feature of this network data model is the use of multiple links and nodes to represent detailed inter-modal connections. These intermodal links can carry a good deal of network information, and can be assigned both shipment loading and unloading costs, as well as within terminal/within seaport storage costs (including any time-sensitive delay costs reported). The top diagram (a) shows the modes are modeled. The bottom two diagrams in this figure show how intermodal transfers are incorporated in the network,

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[70] Lubis, H a-R.S.et al (2003) Multimodal freight transport network planning. *Journal of the Eastern Asia Society for Transportation Studies5*: 666-680.

[71] Beuthe M., et al (2001) Freight transportation demand elasticities: a geographic multimodal transportation network analysis. *Transportation Research 37E*: 253-266.

[72] Jourquin, B., and Beuthe, M. (2003) Multimodal freight networks, analysis with NODUS: methodology and applications. In *Across the Border. Building upon a Quarter Century of Transport Research in Benelux*. Dullaert, W., Jourquin, B. and Polak, J. (Eds.): 163-184.

[73] Jourquin, B., and Beuthe, M. (2006) A decade of freight transport modeling with virtual networks: acquired experiences and new challenges. In *Spatial Dynamics, Networks and Modelling.* Reggiani, A. and Nijkamp, P. (Eds.):181-200.

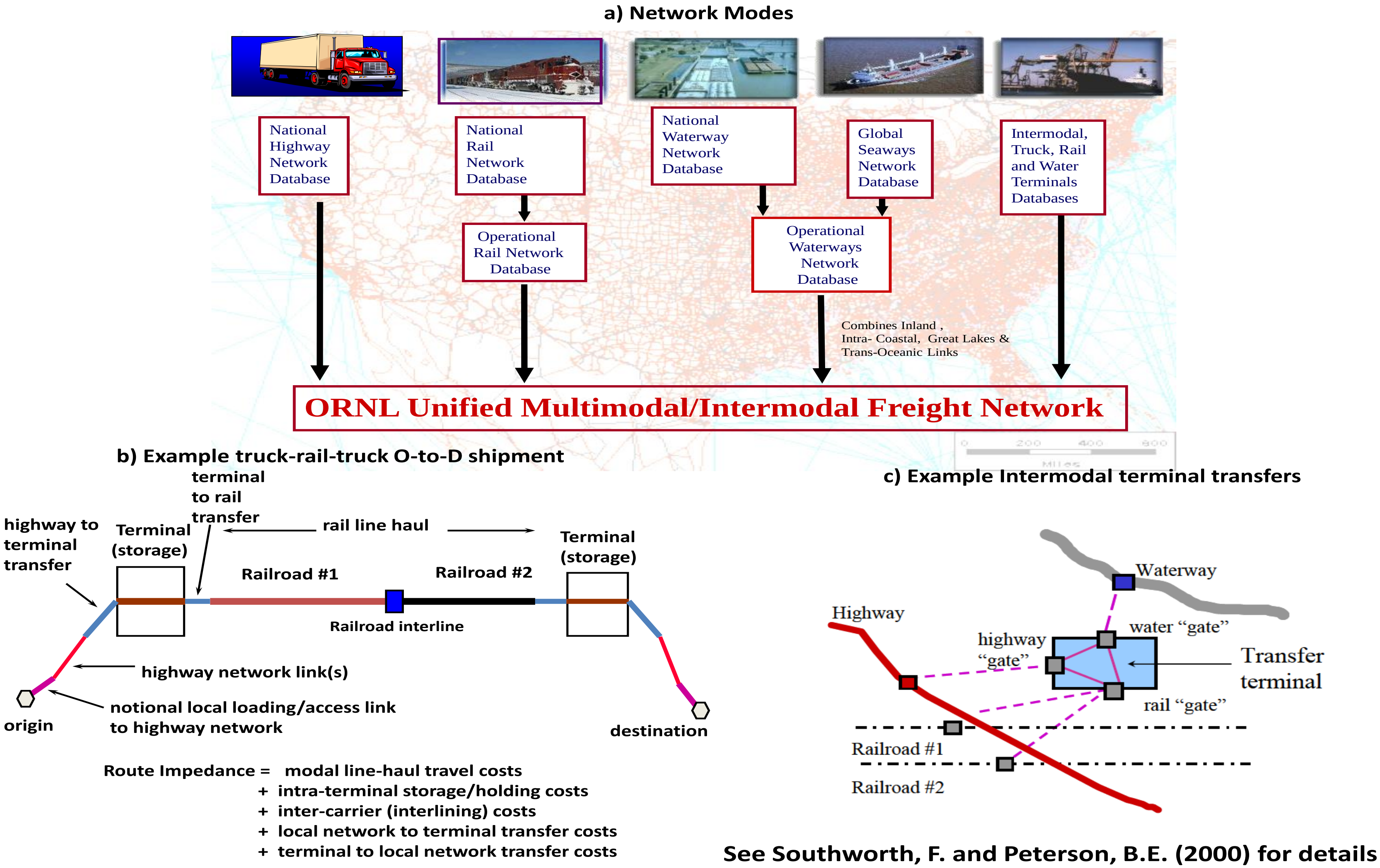
[74] Tavasszy, L.A., Smeenk, B. and Ruijgrok, C.K. (1998) A DSS for modelling logistic chains in freight transport policy analysis. International Transactions in Operational Research 5(6): 447-459.

[75] Bovernkerk, M. (2005) SMILE+: the new improved Dutch national freight model system. European Transport Conference, Strasbourg, France.

[76] F. Southworth, F. and Peterson, B.E. (2000) Intermodal and international freight network modeling. *Transportation Research 8**C**:*147-166.

[77] ORNL (2013) *On-Line Tools: CTA Transportation Networks.* *Intermodal Transportation Network* Center for Transportation Analysis. Oak Ridge National Laboratory, Oak Ridge, TN. http://cta.ornl.gov/transnet/

Figure 4.17 The ORNL Multi-Modal/ Inter-Model Freight Network Data Model



for (b) the most common form of truck-rail-truck intermodal door-to-door shipments, and (c) in terms of moving freight through an inter-modal terminal, such as a seaport (see Southworth and Peterson, 2000 for technical details.).[78]

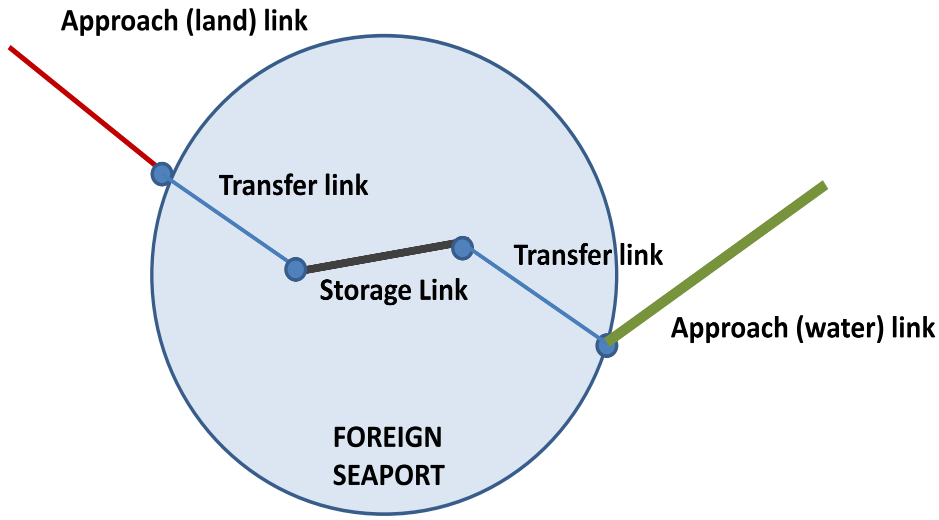
The original network database contains three separate files: a link attributes file, a node attributes file, and a link shape-point file. Of most importance to the current project are the link attributes (see **Table 4.6**), since link lengths determine shipment distances and to which can be added, or from which can be computed specific path (or route) based shipment costs. For this present project, the latest version of this periodically updated network database was expanded to include additional nodes and links for each of the foreign shipper locations as well as foreign seaports of lading reported to have handled West Point, GA bound shipments of automotive parts between mid-2008 and mid-2013. In doing so, each foreign seaport is represented by a four node/three link set of connections between existing land and water inks, as shown in Figure 4.18.

Table 4.6 Network Link Attributes File

Variable		Notes
1	LkSeqNum	Link Sequence Number
2	Block	Mode or Mode Combination Identifier
3	LinkID	Unique Link Identifier
4	A-node	A Node sequence number
5	B-node	B Node sequence number
6	Length	Link length (in miles)
7	Imped	Link Impedance (default or user defined)
8	Access	Type of link access restrictions
9	Domestic	CONUS, AK or HI, Canada, Mexico, et al.
10	Oneway	Flow direction retriction code
11	Heading	Compass headings (N,S,E,W,blank)
12	Mode	Truck, Rail, Water, Terminal, ….
13	Cargo	Code for cargo class specific routes
14	Name	8-character link name (for Highways = Sign Route)
15	NumPts	Number of vertices in polyline (from link shape-file, for GIS mapping purposes)

[78] Ibid.

Figure 4.18 Simplified Foreign Seaport Link-Node Representation



5. Study Summary and Conclusions

The research effort documented in this report set out to explore the little understood linkages between the micro-foundations of industry dynamics and economic activity, and the macro-congestion aspects of freight transport. A major barrier to such understanding has been the difficulty of obtaining the necessary data with which to carry out in-depth empirical analysis. The economic impacts and transportation requirements associated with the rapid development of Kia Motor's large automobile manufacturing plant in West Point, Georgia was chosen for study. Detailed, company and location specific data were collected from multiple sources, in order to piece together the economic impacts of the plant's impacts on the local and regional economy. This included a detailed functional and spatial mapping of the plant's supply chain inputs and outputs, and the demands they place on the broader south-east regional, as well as on the global and multimodal freight transportation system.

Recognizing the limitations of past efforts to link specific instances of economic growth to both local business activity and regional transportation needs, the principal study effort went into collecting and merging the necessary data elements in sufficient detail to allow for in-depth empirical analysis.

First, to get a clear understanding of the manufacturing and related processes, we developed a taxonomy of the automobile supply chain, identifying the major component categories (Section 2). We also provided some details on which types of components are likely to be produced and delivered from areas relatively close to the KMMG plant, and which components may come from locations outside the region. The location of the numerous component suppliers in nearby areas was found to provide a substantial boost to the overall economic activity in the region. We identified all of the component suppliers that have located in Georgia and neighboring Alabama Counties following the decision of Kia Motors to locate in West Point. For these component suppliers, we provided some information on the types of components they manufacture and supply to KMMG, as well as their size, employment and investment amounts. Next, using the American Community Survey (ACS) database, we studied the economic impacts on counties, both core and non-core. Core counties are defined as those where a meaningful number of component suppliers are located, whereas non-core are neighboring counties with lack of meaningful component suppliers. We examined a comprehensive set of variables, including those related to employment in a wide range of occupations, schooling, educational attainment, and population and migration patterns, among others. In our examination of the data and computation of multipliers, we found that in some categories of economic and business development, the core counties showed substantial differences compared to non-core counties, while in other areas the differences were less clear.

To understand the inflow of components to the KMMG plant, and outflow of finished automobiles, we collected data on the various freight flows associated with the automobile manufacturing supply chain, and its uses of local, regional and national highway, rail and waterway (including seaport) networks and cargo transfer facilities. Specific freight costing software tools were identified for use in future network-based flow modeling applications. To better understand the nature of these shipments, we enhanced and modified an existing global truck-rail-trans-oceanic freight network database to allow routing and mapping of individual product shipments, in order to better model the door-to-door costs involved. This included a brief exploration of the potential for significant freight movement bottlenecks, based on an interpretation of recent highway and rail traffic forecasts for the next two to three decades.

While more detailed analytical and econometric modeling is needed to better understand the exact magnitudes of the effects of the KMMG plant's decision to locate in West Point, Georgia, the database constructed during the project represents an excellent starting point for such an effort. The project also demonstrates the level of effort needed to construct similar datasets for other manufacturing plant-based studies.

Appendix A. Component Suppliers

Table A.1. List of Kia Motors Manufacturing Georgia (KMMG) Suppliers in Georgia and Alabama

Company	Component	County	State	Zip Code	Address
Autorica LLC	Factory Automation Systems	Troup	GA	30241	23 Busch Dr, Lagrange, GA
DaeHa America	Plastic resin pellets	Troup	GA	30240	201 Piedmont Circle LaGrange, GA
Daehan Solutions Georgia LLC	NVH parts and interior components	Harris	GA	31833	791 S Progress Pkwy, West Point, GA
Daewon America	Suspension system	Troup	GA	30241	20 Piedmont Circle, LaGrange, GA
DongWon Metals	Door Frames, roof molding, side absorbers, cross bars	Meriwether	GA	30230	475 Meriwether Park Drive, Hogansville GA
GLOVIS America, Inc.	Vehicle Processing Center	Troup	GA	31833	2000 Webb Rd, West Point, GA
GLOVIS Georgia LLC	Integrated logistics	Troup	GA	31833	6101 Sorento Rd, West Point, GA
Hamco America, Inc.	Wheel & Tire Assembly	Troup	GA	31833	6101 Sorento Rd, West Point, GA
Hanil E-Hwa Co., Ltd.	Plastic Auto Trim Parts	Troup	GA	30240	104 Wiley Road, Lagrange, GA
Hiteco USA Inc.	Cutting Tool and Machine Tool Accessory Manufacturing	Troup	GA	31833	6801 Kia Parkway West Point, GA
Hysco America	Steel supplier	Troup	GA	31833	6501 Forte Rd, West Point, GA
Illinois Tool Works, Inc. DaeLim USA (ITW DaeLim)	Plastic interior trip parts	Troup	GA	30241	50 Sl White Blvd, Lagrange, GA
I-Master Corp.	Automated Systems	Troup	GA	30241	112 Corporate Park East LaGrange, GA
Johnson Controls	Automotive seating and door panels	Harris	GA	31833	1700 S Progress Pkwy, West Point, GA
KSI Kyungshin (Kyungshin Lear)	Wiring harnesses	Troup	GA	31833	1201 O.G. Skinner Dr, West Point, GA
Mando Corp.	Electric power-steering gears and anti-lock brakes	Meriwether	GA	30230	955 Meriwether Park Dr, Hogansville, GA
Mobis Alabama, Georgia Plant	Front-end modules, front-rolling chassis	Troup	GA	31833	7001 Kia Pkwy, West Point, GA
Nalara Georgia LLC	Warehousing, Quality Engineering	Troup	GA	31834	7001 Kia Parkway, Suite 201 West Point, GA
Powertech America	Automatic transmissions manufacturing	Troup	GA	31833	6801 Kia Parkway West Point, GA
Pretty Products	Floor mats	Troup	GA	30240	1513 Redding Drive, Lagrange, GA
Prowill, LLC	Industrial supplies and services	Troup	GA	30241	106 Corporate Park E Drive, LaGrange, GA
Sejong Georgia LLC	Muffler and exhaust systems	Troup	GA	30240	1641 Lukken Indus Drive W, Lagrange, GA
Sewon America Inc.	Stamped component and decorative trim	Troup	GA	30241	1000 Sewon Blvd., LaGrange, GA
Sumika Polymer Compounds	Plastic Parts	Spalding	GA	30223	109 E Solomon St, Griffin, GA
Yasufuku, USA, Inc.	Plastic Injection & Blow Molding Parts	Troup	GA	30240	1 Yasufuku Place, LaGrange, GA
A1 Bar Code Systems	Bar Coding Systems; Badge Printers	Baldwin	AL	36526	PO Box 3046, Daphne, AL
AJin USA (Joon LLC)	Automotive Metal Stamping & Robotic Welding	Chambers	AL	36852	1500 County Road 177, Cusseta, AL
Alabama Bolt & Supply Inc.	Hoses, Hydraulics, Fasteners	Montgomery	AL	36108	630 Air Base Blvd, Montgomery, AL
Alabama Graphics & Engineering Supply Inc.	Reprographics	Montgomery	AL	35233	2801 5th Ave S, Birmingham, AL
American Pipe & Supply Co. Inc.	Pipes, Valves, Fitting & Plumbing Distribution	Jefferson	AL	35222	4100 Eastlake Blvd, Birmingham, AL
Arcadian Services	Car Wash Chemicals/Systems	Lauderdale	AL	35630	3109 Northington Ct, Florence, AL
Atchley Steel Company Inc.	Steel Fabrication	Lee	AL	36874	12505 US Highway 280 E, Salem, AL
Bar Bender Steel Inc.	Reinforcement Steel Cutting & Bending Services; Structural Steel & Concrete Distribution	Montgomery	AL	36117	1143 Dozier Rd, Montgomery, AL
Barloworld Handling LP	Distributes, Leases & Repairs Forklift Trucks	Montgomery	AL	36108	3001 Hayneville Rd, Montgomery, AL
Bermco Aluminum	Aluminum Refining & Smelting	Jefferson	AL	35222	3230 Messer Airport Hwy # K, Birmingham, AL
C & J Tech Alabama	Automotive Plastic Injection Molding	Tallapoosa	AL	35010	145 Plant 10 Drive Alexander City, AL
Changer & Dresser Corporation	Resistance Welding Supplies	Calhoun	AL	36207	1527 Itc Way, Anniston, AL
Chowel Weldparts	Automotive Welding Electrodes	Crenshaw	AL	36049	5826 Montgomery Hwy, Luverne, AL
CNC Enterprises Inc.	Metal Fabrication & Equipment Maintenance	Pike	AL	36081	1708 Highway 231 N, Troy, AL
CNJ Inc.	Spec. Precision Mach. of Auto Brake Discs & Knuckles	Lee	AL	36832	265 Teague Ct, Auburn, AL

Cumberland Plastic Systems LLC	Plastic Automotive Components	Lee	AL	36832	229 Teague Ct, Auburn, AL
Cutting Tool Engineers Inc.	Custom Cutting Tools for Metal Cutting	Shelby	AL	35124	208 Commerce Parkway, Pelham, AL
Cutting Tool Engineers Inc.	Custom Cutting Tools for Metal Cutting	Shelby	AL	35124	208 Commerce Parkway, Pelham, AL
DaeDong Hi-Lex America Inc. (DDHLA)	Door Hardware & Module Systems; Power Window	Chambers	AL	36852	1195 County Road 177, Cusseta, AL
Daeil USA Corporation (Daeil)	Struts & Parts for Automotive Industry	Chambers	AL	36863	3509 45th St SW, Lanett, AL
Daewon America	Suspension Bars & Coils	Lee	AL	36801	4600 N Park Dr, Opelika, AL
DAS North America	Automotive Seat Components	Montgomery	AL	36105	201 County Ct, Montgomery, AL
Davison Oil Company Inc.	Lubricant Manufacturing	Mobile	AL	36608	8450 Tanner Williams Road, Mobile AL
Die-Tech Inc.	Die Cast Dies	Lauderdale	AL	35630	4504 Helton Dr, Florence, AL
Dongwon Autopart Technology AL	Door Frames, Side Impact Beams, Roof Molding,Console Brackets	Crenshaw	AL	36049	12865 Montgomery Hwy, Luverne, AL
DSW Converting Knives Inc.	Industrial Knives	Jefferson	AL	35205	1506 Reverend Abraham Woods Jr Blvd, Birmingham, AL
Dudley C. Jackson Inc.	Specialized Industrial Pumping & Spraying Systems	Shelby	AL	35080	177 Mullins Dr, Helena, AL
Fastenal Company	Industrial Supplies, Safety, Jan-san, Tools	Montgomery	AL	36108	4560 Newcomb Avenue, Montgomery, AL
Glovis of Georgia	Auto Warehousing & Logistics Sequencing Services	Chambers	AL	36801	404 Fox Run Ave, Opelika, AL
Halla Climate Systems Alabama Corporation	HVAC Units, Front End Modules/FEM	Macon	AL	36075	676 Hala Bama Drive, Shorter, AL
Hanil USA	Plastic & Steel Tube Component Assembly for Fuel Sys.	Elmore	AL	36080	50 Hanil Drive, Tallassee AL
HPM Alabama Corporation (HONAM Petrochemical Corporation)	Injection Moldable Fiber Reinforced Thermoplastics	Lee	AL	36832	765 W Veterans Blvd, Auburn, AL
HS Automotive Alabama Inc.	Weather Stripping, Tubing & Rubber Hoses	Coffee	AL	36330	100 Sonata Dr, Enterprise, AL
Hwashin America Corporation	Chassis & Drive Train Automotive Body Parts	Bulter	AL	36037	693 Sherling Lake Rd, Greenville, AL
HYSCO America Company	Steel Coil & Sheeting for Chassis & Auto Body Parts	Bulter	AL	36037	200 Team Member Ln, Greenville, AL
Hyundai Motor Manufacturing Alabama LLC	Theta Gasoline Direct Injection & Multi Port Injection Engines, 1.8 Liter Nu Engine	Montgomery	AL	36105	700 Hyundai Blvd, Montgomery, AL
Hyundai Polytech America Company Inc.	Anti-vibration Rubber & Thermoplastic Auto Parts	Barbour	AL	36027	112 Lakepoint Indus Park Road, Eufaula, AL
ILJIN Alabama Corporation	Mechanical Power Transmission Equipment Man.	Russell	AL	36869	14 Downing Dr, Phenix City, AL
Industrial Machine & Supply	Machine Parts	Talladega	AL	35160	101 Costner Street, Talladega AL
Inspec Tech Inc.	Industry Specific Labels	Dekalb	AL	35989	46 Inspec Dr, Valley Head, AL
Jay Mid-South LLC	Metal Seat Frames	Etowah	AL	35904	140 Thomas Dr, Gadsden, AL
JIT Industries	Industrial Hydraulic Cylinders	Morgan	AL	35640	2201 Hwy 31 S, Hartsellt, AL
KC Sol-Tech Company Ltd.	Tool & Die	Lee	AL	36832	1127 W Veterans Blvd, Auburn, AL
Key Safety Restraint Systems	Steering Wheels, Air Bags, Seatbelts	Butler	AL	36037	200 Pleasant Hill Ct, Greenville, AL
Keyport	Warehousing & Distribution	Baldwin	AL	36551	30427 County Road 49, Loxley, AL
KwangSung America Corp.	Blow Plastic Tubing for Auto Ventilation Systems; Automotive Plastic Injection Molding	Tallapoosa	AL	36853	217 Thwthet Industrial Park, Dadeville, AL
LeeHan America	Automotive Air Filtration Systems	Chambers	AL	36852	1230 County Road 177, Cusseta, Alabama
Mando America Corporation Alabama	Braking, Steering & Suspension Systems	Lee	AL	36801	4201 N Park Dr, Opelika, AL
Merryweather Foam Inc.	Gaskets, Auto Dunnage, Waterjet Cutting,Sound Control, Packaging Medical Foams	Talladega	AL	35151	1212 Wynette Rd, Sylacauga, AL
MGM Machining Inc.	Copper Electrodes	Shelby	AL	35080	117 Hicks Drive, Helena AL
Mitchell Plastics	Automotive Interior Components	Madison	AL	35811	1619 Highway 72 E, Huntsville, AL
Mobis Alabama LLC	Chassis, Plastic Injection Molding, Distribution	Montgomery	AL	36108	1395 Mitchell Young Rd, Montgomery, AL
Motion Industries Inc.	Bearings, Power Transmissions, Electric Motors, Pumps, Hoses	Jefferson	AL	36108	540 Trade Center Street, Montgomery, AL
MP Tech America LLC	Plastic Injection Molded Interior Parts	Chambers	AL	36852	1450 County Road 177, Cusseta AL
Nemak USA Inc.	Engine Blocks	Talladega	AL	35150	2100 Old Sylacauga Highway, Sylacauga AL
Neocon USA	Powdered Metal Components	Madison	AL	35805	4950 Gilmer Drive NW, Huntsville AL
Nitto Denko Automotive Alabama LLC	Automotive Seals & Gaskets	Walker	AL	35501	3611 Industrial Pkwy, Jasper, AL
OMI (Opelika MetalFab Inc.)	Automotive Shipping Racks, Steel Tubing, Material	Lee	AL	36804	1200 Steel St, Opelika, AL

	Handling Equipment				
Opelika Scrap Material, Inc.		Chambers	AL	36804	2000 Steel St. Opelika, AL
Posco America Corporation (POSCO-AAPC)	Processed Steel	Jefferson	AL	35111	6500 Jefferson Metro Pkwy, mc Calla, AL
Prolific Plastics	Plastic Products (Injection Molding)	Lee	AL	36801	1304 Fox Run Avenue, Opelika AL
Pyongsan America Inc.	Automotive Plastics Components	Lee	AL	36832	760 W Veterans Boulevard, Auburn AL
R O Deaderick Company Inc.	Metalworking Machinery Merchant Wholesaler	Madison	AL	35824	350 Electronics Boulevard SW Huntsville, AL
REHAU Automotive LLC	Plastic Injection Molding, Painting & Assembly	Cullman	AL	35055	2424 Industrial Drive SW, Cullman AL
Richway Transportation Services	Trucking Terminal- Steel Rolls, Finished Products	Butler	AL	36033	572 Highway 31 S, Georgiana, AL
Sabel Steel Service	Steel Distribution	Montgomery	AL	36104	749 N Court Street, Montgomery AL
SaeHaeSung Alabama Corp.	Vehicle Welding & Stamping Parts	Covington	AL	36421	202 Progress Dr, Andalusia, AL
Saudi Basic Industries Corp.(SABIC) Innovative Plastics	Engineered Plastics	Lowndes	AL	36752	1 Plastics Dr, Lowndesboro, AL
SCA Inc.	Automotive Trimmed Exterior Plastic Parts	Lee	AL	36832	2230 Pumphrey Avenue, Auburn AL
Sejin Alabama	Plastic Injection Molded Automotive Parts	Tallapoosa	AL	36853	274 Thweatt Indus Boulevard, Dadeville, AL
Sejong Alabama LLC	Mufflers & Exhaust Systems	Lowndes	AL	36032	450 Old Fort Rd E, Fort Deposit, AL
Seohan Auto USA Corporation	Auto Front & Rear Axle Assembly	Lee	AL	36832	247 Teague Ct, Auburn, AL
Seohan-NTN Driveshaft USA	Constant Velocity Joints for Drive Shaft Assembly	Lee	AL	36832	249 Teague Ct, Auburn, AL
Seoil America Inc.	Automotive Adhesives & Sealants	Elmore	AL	36078	9 Twin Creeks Drive, Tallassee AL
Simcoe Wood Products Inc.	Wooden Pallets	Cullman	AL	35058	3730 al Highway 69 N, Cullman AL
SMI Auto USA Inc.	Automobile Parts Stamping	Lee	AL	36832	155 Alabama Street, Auburn, AL
Southern Metal Fabricators Inc.	Industrial Metal Fabricator	Marshall	AL	35950	1215 Frazier Road, Albertville, AL
SteelFab Inc. of AL	Structural Steel	Randolph	AL	36274	389 Steel View Dr, Roanoke, AL
Store Room Fasteners	Industrial Distribution	Montgomery	AL	36109	2361 Cong W L Dickinson Drive, Montgomery AL
Sumitomo Electric Carbide Inc.	Machine Tools & Supplies Merchant Wholesaler	Madison	AL	35805	5650 Sanderson Street NW # J, Huntsville AL
Sung Woo USA Corporation	Imports, Warehouses, Charge & Transport Batteries	Montgomery	AL	36116	6177 Perimeter Parkway, Montgomery AL
TekLinks	Computer Software Engineering Design Services	Jefferson	AL	35209	201 Summit Parkway, Birmingham AL
Thompson Tractor Company Inc.	Excavating Equipment, Engines Leasing & Distr.	Jefferson	AL	35217	2401 Pinson Valley Pkwy, Birmingham, AL
ThyssenKrupp System Engineering Inc.	Engineering Services (Systems)	Madison	AL	35758	485 Production Avenue 1/2, Madison AL
Tomita USA Inc.	MRO Supplies; Japanese OEM Machinery Parts Distribution	Calhoun	AL	36207	1400 Commerce Blvd # 8, Anniston, AL
Tool Smith Company Inc.	Power Hand Tools Merchant Wholesaler	Jefferson	AL	35233	1300 4th Ave S, Birmingham, AL
Turner Supply Company	Industrial Supplies Distribution	Mobile	AL	36602	250 N Royal St, Mobile, AL
Vulcan Painters Inc.	Industrial Painting Service	Jefferson	AL	35126	1549 Red Hollow Rd, Pinson, AL
WESCO Distribution Inc.	Electrical Supplies & Equipment Distribution	Jefferson	AL	35233	125 32nd St S, Birmingham, AL
YE Tech Alabama Corporation	Automation Equipment for Auto Assembly	Randolph	AL	36274	182 Industrial Ave, Roanoke, AL
YESAC Corporation	Automation Machinery, Pallets & Racks	Elmore	AL	36078	40 Yesac Drive, Tallasse, AL
Yura Corporation	Wiring Harnesses, Spark Plug Stick Coils	Houston	AL	36301	2431 W Main Street # 301, Dothan, AL

Notes*: (*1) Table A.1 gives a list of 117 component suppliers of KMMG West Point assembly plant (25 in Georgia, 92 in Alabama) with company names, supplying components and location information. (2) Only information for suppliers in Georgia and Alabama is collected. Alabama data are from the 2013 Kia supplier list composed and provided by Alabama Department of Commerce based on their Alabama Industrial Database. Georgia data are from the news and articles on Atlanta Journal Constitution, Georgia Chamber of Commerce website, and 2011 and 2013 Troup County Directory of Manufacturers. Address information, if not provided by the previous sources, is from company websites, Google Maps, or www.manta.com.

Table A.2. Employment and Investments of KMMG Suppliers in Georgia

Company	Component	Year	Location	Jobs	2011 Employment	2013 Employment	Investment
Autorica LLC	Factory Automation Systems	2008	Troup, GA	10			
DaeHa America	Plastic resin pellets	2012	Troup, GA			23	
Daehan Solutions Georgia LLC	NVH parts and interior components	2009	Harris, GA	300	191		$35 million
Daewon America	Suspension System	2012	Troup, GA			45	$14 million
DongWon Metals	Automotive stamplings, Door Frames, bumper side absorbers, carriers	2008	Meriwether, GA	300	224	275	$30 million
Glovis America Inc.	Vehicle Processing Center	2009	Troup, GA		250	285	
GLOVIS Georgia LLC	Integrated logistics	2009	Troup, GA	600-700	224	275	$60 million
Hamco America, Inc.	Wheel & Tire Assembly	2009	Troup, GA		4		
Hanil E-Hwa Co., Ltd.	Interior parts	2010	Troup, GA	173	124	225	$8.45 million
Hiteco USA Inc.	Cutting Tool and Machine Tool Accessory Manufacturing	2010	Troup, GA				
Hysco America	Steel supplier	2008	Troup, GA	50	7	9	
Illinois Tool Works, Inc. DaeLim USA	Plastic interior trip parts	2008	Troup, GA	75	200	200	
I-Master Corp.	Automated Systems	2008	Troup, GA		5	8	
Johnson Controls	Automotive seating	2009	Harris, GA	310	661	670	
KSI Kyungshin	Wiring harnesses	2009	Troup, GA	50-70	50	50	$3.5 million
Mando Corp.	Electric power-steering gears and anti-lock brakes	2011	Meriwether, GA	426		200	$200 million
Mobis AL LLC	Front-end modules, front-rolling chassis	2008	Troup, GA	600	350	840	$60 million
Nalara Georgia LLC	Warehousing, Quality Engineering	2012	Troup, GA			9	
Power Tech America	Transmissions	2010	Troup, GA	355	331	481	$150 million
Pretty Products	Floor mats	2008	Troup, GA	130-185	151		$6.5 million
Prowill, LLC	Industrial supplies & services	2011	Troup, GA				
Sejong Georgia LLC	Muffler and exhaust systems	2009	Troup, GA	250	116	176	$27.8 million
Sewon America Inc.	Stamped component and decorative trim	2009	Troup, GA	700	800	912	$170 million
Sumika Polymer Compounds	Plastic Parts	2009	Spalding, GA	50			
Yasufuku, USA, Inc.	Plastic Injection & Blow Molding Parts	2005	Troup, GA		38	50	

Notes: (1) Georgia data are from the news and articles on Atlanta Journal Constitution and Georgia Chamber of Commerce website, and 2011 and 2013 Troup County Directory of Manufacturers. Address information, if not provided by the previous sources, is from company websites, Google Maps, or www.manta.com. (2) Jobs and investment are the announced job numbers and investment when the projects were launched. (3) 2011 and 2013 employment data are from 2011 and 2013 Troup County Directory of Manufacturers respectively. (4) Pretty Products filed bankruptcy in 2010. See: http://www.burbageweddell.com/2010/06/17/pretty-products-bankruptcy-backgound/

Table A.3. Employment and Investments of KMMG Suppliers in Alabama

Company	Component	Year	Location	Jobs	Investment
A-Jin USA (Joon LLC)	Automotive Metal Stamping & Robotic Welding	2008	Lanett, Chambers, AL	450	$89 million
A-Jin USA (Joon LLC)	Automotive Metal Stamping & Robotic Welding	2010	Lanett, Chambers, AL	150	$50 million
Alabama Bolt & Supply Inc.	Hoses, Hydraulics, Fasteners		Montgomery, AL	Na	Na
Alabama Graphics & Engineering Supply Inc.	Reprographics		Montgomery, AL	Na	Na
American Pipe & Supply Co. Inc.	Pipes, Valves, Fitting & Plumbing Distribution	2008	Birmingham, Jefferson, AL	10	$2 million
Atchley Steel Company Inc.	Steel Fabrication		Lee, AL	Na	Na
Bar Bender Steel Inc.	Reinforcement Steel Cutting & Bending Services; Structural Steel & Concrete Distribution		Montgomery, AL	Na	Na
Barloworld Handling LP	Distributes, Leases & Repairs Forklift Trucks		Montgomery, AL	Na	Na
Bermco Aluminum	Aluminum Refining & Smelting	2011	Bessemer, Jefferson, AL	10	$12 million
C & J Tech Alabama	Automotive Plastic Injection Molding	2011	Alexander City, Tallapoosa, AL	150	$9.8 million
CNJ Inc.	Spec. Precision Mach. of Auto Brake Discs & Knuckles	2007	Auburn, Lee, AL	25	$15.10 million
CNJ Inc.	Spec. Precision Mach. of Auto Brake Discs & Knuckles	2010	Auburn, Lee, AL	25	$7.29 million
CNJ Inc.	Spec. Precision Mach. of Auto Brake Discs & Knuckles	2011	Auburn, Lee, AL	18	$20.76 million
Cumberland Plastic Systems LLC	Plastic Automotive Components	2008	Auburn, Lee, AL	10	$1 million
Cumberland Plastic Systems LLC	Plastic Automotive Components	2009	Auburn, Lee, AL	51	$1.9 million
Cumberland Plastic Systems LLC	Plastic Automotive Components	2010	Auburn, Lee, AL	5	$0.5 million
DaeDong Hi-Lex America Inc. (DDHLA)	Door Hardware & Module Systems; Power Window	2008	Cusseta, Chambers, AL	103	$10.9 million
DaeDong Hi-Lex America Inc. (DDHLA)	Door Hardware & Module Systems; Power Window	2010	Cusseta, Chambers, AL	30	$6.5 million
Daeil USA Corporation (Daeil)	Struts & Parts for Automotive Industry	2010	Lanett, Chambers, AL	70	$10.7 million
Daewon America	Suspension Bars & Coils	2007	Opelika, Lee, AL	Na	$7.3 million
Daewon America	Suspension Bars & Coils	2010	Opelika, Lee, AL	Na	$6.2 million
DAS North America	Automotive Seat Components		Montgomery, AL	Na	Na
DSW Converting Knives Inc.	Industrial Knives	2008	Birmingham, Jefferson, AL	5	$0.55 million
DSW Converting Knives Inc.	Industrial Knives	2009	Birmingham, Jefferson, AL	2	$0.21 million
DSW Converting Knives Inc.	Industrial Knives	2011	Birmingham, Jefferson, AL	0	$0.25 million
Fastenal Company	Industrial Supplies, Safety, Jan-san, Tools		Montgomery, AL	Na	Na
Glovis of Georgia	Auto Warehousing & Logistics Sequencing Services	2010	Valley, Chambers, AL	200	$20 million
Halla Climate Systems Alabama Corporation	HVAC Units, Front End Modules/FEM	2007	Shorter, Macon, AL	130	Na
Hanil USA	Plastic & Steel Tube Component Assembly for Fuel Sys.	2007	Tallassee, Elmore, AL	3	$15 million
Hanil USA	Plastic & Steel Tube Component Assembly for Fuel Sys.	2008	Tallassee, Elmore, AL	90	Na
Hanil USA	Plastic & Steel Tube Component Assembly for Fuel Sys.	2010	Tallassee, Elmore, AL	60	$3 million
HPM Alabama Corporation	Injection Moldable Fiber Reinforced Thermoplastics	2011	Auburn, Lee, AL	30	$9.25 million
Hyundai Motor Manufacturing Alabama LLC	Theta Gasoline Direct Injection & Multi Port Injection Engines, 1.8 Liter Nu Engine	2007	Montgomery, Montgomery, AL	522	$270 million
KC Sol-Tech Company Ltd.	Tool & Die		Auburn, Lee, AL	Na	Na
KwangSung America Corp.	Blow Plastic Tubing for Auto Ventilation Systems; Automotive Plastic Injection Molding	2008	Dadeville, Tallapoosa, AL	200	Na

KwangSung America Corp.	Blow Plastic Tubing for Auto Ventilation Systems; Automotive Plastic Injection Molding	2009	Dadeville, Tallapoosa, AL	170	$5 million
KwangSung America Corp.	Blow Plastic Tubing for Auto Ventilation Systems; Automotive Plastic Injection Molding	2011	Dadeville, Tallapoosa, AL	100	$8.30 million
KwangSung America Corp.	Blow Plastic Tubing for Auto Ventilation Systems; Automotive Plastic Injection Molding	2011	Dadeville, Tallapoosa, AL	1000	$8 million
LeeHan America	Automotive Air Filtration Systems	2011	Cusseta, Chambers, AL	51	$3.2 million
Mando America Corporation Alabama	Braking, Steering & Suspension Systems	2007	Lanett, Chambers, AL	16	$3.3 million
Mando America Corporation Alabama	Braking, Steering & Suspension Systems	2007	Opelika, Lee, AL	77	$21 million
Mando America Corporation Alabama	Braking, Steering & Suspension Systems	2008	Opelika, Lee, AL	200	$25 million
Mando America Corporation Alabama	Braking, Steering & Suspension Systems	2010	Opelika, Lee, AL	5	$4.3 million
Mobis Alabama LLC	Chassis, Plastic Injection Molding, Distribution	2007	Montgomery, Montgomery, AL	140	$55.6 million
Mobis Alabama LLC	Chassis, Plastic Injection Molding, Distribution	2010	Montgomery, Montgomery, AL	250	$59.7 million
Mobis Alabama LLC	Chassis, Plastic Injection Molding, Distribution	2011	Montgomery, Montgomery, AL	133	$38.97 million
Motion Industries Inc.	Bearings, Power Transmissions, Electric Motors, Pumps, Hoses	2011	Birmingham, Jefferson, AL	100	Na
MP Tech America LLC	Plastic Injection Molded Interior Parts	2008	Cusseta, Chambers, AL	250	$30 million
OMI (Opelika MetalFab Inc.)	Automotive Shipping Racks, Steel Tubing, Material Handling Equipment		Opelika, Lee, AL	Na	Na
Posco America Corporation (POSCO-AAPC)	Processed Steel	2009	McCalla, Jefferson, AL	60	$17 million
Prolific Plastics	Plastic Products (Injection Molding)	2007	Opelika, Lee, AL	20	$0.4 million
Pyongsan America Inc.	Automotive Plastics Components	2008	Auburn, Lee, AL	90	$5.4 million
Pyongsan America Inc.	Automotive Plastics Components	2010	Auburn, Lee, AL	100	$5.5 million
Pyongsan America Inc.	Automotive Plastics Components	2010	Auburn, Lee, AL	100	$5 million
Sabel Steel Service	Steel Distribution		Montgomery, Montgomery, AL	Na	Na
SCA Inc.	Automotive Trimmed Exterior Plastic Parts	2007	Auburn, Lee, AL	40	$8.2 million
SCA Inc.	Automotive Trimmed Exterior Plastic Parts	2010	Auburn, Lee, AL	180	$15.1 million
SCA Inc.	Automotive Trimmed Exterior Plastic Parts	2011	Auburn, Lee, AL	21	$1.3 million
Sejin Alabama	Plastic Injection Molded Automotive Parts	2007	Dadeville, Tallapoosa, AL	300	$30 million
Sejin Alabama	Plastic Injection Molded Automotive Parts	2009	Dadeville, Tallapoosa, AL	50	$5 million
Sejin Alabama	Plastic Injection Molded Automotive Parts	2010	Dadeville, Tallapoosa, AL	70	$7 million
Sejin Alabama	Plastic Injection Molded Automotive Parts	2011	Dadeville, Tallapoosa, AL	160	$15.79 million
Seohan Auto USA Corporation	Auto Front & Rear Axle Assembly	2007	Auburn, Lee, AL	74	$22 million
Seohan Auto USA Corporation	Auto Front & Rear Axle Assembly	2009	Auburn, Lee, AL	97	$9.69 million
Seohan Auto USA Corporation	Auto Front & Rear Axle Assembly	2011	Auburn, Lee, AL	10	$7.9 million
Seohan-NTN Driveshaft USA	Constant Velocity Joints for Drive Shaft Assembly	2007	Auburn, Lee, AL	96	$16 million
Seohan-NTN Driveshaft USA	Constant Velocity Joints for Drive Shaft Assembly	2009	Auburn, Lee, AL	32	$6.9 million
Seoil America Inc.	Automotive Adhesives & Sealants		Elmore, AL	Na	Na
SMI Auto USA Inc.	Automobile Parts Stamping	2008	Auburn, Lee, AL	33	$3 million
SteelFab Inc. of AL	Structural Steel	2007	Roanoke, Randolph, AL	52	$0.5 million
SteelFab Inc. of AL	Structural Steel	2009	Roanoke, Randolph, AL	Na	$1 million
Store Room Fasteners	Industrial Distribution	2011	Montgomery, Montgomery, AL	5	$1.85 million
Sungwoo USA Corporation	Imports, Warehouses, Charge & Transport Batteries		Montgomery, Montgomery, AL	Na	Na
TekLinks	Computer Software Engineering Design Services	2009	Birmingham, Jefferson, AL	10	$0.5 million
TekLinks	Computer Software Engineering Design Services	2011	Birmingham, Jefferson, AL	0	$1 million
Thompson Tractor Company Inc.	Excavating Equipment, Engines Leasing & Distr.	2007	Birmingham, Jefferson, AL	25	$2 million

Tool Smith Company Inc.	Power Hand Tools Merchant Wholesaler		Jefferson, AL	Na	Na
Vulcan Painters Inc.	Industrial Painting Service		Jefferson, AL	Na	Na
WESCO Distribution Inc.	Electrical Supplies & Equipment Distribution		Jefferson, AL	Na	Na
YE Tech Alabama Corporation	Automation Equipment for Auto Assembly	2009	Roanoke, Randolph, AL	5	$0.2 million
YESAC Corporation	Automation Machinery, Pallets & Racks	2008	Tallassee, Elmore, AL	60	$0.29 million

Notes: (1) Alabama supplier names and components are from the 2013 Kia supplier list composed and provided by Alabama Department of Commerce based on their Alabama Industrial Database. Address information, if not provided by the previous list, is from company websites, Google Maps, or www.manta.com. (2) Jobs and investment are provided by 2007, 2008, 2009, 2010, and 2011 Alabama New and Expanding Industry Announcement prepared by Alabama Development Office. Expansions of the same company in different years are entered as separate entries. Some Kia suppliers are not recorded in the Announcements.

Appendix B. Economic and Business Effects

The tables in appendix B present the actual data based on which the percentage changes and the multipliers are calculated.

Table B.1. Actual Change in Employment by Industry

State	County	Core	Management		Service		Sales and office		Construction		Manufacturing	
			2006	2010	2006	2010	2006	2010	2006	2010	2006	2010
AL	AL		611,109	642,794	301,058	332,117	507,261	499,240	161,695	139,286	308,148	272,147
AL	Core Avg.		14,608	13,421	6,925	6,897	11,272	9,533	3,022	2,243	5,532	4,736
AL	Non-core Avg		3,686	4,250	2,443	2,786	3,919	3,898	1,201	953	2,231	2,312
AL	Autauga	N	6,333	7,268	3,501	3,877	6,515	6,546	2,084	1,434	3,615	3,082
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	N/A	2,051	N/A	1,550	N/A	1,902	539	481	2,655	1,421
AL	Chambers	Y	2,948	3,230	2,130	1,701	3,582	3,155	1,467	908	4,356	2,777
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	8,770	12,097	4,037	5,633	8,264	8,441	3,368	2,278	4,040	4,210
AL	Lee	Y	21,224	22,762	8,868	10,375	15,184	14,753	4,745	3,731	7,387	6,924
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	2,239	1,690	1,746	1,957	2,523	1,954	606	606	550	915
AL	Montgomery	Y	35,556	34,939	16,617	19,148	25,706	25,836	6,370	4,880	10,473	9,395
AL	Pike	N	3,589	4,016	2,513	2,604	3,515	3,650	851	725	2,073	2,496
AL	Randolph	N	1,913	2,450	1,265	1,088	1,636	1,705	736	500	2,412	2,419
AL	Russell	N	4,356	5,824	3,190	4,405	5,408	5,636	1,729	1,502	2,505	2,646
AL	Tallapoosa	Y	4,542	5,447	2,971	2,976	3,623	3,109	1,640	1,180	4,282	3,686
GA	GA		1,442,258	1,491,797	653,198	698,071	1,130,911	1,069,270	384,108	285,015	498,708	446,074
GA	Core Avg.		7,822	7,472	4,831	4,659	6,863	6,898	1,883	1,292	6,208	5,565
GA	Non-core Avg		19,681	20,199	22,927	21,571	3,105	2,982	1,381	1,319	1,834	1,714
GA	Atlanta MSA		892,757	904,916	326,268	350,562	645,929	594,522	206,636	149,737	204,954	193,808
GA	Harris	N	5,321	6,854	1,582	1,628	3,698	3,741	972	942	1,235	1,248
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	N/A	N/A	N/A	N/A	N/A	N/A	814	533	2,076	1,579
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	7,822	7,472	4,831	4,659	6,863	6,898	1,883	1,292	6,208	5,565
GA	Upson	N	34,041	33,544	44,272	41,513	2,511	2,222	2,356	2,482	2,190	2,316

Notes: (1) This table contains the actual raw data of Table 3.1. (2) All data are from ACS 2005-2007 and ACS 2009-2011. Data of Bullock, Crenshaw, Lowndes, Heard, and Talbot, and some data for Butler and Meriwether are not available. (3) 15 counties are selected to create a smaller area of Atlanta MSA. Those counties are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale.

Table B.1. Actual Change in Employment by Industry … Cont'd

State	County	Core	Wholesale trade		Retail trade		Transportation and warehousing		Finance and insurance		Education and health care	
			2006	2010	2006	2010	2006	2010	2006	2010	2006	2010
AL	AL		70,087	54,517	245,235	239,950	104,934	101,662	119,194	113,057	401,690	435,798
AL	Core Avg.		945	758	4,377	4,594	1,547	1,500	2,596	2,160	7,932	9,210
AL	Non-core Avg		444	318	1,897	1,722	761	747	899	853	2,989	3,583
AL	Autauga	N	887	756	2,873	3,037	970	1,444	1,298	1,416	3,514	4,586
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	123	156	983	1,127	340	381	298	266	1,436	1,466
AL	Chambers	Y	235	216	1,488	1,525	846	627	613	635	2,373	2,578
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	861	793	3,309	3,753	1,872	1,353	2,049	1,957	4,593	7,387
AL	Lee	Y	1,284	835	7,504	7,728	1,835	2,162	4,182	3,392	15,675	17,527
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	178	65	1,029	736	250	272	532	120	2,911	2,831
AL	Montgomery	Y	2,600	2,319	11,589	11,823	3,764	3,779	7,352	6,293	19,931	21,169
AL	Pike	N	435	334	1,910	1,596	1,142	863	656	496	3,249	3,746
AL	Randolph	N	265	129	1,177	716	585	463	231	190	1,654	1,886
AL	Russell	N	454	304	2,496	2,524	856	693	1,777	2,044	3,617	4,866
AL	Tallapoosa	Y	566	227	1,387	1,605	625	696	1,080	418	3,581	5,131
GA	GA		157,458	133,743	513,804	507,617	264,611	249,818	298,689	260,308	800,785	886,003
GA	Core Avg.		685	598	3,481	4,144	1,297	1,526	1,502	1,604	5,789	5,721
GA	Non-core Avg		585	555	1,703	1,457	482	335	1,219	948	1,687	2,213
GA	Atlanta MSA		98,991	83,758	277,532	268,755	153,041	143,899	198,783	167,021	395,212	435,161
GA	Harris	N	270	618	1,584	1,627	496	457	1,811	1,241	2,792	4,427
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	213	218	894	1,097	754	487	570	378	1,534	1,652
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	685	598	3,481	4,144	1,297	1,526	1,502	1,604	5,789	5,721
GA	Upson	N	1,273	830	2,631	1,648	197	60	1,276	1,226	736	559

Notes: (1) This table contains the actual raw data of Table 3.1 Cont'd.
(2) All data are from ACS 2005-2007 and ACS 2009-2011. Data of Bullock, Crenshaw, Lowndes, Heard, and Talbot are not available.
(3) 15 counties are selected to create a smaller area of Atlanta MSA. Those counties are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale.

Table B.2. Actual Change in Migration

State	County	Core	Residents from other counties		Residents from other states		Residents from abroad		US born citizen		Foreign-born citizen		Naturalized citizen		Non-citizens	
			2006	2010	2006	2010	2006	2010	2006	2010	2006	2010	2006	2010	2006	2010
AL	AL		152,684	152,446	133,710	114,048	17,909	15,228	4,422,755	4,576,478	130,790	168,416	40,389	50,505	90,401	117,911
AL	Core Avg.		4,391	4,033	3,152	3,210	535	400	84,202	86,894	2,302	3,275	885	1,176	1,873	2,728
AL	Non-core Avg		1,170	1,324	1,662	1,731	81	265	33,797	35,757	566	764	248	252	317	512
AL	Autauga	N	1,596	2,188	2,056	2,145	131	66	47,460	53,122	708	928	419	290	289	638
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	252	326	182	142	0	53	20,167	20,653	20	133	N/A	N/A	N/A	N/A
AL	Chambers	Y	539	739	1,384	847	30	71	34,707	33,585	128	464	15	127	113	337
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	7,934	5,914	1,771	1,373	194	157	73,744	77,064	1,156	1,616	541	488	615	1,128
AL	Lee	Y	8,173	8,390	7,139	7,656	1,208	983	121,278	132,164	5,024	7,084	1,555	1,608	3,469	5,476
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	543	665	1,729	1,184	22	73	22,084	20,670	356	434	76	399	280	35
AL	Montgomery	Y	7,493	7,306	7,930	8,234	1,734	1,026	215,204	217,435	7,036	9,341	2,213	3,443	4,823	5,898
AL	Pike	N	2,170	2,074	763	1,353	78	615	29,131	31,322	649	1,262	55	64	594	1,198
AL	Randolph	N	670	451	1,057	620	54	47	22,280	22,312	156	408	42	75	114	333
AL	Russell	N	872	1,240	2,705	3,353	122	524	48,031	51,361	959	789	650	433	309	356
AL	Tallapoosa	Y	1,955	1,520	507	1,007	45	109	40,113	40,460	448	1,012	103	212	345	800
GA	GA		484,463	455,652	354,713	262,126	58,687	43,655	8,385,737	8,649,632	841,282	941,301	265,429	342,847	575,853	598,454
GA	Core Avg.		2,573	2,681	2,401	1,711	114	496	60,914	63,694	1,553	2,986	402	872	1,151	2,114
GA	Non-core Avg		1,394	1,568	597	202	62	14	25,455	26,389	516	471	229	389	287	225
GA	Atlanta MSA		252,021	239,550	203,755	135,408	36,137	25,283	4,010,963	4,077,738	658,631	715,880	206,099	266,562	452,532	449,318
GA	Harris	N	1,947	1,957	897	253	33	37	26,926	30,760	825	754	591	583	234	171
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	909	1,698	389	119	60	6	22,453	21,789	250	186	0	N/A	250	N/A
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	2,573	2,681	2,401	1,711	114	496	60,914	63,694	1,553	2,986	402	872	1,151	2,114
GA	Upson	N	1,325	1,050	504	233	92	0	26,987	26,617	474	473	97	195	377	278

Notes: (1) This table contains the actual raw data of Table 3.2. (2) All data are from ACS 2005-2007 and ACS 2009-2011. Data of Bullock, Crenshaw, Lowndes, Heard, and Talbot, and some data of Butler and Meriwether are not available. (3) 15 counties are selected to create a smaller area of Atlanta MSA. Those counties are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale.

Table B.3. Actual Change in Education

State	County	Core	Population 25 years and over		Less than 9th grade		9th to 12th grade, no diploma		High school graduate (includes equivalency)	
			2006	2010	2006	2010	2006	2010	2006	2010
AL	AL		3,015,910	3,168,795	199,377	190,935	404,661	371,406	973,126	982,556
AL	Core Avg		54,310	57,667	3,218	2,872	7,152	6,554	16,197	16,917
AL	Non-core Avg		22,167	23,502	1,754	1,571	3,276	3,170	7,728	7,863
AL	Autauga	N	31,540	35,246	1,550	1,669	3,276	3,471	11,290	12,094
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	13,332	14,009	1,084	1,076	2,258	2,404	4,966	5,051
AL	Chambers	Y	23,974	23,589	2,109	1,788	4,626	4,605	8,505	8,120
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	49,147	53,208	2,842	1,981	6,440	5,378	18,104	16,962
AL	Lee	Y	71,089	79,611	3,776	2,892	7,313	8,242	18,465	21,599
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	13,312	12,894	1,281	1,004	1,905	1,873	3,293	3,628
AL	Montgomery	Y	140,048	146,610	6,765	7,387	17,192	14,571	38,352	39,975
AL	Pike	N	18,034	19,071	1,547	880	3,355	2,723	5,965	6,640
AL	Randolph	N	14,988	15,606	1,618	1,904	2,415	2,682	5,966	5,431
AL	Russell	N	32,960	34,691	2,773	2,397	5,430	5,103	12,125	11,522
AL	Tallapoosa	Y	28,269	28,973	2,732	2,107	5,085	4,122	8,792	9,792
GA	GA		5,945,347	6,243,020	378,127	368,744	678,996	612,985	1,799,261	1,821,432
GA	Core Avg		39,856	42,681	3,223	2,866	5,169	5,888	14,209	14,891
GA	Non-core Avg		17,458	18,353	1,331	1,227	2,692	2,244	6,408	6,316
GA	Atlanta MSA		3,032,660	3,124,259	157,105	160,092	247,153	215,493	778,884	748,913
GA	Harris	N	18,880	22,136	1,054	794	1,756	1,443	5,671	6,028
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	15,049	14,625	1,265	1,339	2,609	2,642	6,371	6,062
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	39,856	42,681	3,223	2,866	5,169	5,888	14,209	14,891
GA	Upson	N	18,446	18,297	1,675	1,549	3,712	2,646	7,181	6,859

Notes: (1) This table contains the actual raw data of Table 3.3. (2) All data are from ACS 2005-2007 and ACS 2009-2011. Data of Bullock, Crenshaw, Lowndes, Heard, and Talbot are not available. (3) 15 counties are selected to create a smaller area of Atlanta MSA. Those counties are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale.

Table B.3. Actual Change in Education … Cont'd

State	County	Core	Some college, no degree		Associate's degree		Bachelor's degree		Graduate or professional degree	
			2006	2010	2006	2010	2006	2010	2006	2010
AL	AL		601,540	695,347	199,544	228,587	402,159	445,355	235,503	254,609
AL	Core Avg.		10,649	12,322	3,438	3,719	8,061	9,402	5,595	5,883
AL	Non-core Avg		4,353	5,139	1,374	1,610	2,216	2,739	1,466	1,410
AL	Autauga	N	6,717	8,164	2,196	2,596	4,292	4,961	2,219	2,291
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	2,261	2,586	1,124	967	1,215	1,264	424	661
AL	Chambers	Y	4,547	5,009	1,744	1,367	1,678	1,729	765	971
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	9,817	13,009	3,015	4,149	6,171	7,681	2,758	4,048
AL	Lee	Y	14,319	16,297	5,338	5,866	12,173	14,291	9,705	10,424
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	2,645	3,006	1,165	879	1,650	1,182	1,373	1,322
AL	Montgomery	Y	27,765	31,685	7,457	7,537	24,326	27,919	18,191	17,536
AL	Pike	N	2,904	3,863	585	614	2,162	2,869	1,516	1,482
AL	Randolph	N	2,252	2,979	996	944	857	1,092	884	574
AL	Russell	N	7,247	7,681	1,927	3,015	2,120	3,593	1,338	1,380
AL	Tallapoosa	Y	5,184	5,345	1,948	2,425	2,802	3,526	1,726	1,656
GA	GA		1,130,853	1,310,045	379,421	416,902	1,026,571	1,098,226	552,118	614,686
GA	Core Avg.		7,221	9,025	2,445	2,309	4,868	4,702	2,721	3,000
GA	Non-core Avg		3,075	4,027	1,109	1,150	1,731	2,058	1,111	1,330
GA	Atlanta MSA		584,362	653,766	196,847	213,267	709,138	739,612	359,171	393,116
GA	Harris	N	3,916	5,033	1,643	2,006	3,010	4,166	1,830	2,666
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	2,395	2,723	754	460	881	935	774	464
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	7,221	9,025	2,445	2,309	4,868	4,702	2,721	3,000
GA	Upson	N	2,915	4,325	931	985	1,302	1,073	730	860

Notes: (1) This table contains the actual raw data of Table 3.3 Cont'd. (2) All data are from ACS 2005-2007 and ACS 2009-2011. Data of Bullock, Crenshaw, Lowndes, Heard, and Talbot are not available. (3) 15 counties are selected to create a smaller area of Atlanta MSA. Those counties are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale.

Table B.4. Actual Change in Schooling

State	County	Core	Population 3 years and over enrolled in school		Nursery school, preschool		Kindergarten		Elementary school (grades 1-8)		High school (grades 9-12)		College or graduate school	
			2006	2010	2006	2010	2006	2010	2006	2010	2006	2010	2006	2010
AL	AL		1,165,158	1,232,117	70,367	68,700	63,445	66,480	495,915	509,710	251,292	257,080	284,139	330,147
AL	Core Avg.		25,445	26,656	1,458	1,500	1,133	1,276	9,491	9,588	5,039	4,866	8,324	9,426
AL	Non-core Avg		9,426	10,848	507	476	390	426	3,914	3,975	1,908	2,213	2,707	3,759
AL	Autauga	N	12,783	15,566	796	655	581	832	6,118	6,858	3,060	3,843	2,228	3,378
AL	Bullock	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Butler	Y	4,796	5,201	241	217	340	209	2,247	2,426	1,223	1,226	745	1,123
AL	Chambers	Y	8,038	7,788	493	589	471	451	3,777	3,509	1,919	1,637	1,378	1,602
AL	Crenshaw	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Elmore	Y	18,781	19,723	857	1,416	911	1,433	8,659	8,100	5,067	5,191	3,287	3,583
AL	Lee	Y	48,423	52,793	1,954	2,537	1,326	1,970	13,182	13,762	6,542	6,333	25,419	28,191
AL	Lowndes	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
AL	Macon	N	8,405	6,969	335	403	229	145	2,485	1,683	1,188	1,319	4,168	3,419
AL	Montgomery	Y	63,536	65,368	4,577	3,901	3,116	3,107	24,934	25,706	13,150	12,475	17,759	20,179
AL	Pike	N	9,076	12,318	264	471	271	320	3,009	3,083	1,535	1,582	3,997	6,862
AL	Randolph	N	5,574	4,857	448	198	281	128	2,472	2,577	1,203	1,061	1,170	893
AL	Russell	N	11,291	14,531	690	652	588	703	5,486	5,673	2,555	3,259	1,972	4,244
AL	Tallapoosa	Y	9,095	9,061	624	341	635	484	4,149	4,026	2,332	2,333	1,355	1,877
GA	GA		2,531,690	2,732,121	186,497	179,634	138,732	148,769	1,070,865	1,114,437	542,397	557,274	593,199	732,007
GA	Core Avg		16,897	18,184	1,220	1,554	993	1,283	7,299	8,031	3,974	3,650	3,411	3,666
GA	Non-core Avg		6,425	6,846	525	497	479	307	2,933	2,855	1,449	1,814	1,038	1,373
GA	Atlanta MSA		1,287,880	1,414,816	101,654	99,165	69,932	75,090	551,958	577,255	271,957	290,838	292,379	372,468
GA	Harris	N	7,109	8,551	458	579	480	501	3,188	3,329	1,604	2,240	1,379	1,902
GA	Heard	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Meriwether	N	5,714	5,033	494	478	495	220	2,679	2,142	1,187	1,341	859	852
GA	Talbot	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GA	Troup	Y	16,897	18,184	1,220	1,554	993	1,283	7,299	8,031	3,974	3,650	3,411	3,666
GA	Upson	N	6,451	6,955	623	435	463	201	2,931	3,093	1,557	1,861	877	1,365

Notes: (1) This table contains the actual raw data of Table 3.4. (2) All data are from ACS 2005-2007 and ACS 2009-2011. Data of Bullock, Crenshaw, Lowndes, Heard, and Talbot are not available. (3) 15 counties are selected to create a smaller area of Atlanta MSA. Those counties are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale.

Table B.5. Actual Change in Household Income

State	County	Core	Median Household Income		Mean Household Income	
			2006	2010	2006	2010
AL	AL		40,052	41,973	54,830	58,084
AL	Core Avg		38,692	39,838	51,399	52,947
AL	Non-core Avg		33,147	36,624	45,793	50,250
AL	Autauga	N	48,052	53,471	58,461	64,783
AL	Bullock	Y	N/A	N/A	N/A	N/A
AL	Butler	Y	31,829	29,313	41,342	39,843
AL	Chambers	Y	33,570	31,137	41,119	42,243
AL	Crenshaw	N	N/A	N/A	N/A	N/A
AL	Elmore	Y	50,675	54,075	60,188	66,274
AL	Lee	Y	38,849	41,231	51,287	55,888
AL	Lowndes	N	N/A	N/A	N/A	N/A
AL	Macon	N	26,670	28,424	42,622	40,258
AL	Montgomery	Y	41,973	43,972	60,857	60,284
AL	Pike	N	24,849	31,829	41,147	45,988
AL	Randolph	N	34,908	34,503	46,687	53,747
AL	Russell	N	31,256	34,894	40,050	46,476
AL	Tallapoosa	Y	35,256	39,297	53,602	53,147
GA	GA		48,540	47,690	65,227	65,279
GA	Core Avg.		39,313	41,875	48,639	53,651
GA	Non-core Avg		31,039	35,854	40,014	45,537
GA	Harris	N	57,045	69,764	72,053	88,164
GA	Heard	N	N/A	N/A	N/A	N/A
GA	Meriwether	N	35,560	37,569	46,042	45,960
GA	Talbot	N	N/A	N/A	N/A	N/A
GA	Troup	Y	39,313	41,875	48,639	53,651
GA	Upson	N	511	230	1,948	2,486

Notes: (1) All the data are calculated based on ACS 2005-2007 and ACS 2009-2011 estimates. (2) Unit of all the numbers are percentages. Data of Bullock, Crenshaw, Lowndes, Heard, Talbot, and Atlanta MSA are not available. (3) 15 counties are selected to create a smaller area of Atlanta MSA. Those counties are: Carroll, Cherokee, Clayton, Cobb, Coweta, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Henry, Paulding, and Rockdale.