# Contents

Preface ............................................................................................................................................. i
  Acknowledgements ......................................................................................................................... ii
  Chapter Authors and Other Contributors .................................................................................. iii

Executive Summary ............................................................................................................................. v
  Transportation Issues Affecting Agricultural Shippers ............................................................... v
  Transportation Supports Rural America ........................................................................................ vi
  Transporting Biofuels ..................................................................................................................... vii
  Transporting Coal ........................................................................................................................ vii
  Rail Competition and Agriculture ............................................................................................... viii
  Rail Rates ..................................................................................................................................... ix
  Rail Service ................................................................................................................................... ix
  Rail Capacity .................................................................................................................................. x
  Rail Investment ............................................................................................................................... x
  Rail Rate Relief .............................................................................................................................. xi
  Barge Transportation ................................................................................................................... xi
  Truck Transportation .................................................................................................................... xii
  Ocean Transportation .................................................................................................................. xiii
  Multimodal Issues ......................................................................................................................... xiii

Contents ............................................................................................................................................ xv

Figures ............................................................................................................................................ xx

Tables .......................................................................................................................................... xxvii

Chapter 1: Introduction and Overview ........................................................................................... 1
  Agriculture Requires Transportation ......................................................................................... 1
  Agriculture, Trade, and the Economy ....................................................................................... 3
  Railroads ...................................................................................................................................... 4
  Barge Transportation ................................................................................................................ 8
  Ocean Transportation ............................................................................................................... 11
  Truck Transportation ............................................................................................................... 15
  Conclusions .............................................................................................................................. 18

Chapter 2: The Importance of Freight Transportation to Agriculture ........................................... 19
  How Agriculture Uses Transportation ..................................................................................... 20
  Relative Modal Importance ....................................................................................................... 22
  Moving Agricultural Commodities to Market ......................................................................... 27
  Grains and Oilseeds Profile ....................................................................................................... 27
  Corn Profile ............................................................................................................................... 34
  Soybean Profile .......................................................................................................................... 40
  Wheat Profile .............................................................................................................................. 44
  Rice Profile ................................................................................................................................. 49
  Livestock and Livestock Products Profile ............................................................................... 54
  Meat and Poultry Exports Outlook ......................................................................................... 60
  Cattle and Beef Profile .............................................................................................................. 63
# Table of Contents

- Hogs and Pork Profile ................................................................. 67
- Poultry Profile ......................................................................... 70
- Dairy Profile ........................................................................... 73
- Fruit and Vegetables Profile ....................................................... 79
- Apple, Lettuce, and Potato Profiles .......................................... 89
- Apple Profile ........................................................................... 90
- Lettuce Profile ......................................................................... 92
- Potato Profile .......................................................................... 95
- Trends in Fruit and Vegetable Consumption .............................. 98
- Fertilizer Profile ....................................................................... 102
- Conclusions ............................................................................ 113

Chapter 3: How Freight Transportation Supports Rural America .......... 115
- Rural America ......................................................................... 116
- Rural Vitality ........................................................................... 122
- Rural Manufacturing .................................................................. 123
- Conclusions ............................................................................ 129
- Appendix 3-1 ........................................................................... 130

Chapter 4: Biofuels Transportation .................................................. 131
- The Current Distribution System ............................................... 132
- EPA’s Biofuel Distribution Analysis ........................................... 138
- Ethanol and Co-product Transportation ..................................... 142
- Potential Phases of Biofuels Expansion from the Transportation Demand Perspective ...... 147
- Market Uncertainty and its Implications for Infrastructure Investment ....................... 148
- Conclusions ............................................................................ 151

Chapter 5: Coal Transportation ........................................................ 153
- Production ............................................................................... 155
- Demand and Utilization ............................................................ 160
- Transportation Flows ............................................................... 170
- Rail Rates ............................................................................... 173
- Service .................................................................................... 177
- Paper Barriers ......................................................................... 184
- Bottleneck Rates ..................................................................... 186
- Recent Decision by STB in Favor of Coal Shippers ....................... 189
- Conclusions ............................................................................ 189

Chapter 6: Rail Competition and its Importance to Agriculture ............ 191
- U.S. Agriculture Depends on Rail Transportation .......................... 191
- Government Promotion and Regulation of Railroads ..................... 193
- Rail Competition in an Era of Deregulation .................................. 197
- Rail-to-Rail Competition .......................................................... 203
- Geographic and Product Competition ........................................ 205
- Railroad Concentration and Market Shares .................................. 210
- Inverse Herfindahl-Hirschman Analysis of Rail-to-Rail Competition ......................... 213
- Comparison of Rail-to-Rail Competition and Distance-to-Water Transportation by State .... 225
- Conclusions ............................................................................ 230
Figures

Figure 1-1: U.S. agricultural supply chain for raw and processed products ........................................... 1
Figure 1-2: Refrigerated trucks enable the trucking industry to provide special services ........ 2
Figure 1-3: A unit train has more than 50 cars, all of which are shipped from the same origin to the same destination ........................................................................................................ 7
Figure 1-4: A 1,200-foot barge tow—a common length—passes through a 600-foot lock in two stages ....................................................................................................................................... 10
Figure 1-5: The Estelle Maersk has a capacity of 11,000 TEUs .......................................................... 13
Figure 1-6: Highways are vital to the trucking industry ...................................................................... 15
Figure 2-1: Peas being harvested directly into a field truck ............................................................. 19
Figure 2-2: Agricultural and total freight moving on U.S. interstate system, 2002 ......................... 20
Figure 2-3: Agricultural and total freight moving on U.S. rail lines, 2006 ....................................... 21
Figure 2-4: Agricultural and total freight moving on U.S. waterways ............................................. 22
Figure 2-5: Grain movements by type of movement, 1978 to 2006 ................................................. 31
Figure 2-6: Grain movements by mode, 1978 to 2006 ................................................................... 31
Figure 2-7: Location of elevator storage capacity, with rail and barge systems ......................... 33
Figure 2-8: Grain and oilseed milling facilities, 2000 ................................................................. 34
Figure 2-9: Corn surplus/deficit map with the transportation system ............................................. 36
Figure 2-10: Modal shares of corn exports, 2000-2006 ................................................................. 39
Figure 2-11: Corn export inspections by port region, 2007 ........................................................... 39
Figure 2-12: Soybean surplus/deficit map with transportation system ........................................ 41
Figure 2-13: Modal shares of soybean exports, 2000-2006 ........................................................... 42
Figure 2-14: Soybean exports by port region .................................................................................. 44
Figure 2-15: Wheat surplus/deficit map with a transportation system overlay ............................ 46
Figure 2-16: Modal shares of wheat exports, 2000-2006 .............................................................. 47
Figure 2-17: Wheat exports by port region ...................................................................................... 49
Figure 2-18: Rice being harvested into a bankout truck ................................................................. 50
Figure 2-19: Rice surplus/deficit map with transportation system overlay .................................. 53
Figure 2-20: 2007 waterborne rice exports by port region .......................................................... 54
Figure 2-21: Estimated grain-consuming animal units per county .............................................. 55
Figure 2-22: Livestock processing facilities, 2002 ....................................................................... 56
Figure 2-23: U.S. per-capita meat consumption .......................................................................... 58
Figure 2-24: U.S. meat exports ...................................................................................................... 59
Figure 2-25: U.S. red meat and poultry production ......................................................................... 59
Figure 2-26: Long-term projections of U.S. meat and poultry exports ......................................... 61
Figure 2-27: U.S. red meat surplus-deficit ....................................................................................... 64
Figure 2-28: Port regions moving beef exports, 2007 ................................................................. 66
Figure 2-29: Port regions moving pork exports, 2007 ................................................................. 69
Figure 2-30: U.S. poultry meat surplus-deficit ................................................................................. 71
Figure 2-31: Top ten ports moving poultry exports, 2007 ............................................................ 72
Figure 2-32: Dairy farms have been getting larger, driven by economies of scale .................... 74
Figure 2-33: U.S. dairy surplus-deficit, U.S. highway system ..................................................... 75
Figure 2-34: U.S. port regions used to move dairy exports, 2007 ........................................ 76
Figure 2-35: Loading oranges in California ........................................................................ 80
Figure 2-36: Fruit and vegetable processors per State ........................................................ 83
Figure 2-37: U.S. ports used to export vegetables, 2007 .................................................. 87
Figure 2-38: U.S. ports used to import vegetables, 2007 .................................................. 87
Figure 2-39: U.S. ports used to export fruit, 2007 .............................................................. 88
Figure 2-40: U.S. ports used to import fruit, 2007 .............................................................. 88
Figure 2-41: U.S. apple surplus/deficit map with transportation overlay .......................... 90
Figure 2-42: Ports used to export U.S. apples, 2007 .......................................................... 91
Figure 2-43: Ports used to import U.S. apples, 2007 .......................................................... 92
Figure 2-44: U.S. lettuce surplus/deficit map with transportation network ....................... 93
Figure 2-45: Ports used to export U.S. lettuce, 2007 .......................................................... 94
Figure 2-46: Ports used to import U.S. lettuce, 2007 .......................................................... 95
Figure 2-47: U.S. potato surplus/deficit map with transportation overlay ............................ 96
Figure 2-48: U.S. ports used to export potatoes, 2007 ....................................................... 97
Figure 2-49: Ports used to import U.S. potatoes, 2007 ....................................................... 98
Figure 2-50: Value of import horticulture trade ................................................................. 99
Figure 2-51: Fertilizer use from 1960 to 2007 ................................................................. 104
Figure 2-52: Fertilizer production facilities ........................................................................ 106
Figure 2-53: Nitrogen fertilizer use, top 10 States ............................................................. 107
Figure 2-54: Phosphate fertilizer use, top 10 States .......................................................... 108
Figure 2-55: Potash fertilizer use, top 10 States ................................................................. 108
Figure 2-56: U.S. international fertilizer trade – 10-year history ...................................... 109
Figure 2-57: U.S. fertilizer imports, top 10 supplying countries, 2008 ............................... 110
Figure 2-58: U.S. fertilizer export customers, top 10 countries, 2008 ............................... 110
Figure 2-59: Fertilizer modal share .................................................................................. 111
Figure 3-1: People often choose to live in rural areas for a more relaxed quality of life and closeness to nature ......................................................................................... 115
Figure 3-2: Rural and metropolitan counties ..................................................................... 116
Figure 3-3: Rural America depends on trucks to move its products .................................. 117
Figure 3-4: Composition of rural employment .................................................................. 118
Figure 3-5: Per-capita income gap .................................................................................... 122
Figure 4-1: Ethanol being loaded into rail tank cars ......................................................... 132
Figure 4-2: U.S. ethanol production, 1981-2008 ............................................................ 133
Figure 4-3: The U.S. ethanol market landscape in 2007 ..................................................... 134
Figure 4-4: Ethanol Distribution ....................................................................................... 135
Figure 4-5: The Petroleum Administration for Defense Districts (PADD) and their typical share of consumption of all U.S. motor gasoline consumption .......................... 136
Figure 4-6: Corn stover being gathered for ethanol production ...................................... 137
Figure 4-7: Projected U.S. cellulosic ethanol facilities ...................................................... 138
Figure 4-8: Energy Independence and Security Act 2007, Renewable Fuel Standard (RFS-2) ............................................................................................................................................. 139
Figure 4-9: Key rail corridors for shipping ethanol and DDGS ......................................... 141
Figure 4-10: Ethanol modal shares in 2006 ..................................................................... 143
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 4-11</td>
<td>Quarterly carloads of alcohol and co-products terminated by major railroads in the United States, 4th quarter 2003-1st quarter 2009</td>
</tr>
<tr>
<td>Figure 4-12</td>
<td>Loading a truck with DDGS in South Dakota</td>
</tr>
<tr>
<td>Figure 4-13</td>
<td>U.S. exports of DDGS, Jan 2006–Feb 2009</td>
</tr>
<tr>
<td>Figure 4-14</td>
<td>Major destinations of U.S. DDGS exports, Jan–Feb, 2009</td>
</tr>
<tr>
<td>Figure 4-15</td>
<td>DOE’s estimate of intermediate saturation points</td>
</tr>
<tr>
<td>Figure 5-1</td>
<td>U.S. electric power industry net generation, 2007</td>
</tr>
<tr>
<td>Figure 5-2</td>
<td>U.S. coal production by region, 1949-2007</td>
</tr>
<tr>
<td>Figure 5-3</td>
<td>Coal production by region, 2008, million tons and percent change from 2007</td>
</tr>
<tr>
<td>Figure 5-4</td>
<td>Coal trains passing in Wyoming</td>
</tr>
<tr>
<td>Figure 5-5</td>
<td>Number of coal mines per state</td>
</tr>
<tr>
<td>Figure 5-6</td>
<td>Value of coal shipments per state</td>
</tr>
<tr>
<td>Figure 5-7</td>
<td>U.S. coal consumption by sector, 1987-2006</td>
</tr>
<tr>
<td>Figure 5-8</td>
<td>Share of electric power sector net generation by energy source, 2007 and 2008</td>
</tr>
<tr>
<td>Figure 5-9</td>
<td>U.S. electric industry net generation by State, 2007</td>
</tr>
<tr>
<td>Figure 5-10</td>
<td>Electric power sector coal consumption by census region, 2008</td>
</tr>
<tr>
<td>Figure 5-11</td>
<td>Proportion of electricity capacity from coal, 1990</td>
</tr>
<tr>
<td>Figure 5-12</td>
<td>Proportion of total electricity capacity from coal, 2007</td>
</tr>
<tr>
<td>Figure 5-13</td>
<td>Number of electricity producers per State, 1990</td>
</tr>
<tr>
<td>Figure 5-14</td>
<td>Number of electricity producers per State, 2007</td>
</tr>
<tr>
<td>Figure 5-15</td>
<td>America’s electric cooperative network</td>
</tr>
<tr>
<td>Figure 5-16</td>
<td>Total annual up-bound waterborne coal shipments, 2007</td>
</tr>
<tr>
<td>Figure 5-17</td>
<td>Total annual down-bound waterborne coal shipments, 2007</td>
</tr>
<tr>
<td>Figure 5-18</td>
<td>Density of coal shipments by rail</td>
</tr>
<tr>
<td>Figure 5-19</td>
<td>Annual rail shipments of coal in 1987-2006 by real revenue, tonnage</td>
</tr>
<tr>
<td>Figure 5-20</td>
<td>STB rail rate index, 1985 to 2007</td>
</tr>
<tr>
<td>Figure 5-21</td>
<td>Coal rates and car ownership</td>
</tr>
<tr>
<td>Figure 5-22</td>
<td>Coal rates and shipment distance</td>
</tr>
<tr>
<td>Figure 5-23</td>
<td>Changes in average speed by railroad and train type, 1999-2005</td>
</tr>
<tr>
<td>Figure 5-24</td>
<td>Year-end coal stocks, 1999-2008</td>
</tr>
<tr>
<td>Figure 5-25</td>
<td>On-time delivery index for coal shipments, 1997-2008</td>
</tr>
<tr>
<td>Figure 5-26</td>
<td>On-time average for rail shipments: grain and coal</td>
</tr>
<tr>
<td>Figure 5-27</td>
<td>Captive vs. competitive freight rail rates</td>
</tr>
<tr>
<td>Figure 6-1</td>
<td>Railroad shipment/grain production ratio, average 2004-2007 marketing years</td>
</tr>
<tr>
<td>Figure 6-2</td>
<td>Railroad grain origination market shares, 2007</td>
</tr>
<tr>
<td>Figure 6-3</td>
<td>Railroad grain origination market shares, 1980</td>
</tr>
<tr>
<td>Figure 6-4</td>
<td>Railroad wheat origination market shares, 2007</td>
</tr>
<tr>
<td>Figure 6-5</td>
<td>Railroad wheat origination market shares, 1994</td>
</tr>
<tr>
<td>Figure 6-6</td>
<td>Inverse HHI for grain and oilseed shipments by rail, 2003-2007</td>
</tr>
<tr>
<td>Figure 6-7</td>
<td>Inverse HHI for grain and oilseed shipments by rail, 1985-1992</td>
</tr>
<tr>
<td>Figure 6-8</td>
<td>Change in inverse HHI for grain and oilseed shipments by rail, 1985-1992</td>
</tr>
</tbody>
</table>
Figure 6-9: Change in R/VC for grain and oilseed shipments by rail, 1985-1992 compared to 2003-2007 ................................................................. 213
Figure 6-10: Grain and oilseeds: nominal rail revenues per ton for States with less transportation competition, by year ........................................ 221
Figure 6-11: Grain and oilseeds: nominal rail revenues per ton for States with more transportation competition, by year ........................................ 222
Figure 6-12: Grain and oilseeds: rail R/VC ratios for States with less transportation competition, by year ....................................................... 223
Figure 6-13: Grain and oilseeds: rail R/VC ratios for States with more transportation competition, by year ....................................................... 223
Figure 6-14: Grain and oilseeds: nominal rail (tariff only) revenues per ton for States with less transportation competition, by year .......... 224
Figure 6-15: Grain and oilseeds: nominal rail (tariff only) revenues per ton for States with more transportation competition, by year .......... 228
Figure 6-16: Grain and oilseeds: rail R/VC ratios (tariff) for States with less transportation competition, by year ....................................................... 229
Figure 6-17: Grain and oilseeds: rail R/VC ratios (tariff only) for States with more transportation competition, by year ....................................................... 229
Figure 6-18: Inverse Herfindahl Index for rail shipments: grain products for 2003 to 2007.. 232
Figure 6-19: Inverse Herfindahl Index for rail shipments: grain products for 1985 to 1992.. 232
Figure 6-20: Inverse Herfindahl Index for rail shipments: grain products period 1 to period 3 ................................................................. 233
Figure 6-21: Inverse Herfindahl Index for rail shipments: grain products period 1 to period 3 ................................................................. 233
Figure 6-22: Inverse Herfindahl Index for rail shipments: food products 2003 to 2007.... 234
Figure 6-23: Inverse Herfindahl Index for rail shipments: food products 1985 to 1992.... 234
Figure 6-24: Change in Inverse Herfindahl Index for rail shipments: food products period 1 to period 3 ................................................................. 235
Figure 6-25: Change in revenue to variable cost for rail shipments: food products period 1 to period 3 ................................................................. 235
Figure 6-26: Change in Inverse Herfindahl Index for rail shipments: fertilizer products period 1 to period 3 ................................................................. 236
Figure 6-27: Change in revenue to variable costs for rail shipments: fertilizer products period 1 to period 3 ................................................................. 236
Figure 7-1: Wheat—average rail tariff compared to average farm price .................. 239
Figure 7-2: STB rail rate index ........................................................................ 242
Figure 7-3: Tonnage traveling at rates over 300 percent R/VC, 1985-2005 ............... 244
Figure 7-4: Percent of grain and oilseed tons moved at R/VC over 300 percent ...... 245
Figure 7-5: Selected States with higher percentages of grain and oilseeds moving at R/V. 246
Figure 7-6: Miscellaneous revenue in waybill sample, 2000-2005 .......................... 246
Figure 7-7: Rate changes for coal, grain, mixed shipments, and motor vehicles ....... 247
Figure 7-8: Average freight revenue per grains and oilseeds carload ..................... 248
Figure 7-9: Railroad fuel surcharges ................................................................ 249
Figure 7-10: Average quarterly revenue per railcar for wheat ............................... 249
Figure 7-11: Grain rates and car ownership................................................................. 250
Figure 7-12: Grain and oilseeds tariff revenue (current $’s) per ton-mile by shipment size . 251
Figure 7-13: Grains and oilseeds revenue (current $’s) per ton-mile by shipment size. 253
Figure 7-14: U.S. grain hopper car fleet capacity....................................................... 254
Figure 7-15: U.S. covered hopper car fleet ................................................................. 256
Figure 7-16: Railroad fuel surcharges for grain by quarter ..................................... 258
Figure 7-17: Comparison of grain fuel surcharges to railroad fuel costs .............. 260
Figure 7-18: Class I railroad cost of capital and return on net investment, 1997-2007 ... 261
Figure 7-19: Class I railroad profitability, 1998-2007 ............................................... 265
Figure 7-20: Railroad industry average cost, variable cost, and fixed cost in dollars per ton-mile ........................................................................................................ 266
Figure 7-21: Railroad industry average revenue and marginal costs ...................... 267
Figure 7-22: Grain products revenue (current $) per ton-mile by shipment size .... 269
Figure 7-23: Grain products revenue (current $) per ton-mile by shipment distance 273
Figure 7-24: Food products revenue (current $) per ton-mile by shipment size .... 273
Figure 7-25: Food products revenue (current $) per ton-mile by shipment distance 274
Figure 7-26: Fertilizer revenue (current $) per ton-mile by shipment size ... 274
Figure 7-27: Fertilizer revenue (current $) per ton-mile by shipment distance .... 275
Figure 7-28: Fertilizer revenue (current $) per ton-mile by shipment distance .... 275
Figure 8-1: Average on-time delivery index for all Class I Railroads for grain ......... 278
Figure 8-2: Customer service index for Class I Railroads for grain ...................... 281
Figure 8-3: Average on-time delivery index for grain—BNSF & UP ...................... 281
Figure 8-4: Customer service index for grain—BNSF & UP .................................. 283
Figure 8-5: Average on-time delivery index for grain – CSXT & Norfolk Southern .. 283
Figure 8-6: Customer service index for grain—CSXT & Norfolk Southern .......... 284
Figure 8-7: Customer service index for grain—CN & C .......................................... 284
Figure 8-8: Customer service index for grain—CSXT, NS, CN, and CP ................. 285
Figure 8-9: Percentage of grain and oilseeds by type of movement .................... 286
Figure 8-10: Grain tonnages moved by type of covered hopper car .................... 290
Figure 8-11: Percentage of grain moved by type of covered hopper car .......... 291
Figure 8-12: Schematic of a paper barrier .............................................................. 292
Figure 8-13: Schematic of a paper barrier .............................................................. 295
Figure 9-1: Change in rail tonnage and real gross domestic product, 2000 to 2007..... 306
Figure 9-2: Estimated interstate capacity to 2010 ............................................... 307
Figure 9-3: Rail capacity in 2007 ........................................................................... 308
Figure 9-4: Rail commodity flow map of total vs. agricultural component ........ 309
Figure 9-5: Average train speed, all trains, 1999–2003 .......................................... 312
Figure 9-6: Average train speed for grains, 1999-2003 ........................................ 313
Figure 9-7: Average train speed (all trains) from 2004-2008 ................................. 314
Figure 9-8: Average train speed for grains, 2004-2008 ........................................ 315
Figure 9-9: Average BNSF Railway train speed (all trains), 2003-2008 .............. 316
Figure 9-10: Average BNSF Railway train speed for grain, 2003-2008 .............. 317
Figure 9-11: Average Union Pacific train speed (all trains), 2003-2008 .......... 318
Figure 9-12: Average Union Pacific train speed for grains, 2003-2008 .............. 319
Figure 9-13: Average train dwell times, 2001-2004 .................................................. 320
Figure 9-14: Average train dwell times, 2005-2008 .................................................. 321
Figure 9-15: Average train dwell times for BNSF Railway, 2003-2008 .................. 322
Figure 9-16: Average train dwell times for Union Pacific, 2003-2008 .................. 322
Figure 9-17: Average train dwell times for Norfolk Southern, 2003-2008 ............ 323
Figure 9-18: Average train dwell times for CSX, 2003-2008 ................................. 324
Figure 9-19: Average train dwell times for CN, 2003-2008 ................................. 325
Figure 9-20: Miles of track of Class I Railroads, 1987-2006 ................................. 326
Figure 9-21: Percent of track miles owned and operated by Class I Railroads, 1987-2006 ... 326
Figure 10-1: Railroads must invest in infrastructure to keep up with increasing transportation demand .......................................................... 333
Figure 10-2: Class I Railroad capital expenditures .................................................. 340
Figure 10-3: A Norfolk Southern dispatch center. Railroads have been investing in new technology to increase efficiency ........................................ 343
Figure 10-4: The Alameda Corridor moves freight quickly through Los Angeles to the Port of LA ................................................................. 346
Figure 12-1: Ohio packet boats in the early 19th Century ........................................ 369
Figure 12-2: Barge tonnage by commodity group, 2007 .......................................... 371
Figure 12-3: Agriculturally-significant waterways .................................................. 372
Figure 12-4: Barge Tow on the Mississippi River ..................................................... 373
Figure 12-5: Grain barge being loaded ................................................................. 376
Figure 12-6: Quarterly barge rates from St. Louis to New Orleans, 2004-08 ......... 379
Figure 12-7: Weekly barge rates, St. Louis to New Orleans, 10-year average (1990-1999) ... 380
Figure 12-8: Grain barge rates in 2008 above the 4-year average ............................. 381
Figure 12-9: Quarterly barge rates from St. Louis to New Orleans, 1994-2009 ........ 381
Figure 12-10: Spot barge rates, pre- & post-Katrina .............................................. 382
Figure 12-11: Katrina corn basis impact in 2005 ..................................................... 382
Figure 12-12: Upper Mississippi River and the Illinois Waterway ......................... 384
Figure 12-13: Building Olmsted locks and dam on the Ohio River. Construction work began in 1991 and originally was scheduled to be finished by 2006 ...... 387
Figure 12-14: Annual commercial tonnage and lockage numbers at Lock 25, 1989-2009....... 388
Figure 12-15: A barge tow on the Mississippi river in St. Louis ............................... 390
Figure 12-16: Missouri River .................................................................................. 392
Figure 12-17: Big Bend Dam on the Missouri River, South Dakota. One of the six reservoirs making up the Missouri River system ............................................. 393
Figure 12-18: Columbia-Snake River System ......................................................... 394
Figure 12-19: Barge tow on the Columbia River .................................................... 395
Figure 13-1: Unloading a truck. Trucks are usually the first and last links in the supply chain ................................................................. 403
Figure 13-2: Half of all trucking operations are owner-operator companies .......... 405
Figure 13-3: Potato harvest being loaded into trucks ............................................. 408
Figure 13-4: Trucks in line to load during a wheat harvest. Many extra drivers are needed during the harvest season .......................................................... 417
**Tables**

| Table 2-1: | Transportation characteristics of agricultural commodities, 2002 and 2007 | 24 |
| Table 2-2: | Modal transportation characteristics of agricultural commodities by volume, 2002 | 25 |
| Table 2-3: | Modal transportation characteristics of agricultural commodities, by ton-miles, 2002 | 26 |
| Table 2-4: | Key Supply and Demand Indicators: U.S. Major eight Field Crops, (million metric tons) | 29 |
| Table 2-5: | Corn usage by sector, percentage | 34 |
| Table 2-6: | U.S. corn supply and use for various marketing years, million bushels | 35 |
| Table 2-7: | Corn modal shares | 38 |
| Table 2-8: | U.S. soybean supply and use for various marketing years (in million bushels) | 40 |
| Table 2-9: | Soybean modal shares, 2000-2006 | 43 |
| Table 2-10: | U.S. wheat supply and use, (million bushels) | 45 |
| Table 2-11: | Wheat modal shares, 2000–2006 | 48 |
| Table 2-12: | U.S. rough and milled rice (rough equivalent) supply and use (million hundredweights) | 51 |
| Table 2-13: | Share of private vs. for-hire truck activity, 2002 | 57 |
| Table 2-14: | U.S. beef, pork, chicken, and turkey supply and use long-term projections | 62 |
| Table 2-15: | Major U.S. cattle slaughter States, 2007 | 63 |
| Table 2-16: | U.S. beef supply and use, 1999-2009 | 65 |
| Table 2-17: | Hogs and pigs inventory in major States on December 1, 1987-2007 | 67 |
| Table 2-18: | U.S. pork supply and use, 2004-2008 | 68 |
| Table 2-19: | Major U.S. chicken slaughter States, 2007 | 70 |
| Table 2-20: | U.S. poultry supply and use, 2007 | 72 |
| Table 2-21: | Major milk producing States, 2007 | 75 |
| Table 2-22: | U.S. dairy supply and use long-term projections | 78 |
| Table 2-23: | Supply and demand of apples, lettuce, and potatoes | 89 |
| Table 2-24: | Fruit and vegetable long-term supply and use projections | 101 |
| Table 2-25: | Chemical fertilizer movements for rail and barge | 112 |
| Table 3-1: | Comparison of economic and demographic indicators in metropolitan and rural America | 119 |
| Table 3-2: | Key economic and demographic indicators for nonmetropolitan America | 120 |
| Table 3-3: | Population employed in manufacturing | 123 |
| Table 3-4: | Rural population employed in manufacturing by State | 124 |
| Table 3-5: | Rural manufacturing employment by sector in 1996 | 125 |
| Table 3-6: | Major factors affecting rural manufacturers | 127 |
| Table 4-1: | EPA projected renewable fuel volumes (billion gallons) | 140 |
| Table 4-2: | Summary of EPA-projected renewable fuel volumes (billion gallons) | 140 |
| Table 4-3: | Ethanol capacity distribution, March 2008 | 142 |
| Table 4-4: | Renewable Fuels Standard-2 (as mandated by EISA 2007) and possible phases | 148 |
| Table 5-1: | Electric utility providers by type of ownership | 167 |
Table 5-2: Sales by customer type and by type of ownership ................................. 167
Table 5-3: Changes in average speed by railroad and train type, 1999-2005 .............. 177
Table 5-4: Variability in average train speed by railroad and train type, measured by coefficients of variation................................................................. 179
Table 5-5: Summary of STB consumer complaint statistics, 2005-2008 ....................... 183
Table 6-1: Number of two-party agreements required to collude .............................. 208
Table 6-2: Grain and oilseeds, changes in inverse HHI by number of CRD ..................... 218
Table 6-3: Grain and oilseeds, changes in R/VC ratios by inverse HHIs ....................... 220
Table 6-4: Grain and oilseeds, comparisons of nominal tariff rail revenue per ton and ton-mile and R/VC by State (in $/ton) ................................................... 226
Table 6-5: Summary of HHIs and R/VCs for four commodity groups analyzed by number of CRDs ............................................................ 237
Table 7-1: U.S. covered hopper car fleet ................................................................. 257
Table 7-2: Merger of Atchison, Topeka & Santa Fe with Burlington Northern ............... 262
Table 7-3: Union Pacific purchase of Southern Pacific .............................................. 263
Table 7-4: Union Pacific Purchase of Chicago Northwestern (CNW) .......................... 263
Table 8-1: On-time delivery and customer service indices by Class I railroads, June 2, 1997 through December 8, 2008 .................................................. 287
Table 8-2: Summary of UP/M&NA lease contract .................................................. 297
Table 8-3: Complaint cases by category and region, 2008 ......................................... 300
Table 8-4: Complaint cases by category and region, 2006 .......................................... 301
Table 8-5: Complaint cases by category and region, 2005 ......................................... 301
Table 8-6: Complaint cases by commodity group, 2005, 2006, and 2008 .................... 302
Table 9-1: Percent of privately owned railcars on line, 1999–2007 ............................ 327
Table 9-2: Freight railcar acquisitions, 1981–2007 ................................................... 328
Table 9-3: Selected railcar fleet statistics, 1976–2007 ............................................... 329
Table 9-4: Selected locomotive fleet statistics, 1992–2007 ........................................ 330
Table 9-5: Changes in annual expenditures for Class I Railroads, 1988–2006 .............. 331
Table 10-1: Eastern railroads, capital expenditures ($1,000) ...................................... 341
Table 10-2: Western railroads, capital expenditures ($1,000) ...................................... 342
Table 12-1: Covered barges on the Mississippi River system, by operator, 2008 ........... 375
Table 12-2: Quarterly barge rates from St. Louis to New Orleans, 2004–2008 .......... 378
Table 12-3: Importance of Upper Mississippi River and Illinois Waterway to agriculture ... 389
Table 12-4: Up-bound and down-bound barge tonnage, by river, 1998–2007 .......... 396
Table 12-5: Current funding allocations for inland waterway projects ....................... 399
Table 12-6: Up-bound and down-bound barge tonnage, by river, 1998–2007 .......... 402
Table 13-1: Commercial vehicle size limits ............................................................. 413
Table 14-1: Global dry bulk fleet, February 2010 ..................................................... 443
Table 14-2: Global dry bulk orderbook, 2010-2015 .................................................. 444
Table 14-3: World oceangoing merchant fleet ....................................................... 445
Table 14-4: World merchant fleet by country of owner and type ............................... 446
Table 14-5: Global container ship fleet, February 2010 .......................................... 449
Table 14-6: Global container ship orderbook, 2010-2014 ......................................... 449
Table 14-7: Waterborne agricultural exports ............................................................ 457
Table 14-8: Container shipping lines for agricultural exports ................................................. 458
Table 14-9: Bulk waterborne agricultural exports ................................................................. 462
Table 14-10: Major U.S. grain export ports ............................................................................ 464
Table 14-11: Mississippi gulf ports and export grain elevators ........................................... 465
Table 14-12: Texas gulf ports and export grain elevators ..................................................... 466
Table 14-13: Comparison of port fees at Ports of Los Angeles and Long Beach ................... 475
Table 14-14: Fee scenarios for moving containers through Southern California ports ......... 476
Table 14-15: Bulk grains ocean freight rates ........................................................................ 477
Table 14-16: Comparisons of filing requirements by mode .................................................. 485
Table 15-1: Fuel price and freight rate changes by mode ...................................................... 502