



Chapter 10. Case Studies

The multiple topics introduced in this Reference are all interconnected. Many come into play simultaneously. This chapter highlights a variety of specific contexts that demonstrate this interconnectedness. These transportation case studies involve both qualitative and quantitative analyses for comprehensive assessment of economic impacts and indicators:

1. Conducting cost-benefit assessments of network improvements
2. Quantifying the sales losses associated with highway relief routes
3. Forecasting the traveler welfare effects of different tolling policies
4. Anticipating right-of-way acquisition costs

In addition to the case studies, also presented is an introduction to Transportation Project Impact Case Studies (T-PICs), a collection of case studies tracking the economic impacts of highway projects collected by the U.S. Strategic Highway Research Program. The use of T-PICS to anticipate potential economic impacts of highway projects is discussed after the four case studies.

Case Study 1: Cost-Benefit Evaluation of Network Improvements

As discussed in Chapter 6, competing investment opportunities and policies can be compared via *cost-benefit analysis* (CBA). CBA seeks to identify the most cost-effective opportunities, by monetizing the impacts of network investments, road pricing, and other transportation projects, in order to prioritize them in the face of limited budgets. This section first describes a New Jersey DOT CBA for network improvement options, and then discusses the use of a comprehensive Project Evaluation Toolkit (PET) for Texas applications.

Evaluating Network Improvement Opportunities in New Jersey

The NJDOT used CBA to place a value on the expected impacts of a State Route 18 (SR 18) improvement project on the Piscataway, NJ economy. The proposed project was a 2.5-mile extension of SR 18 at its northern terminus, connecting it to IH 287. CBA was required to compete for a USDOT TIGER II grant. The corridor's repair costs were based on expected resurfacing and maintenance expenses, and its economic effects were the monetized values of travel time and delay savings. The TIGER grant's livability considerations provide equations for monetizing a project's air and noise pollution impacts, and its safety considerations provide equations for quantifying changes in crash costs. The equations are used to monetize all six impact types: vehicle operating, congestion, crash, air pollution, noise, and maintenance.

Assuming a capacity increase of 120% (a high-end estimate), the NJDOT's CBA suggested that over a 25-year span (with a decidedly low annual discount rate of 2.8%), the project benefits would equal \$6.82 billion of cost savings over the base case. In contrast, costs were estimated to be just \$49.7 million, returning a benefit-cost (B/C) ratio estimate of a striking 138.

Uncertainty is always associated with the various inputs, particularly as a project's precise capacity impacts are difficult to estimate. A basic sensitivity analysis was performed by varying two key inputs: the value that can be placed on the travelers' time—known as *value of travel time* (VOTT) as described in Chapter 1—and capacity increase. The single VOTT varied from \$7.90 to \$27.20 per hour for passenger cars (with truckers' VOTT held fixed at just \$19.90 per hour) and the capacity increase ranged from 25% to 120%. The resulting B/C ratios ranged from 108 to 207, and NJDOT used these ratios to defend the long-term economic viability of the proposed project in their pursuit of the TIGER grant monies.

A Project Evaluation Toolkit (PET)

To allow for a wide range of network improvement scenarios when evaluating competing opportunities, University of Texas researchers developed a user-friendly and fast-running Project Evaluation Toolkit (PET) to compute B/C ratios, internal rates of return, emissions totals, toll revenues, and other indicators of interest. New roads, variable tolls, capacity addition, speed harmonization, and other system changes can be compared against one another and against a no-build alternative to guide early project selections within a city or regional network. The Toolkit anticipates near- and long-term project impacts, including traveler welfare, multiple emissions species, crash counts by severity, travel time reliability effects, and toll revenues. PET generates these estimates by modeling traffic pattern changes (using utility-maximizing logit model specifications, as discussed in the Chapter 8). It also relies on the rule of half (Chapter 2); monetized values of reliability, emissions, and crash changes (Chapter 1); and optimization and sensitivity analysis techniques (Chapter 6). Designed to be an easy-to-use, quick-response tool, PET enables decision-makers to optimally allocate scarce resources.

Fagnant et al. (2011) demonstrated the use of PET through two Austin applications:

- (1) Capacity expansion of US 290 between US 183 and SH 130 (with three alternative scenarios: grade-separated freeway upgrade, grade-separated flat-rate tollway, and grade-separated variable-rate tolling by time of day).
- (2) Travel demand management along IH 35 between US 183 and 15th Street (including \$1 toll, \$2 toll, and lane-removal strategies).

The results of the first case study (US 290's expansion) show favorable B/C ratio estimates for all three scenarios: 14.0 for the freeway upgrade, 6.5 for the tollway, and 3.9 with variable tolling. The freeway upgrade produced the highest traveler welfare impacts (and, to a lesser degree, travel-time reliability benefits), while crashes and emissions were predicted to fall under all three scenarios (although VMTs rose, thanks to improved travel conditions). Both tolling scenarios resulted in very favorable revenues for project financing, with projected internal rates of return (IRRs) estimated at 23% for the flat-rate tollway and 29% for variable-rate tolling, by time of day.

Fagnant and Kockelman (2012) also conducted a sensitivity analysis (as described in Chapter 6) to evaluate the impacts of 28 sets of unknown model inputs (like travelers' values of time, agency valuation of emissions and lives, and link-performance parameters). Their 600 simulation runs relied on Monte Carlo random draws (from lognormal distributions of inputs), resulting in a wide distribution of potential outcomes (including some negative B/C ratios) and average B/C values that were slightly less than the single-run, average-input solutions. The sensitivity results also highlighted the fact that project outcomes (B/C ratios, IRRs, and other economic indicators) were best when system-wide capacity values were lowered—thus raising the benefits of added capacity.

Fagnant et al.'s (2011) second case study (travel demand management along IH 35) showed how many travelers re-routed their trips to city streets, rather than forego most existing trips or switching to less congested times of day. This behavior resulted in higher VMT values overall, causing even more delays to travelers, worsening reliability, and raising crash counts and emissions. For instance, in the \$2 toll scenario's initial year, traffic in the surrounding links increased by 40%, while traffic on IH 35 fell by 22%, resulting in a net system-wide VMT increase of 1.3%, or 70.5 million annual VMT. **Economic techniques embodied in tools like PET help policymakers, planners, engineers, and other stakeholders quickly and rigorously evaluate a variety of transportation investment and policy options to anticipate the best scenario (and avoid the worst).**

Case Study 2: The Economic Impacts of Bypasses

Bypasses or "relief routes" are built to improve traffic flow around a city's central business district and often impact local and regional economic development, land use, and city growth patterns. Yeh et al. (1998) estimated that bypasses reduced average downtown, main-route traffic by 72% in small communities (populations under 2,000). Such rerouting of passerby traffic away from existing, downtown businesses can noticeably reduce local business sales, while causing shifts in regional economies through changes in access, travel times, travel costs, and safety.

Bypass effects can be both positive and negative. They are largely designed to save time by allowing through travelers to avoid speed reductions and intersection stops in a city or town center. They may spur development that caters to longer-distance travelers, from nearby towns and other parts of the region, including big-box retail, automobile dealers, department stores, and hospitals. In the broadest sense, lowering transportation costs should decrease production costs, thereby increasing profits, sales, and regional employment levels.

Many bypasses are also pursued in order to reduce congestion, traffic noise, and downtown crashes (involving both pedestrians and vehicles). A Kansas study by Babcock and Davalos (2004) noted that many local businesses, formerly downtown, opened new locations along Kansas's relief routes, along with entirely new establishments that target a wider, out-of-town market. Further, this finding is complemented by that of Thompson et al. (2001), who observed that 57% of businesses along Kentucky bypasses were from the retail sector, compared to 31% of businesses in downtown areas.

Negative impacts to local economies vary in scale and over time, and can depend on city size, businesses present, through flows, truck shares, proximity to the bypassed site, and proximity to a metropolitan area. Some bypassed businesses may fail in the face of lost traffic. Thompson et al. (2001, p. 22) found that "the average vacancy rate in the downtown area of communities with a bypass was 18.4% versus 10.9% in similar communities without a bypass" and that 7.6% of bypass businesses had previously been located in the bypassed, downtown areas. Yeh et al. (1998) argued that small communities lose traffic and businesses to bypasses because they lack the economic diversity that will attract through travelers. Either way, business counts and traffic counts are not the same as business sales. The following section describes econometric models for traffic and sales volumes, before and after the installation of Texas relief routes.

Econometric Modeling to Assess the Economic Impacts of Relief Routes

In an effort to more rigorously and comprehensively assess the economic impacts of bypasses on small and mid-size communities, researchers Srinivasan and Kockelman (2002) examined sales data between 1954 and 1992 across 42 Texas locations (23 with bypasses and 19 without bypasses). All towns had populations between 2,500 and 50,000, and the sales data were by industry, as obtained every 5 years in the U.S. Economic Census. Additional demographic data, such as unemployment rates, income per capita, the share of elderly in the population, and the ratio of median household income to average household size, were also obtained for each community via the U.S. Population Census.

Per-capita sales data were obtained for the following four industry categories: all retail establishments, gasoline service stations, eating and drinking establishments, and services. These categories were used as the dependent or response variable, as defined in Chapter 8. To reflect the repeat observation of the same community (nine times each) in the nearly four decades of data, Srinivasan and Kockelman (2002) relied on random-effects models, one for each industrial sector's per-capita sales. An unobserved error component or "random effect" term was included for each community. Because the cities were observed at the same points in time, another form of correlation was also permitted: where sales observed in the same year had the same unobserved error-related term. Moreover, because unobserved city-specific factors impacting one industrial sector are likely to impact the other three sectors, a system of seemingly unrelated regression (SUR) equations was used, and estimated using feasible generalized least squares techniques (as described in Chapter 8). The relatively sophisticated model specification allows analysts to improve parameter estimates by reducing uncertainty of final estimates (as measured by standard errors). The final coefficient estimates from this correlated structure of equations and observations (following a process of stepwise removal of statistically insignificant factors) are shown in Table 2.

As the results show, several variables were helpful in explaining the sectors' per-capita sales. For example, per-capita sales at the state level (STATE SALES PERCAP) helped control or account for global trends in that specific industry's sales levels over time (reflecting recessions and expansionary periods), and thus this variable enters with a positive coefficient (because the state-level sales generally move in synch with the city-level sales values for that same industry category). Inclusion of a year variable (YEAR) for each data point/observation helped account for time-related trends (with YEAR 1982 serving as an indicator variable, due to the fact that the 1982 economic census only provided sales data for establishments with payrolls). The share of population that is elderly and the unemployment rate of the town were only useful in predicting overall retail sectors, and were estimated to have a positive effect on that sector's sales, at least locally; they were not statistically significant in the other equations. As expected, per-capita traffic levels along the original route, upstream of the bypass point (TOT TRAFFIC PERCAP), represented a major positive factor for sales in all four sectors, and the share of traffic splitting onto the bypass had a negative effect.

Table 2: Coefficient Estimates

| <i>Per Capita Sales</i> | <i>Total Retail</i> | <i>Gasoline Service Stations</i> | <i>Eating & Drinking Establishments</i> | <i>Service Industries</i> |
|---|-----------------------------|----------------------------------|---|---------------------------|
| Variable | Coefficient Estimate | | | |
| CONSTANT | 5.34E+05 | 3.81E+04 | 1.50E+04 | 9.36E+04 |
| STATE SALES PERCAP | 1.52E+00 | 3.01E+00 | 6.97E-01 | 6.51E-01 |
| YEAR | -2.78E+02 | -1.99E+01 | -7.81E+00 | -4.85E+01 |
| YEAR 1982 | | -3.92E+02 | -1.16E+02 | 3.18E+01 |
| ELDERLY SHARE | 1.09E+02 | | | |
| UNEMP RATE | 1.21E+02 | | | |
| INCOME PERCAPITA | 6.49E-01 | | 2.59E-02 | 1.53E-01 |
| LARGECITY POP/DIST | 1.14E-01 | | 1.44E-02 | 3.14E-02 |
| TOT TRAFFIC PERCAP | 2.80E+03 | 2.97E+02 | 1.66E+02 | 3.97E+02 |
| RELIEF ROUTE INDIC. | 5.35E+03 | -8.83E+01 | 1.77E+02 | 6.54E+02 |
| NUM YEARS SQUARED | | | | -1.52E+00 |
| TRAFFIC SPLIT | -1.72E+04 | -7.57E+02 | -6.75E+02 | -1.51E+03 |
| <i>Adj. R² (fit statistic)</i> | 0.59 | 0.31 | 0.59 | 0.65 |

The presence of the bypass (as indicated by the binary variable RELIEF ROUTE INDIC.) has a positive coefficient, as it enters the equations along with the last two variables in the table: number of years (squared) since the bypass was added and the split in traffic along the new route, both of which have negative impacts, offsetting this indicator's ostensibly positive effect. It is important to recognize this interplay across competing and complementary variables when

interpreting results. The model results also indicated that the longer a relief route has been in service (indicated by NUM YEARS SQ), the lower the predicted per-capita service-industry sales. These results allow the computation of the critical split in traffic where introduction of a bypass and the resulting traffic diversion will reduce a town's overall sales (per capita). The model yielded the following estimated amounts by which sales will fall: Srinivasan and Kockelman (2002) report this as 31% for retail sales, 26% for eating and drinking establishments, and 43% for service industries. On average, gasoline service station sales were negatively impacted regardless, according to the model results, making gas sales the most economically impacted of the sectors studied. Such results highlight the industry types that are more sensitive to traffic diversion, presumably based on their customer base.

Interestingly, the ratio of the population of the nearest central city (of a metropolitan statistical area) to its distance from the bypassed town (i.e., LARGE CITY POP/DIST) was estimated to have a positive effect on per-capita sales. This result implies that the closer a bypassed community is to a large city, or the more populated that city, the lesser the effect of a bypass, presumably thanks to a broader base of region-familiar, potential customers and/or less reliance of travelers on town businesses before the relief route's introduction.

As Srinivasan and Kockelman note, "the better a relief route works from a traffic standpoint, the greater its adverse impact on local per capita sales" (2002, p. 68). This serves a cautionary reminder that communities are sensitive to bypasses and altering traffic flows in such a major way can be expected to impact economies in significant and unique ways. However, higher volume locations (for example, those with five average annual daily traffic (AADT) per capita) were much less affected than others. Related surveys of businesses and other key stakeholders, per Handy et al.'s (2001) report, indicated that many affected individuals appreciated the accompanying loss in heavy-duty truck traffic through their town centers, suggesting that noise, emissions, safety, and pavement damage benefits may more than offset sales-dollar effects. **In general, such comprehensive investigations highlight the complexity and wide variety of economic impacts that transportation decisions can have, while quantifying their magnitudes. Census data, statistical rigor, and thoughtful model specification, coupled with some qualitative analysis, can provide a wealth of understanding for more sound transportation decision-making.**

Case Study 3: The Economic Impacts of Congestion Pricing

As discussed in Chapter 2, the variable-rate tolling of roadways to moderate congestion—a policy called *congestion pricing*—can inequitably impact lower-income travelers. Kalmanje and Kockelman (2004) proposed credit-based congestion pricing (CBCP) to help address such equity issues and improve all travelers' net benefits, by providing certain drivers in a region (such as vehicle owners, workers, or all adult residents) with a monthly toll credit. Those who exhaust their credits early in the month simply pay out of pocket to continue using congested roadways, while more budget-conscious travelers—who conserve their credits by driving at off-peak times of day, carpooling, or using alternative modes of transportation—end each month with extra credits. These can be applied toward other goods (such as transit passes) or sold to fellow travelers. Gulipalli and Kockelman (2008) estimated joint destination-mode choice models to examine the traffic, air-quality, traveler-welfare, and administrative costs impacts of such a policy's implementation across the Dallas-Fort Worth (DFW) networks.

They simulated three traffic scenarios in order to assess CBCP's economic impacts: the status quo (including existing flat-rate tolls); marginal cost pricing (MCP) on freeways (14% of the region's coded lane miles); and MCP on all road network links. As described in Chapter 2, *marginal cost* is the value of total travel time that new drivers add to those traveling behind/with them. Nested logit models (as described in Chapter 8) for destination and mode choices were used to simultaneously allocate/predict trip ends and modes, using DFW's 1996 household survey data and Dallas Area Rapid Transit (DART) on-board survey data. In all, 4,874 destination zones, 4 modes (drive alone, shared ride, transit, and walk/bike), 3 trip purposes (home-based work, home-based non-work, and non-home-based), and 6 traveler classes (based on income and vehicle ownership) were tracked using TransCAD, in conjunction with a background commercial-trip table.

As utility-maximizing decision-makers, many travelers avoided higher-toll facilities and higher-toll times of day, with only slight changes in mode and destination choices, while enjoying lower travel times on previously congested facilities. System-wide VMT was predicted to fall by 7 to 8% following the implementation of MCP, with average trip length falling from 9.63 to 9.09 miles. In the long run, with work-trip destinations (job locations) allowed to vary for all workers, VMT at volume-to-capacity ratios above 1.0 was predicted to fall 73% in the MCP-on-freeways-only scenario and 81% in the MCP-on-all-roads scenario, suggesting dramatic improvements in what were previously bottleneck/traffic-queued locations. The fall in VMT and congestion also resulted in air quality benefits, with 5 to 7% emissions reductions, compared to the status quo.

Gulipalli and Kockelman (2008) also estimated traveler welfare impacts via a measure of *consumer surplus* (which is the benefits to travelers beyond what they pay to access destinations of interest, in time and money, as described in Chapter 2). The net benefits of MCP were calculated as the differences in probability-weighted choice utilities for all trips, normalized by each traveler class's marginal utility of money (MU\$), in order to arrive at units of dollars. A travel budget of \$15 per month per eligible traveler also was added. This amount was derived from congestion-pricing toll revenues that well exceeded system-administration costs in the case of tolling congested freeways (rather than applying such technology to all DFW roadways). Average net benefits per traveler per day were estimated to be highest (at +40¢) for travelers residing near the central business districts, and lowest (at -30¢) for those in the northwest DFW region (west of Carrollton) and in the south (between Cleburne and Waxahachie). In the losing regions, low-income groups were estimated to benefit more than medium- and high-income groups (due to less extensive pre-policy trip-making). The authors noted that travelers from neighborhoods least likely to benefit from such a policy could be given larger monthly CBCP budgets, at least for some period of time, to even out the spatial distribution of welfare changes, thereby addressing, to some extent, questions of environmental justice.

Assuming 140 new toll plazas (1 toll plaza for every 3 centerline miles of congested or nearly congested freeway), 700 electronic toll readers, 350 high-speed cameras, and transponders for every DFW adult yields an estimated start-up cost of \$48.3 million (or \$11 per DFW resident) to implement such a pricing scheme. Maintenance and operation costs were estimated to be \$260,000 million per year based on a \$100,000 per year per lane-mile cost, or \$54 annual cost per DFW resident (using FHWA values from past electronic tolling applications). Applying a capital recovery factor or discount rate assumption of 6% over the 10-year toll-collection system, the net present cost (per DFW adult) was estimated to be \$55. This is small when compared to

the estimated \$440 “lost” each year in freeway-related congestion costs per resident. Moreover, transponder costs have fallen dramatically (with Texas TollTags now costing under \$1 each, rather than the \$10-per-transponder assumption in the original estimate) and Texas has fully automated much of its toll collection process, resulting in lower start-up and administration/operations costs. **CBCP encourages travelers to budget their travel based on congestion. Revenue redistribution, which can aid in bridging the gap of user benefits of different income groups, has played a key role in increasing the political acceptability of congestion pricing.**

Case Study 4: Right-of-Way Acquisition Costs

Project construction and corridor expansions often require right-of-way (ROW) purchases, which are a key expense for most DOTs. These ROW costs are often difficult to estimate in advance and can represent a public relations challenge. Being able to predict ROW expenses helps planners estimate total costs and secure project financing, but the estimation process is fraught with challenge and mis-predictions. Project administrators often claim that they lack adequate information on parcels, lack time to perform an in-depth analysis, and must often provide estimates years before properties are acquired, resulting in long-run under-estimation biases. To expedite cost estimation and reduce uncertainties in ROW budgeting, basic least-squares regression models can be quickly developed, using existing DOT data sets (and MS Excel or other software, as described in Chapter 8).

Researchers Heiner and Kockelman (2005) used such models to predict property values and anticipate ROW acquisition costs along Texas corridors in Austin, DFW, Houston, and San Antonio. To get a sense of entire-property purchase prices, they used commercial and residential transactions data, along with detailed parcel information, from CoStar (a real estate information provider) and the Travis County Appraisal District (TCAD). For payments to property owners for whole and partial acquisitions, they relied on TxDOT’s ROW Information System, or ROWIS, supplemented by spatial details available in parcel maps. In the case of the latter, acquisition sizes were interacted with parcel indicators, to reflect the fact that twice the level of acquisition should cost (approximately) twice as much, everything else constant. The resulting equation (for each distinct data point or acquisition) is as follows:

$$TOTALCOST = \beta_0 + SF_{acquired} \sum_i (\beta_{i,land} X_{i,land}) + SF_{improvement} \sum_j (\beta_{j,land} X_{j,land}) + SF_{remainder} \sum_k (\beta_{k,land} X_{k,land}) + \varepsilon$$

where $SF_{acquired}$ represents the square footage of acquired land, $SF_{improvement}$ is square footage of taken improvements (i.e., structures built on the parcel), and $SF_{remainder}$ is the size of remainder/non-acquired area (where applicable). $X_{i,land}$ is a vector of explanatory variables indicating land use type, number of driveways, frontage length, parcel shape, year of acquisition, location, and whether the site is a corner property (as those tend to be more expensive, thanks to better customer access). Similarly, $X_{j,imp}$ variables describe the structure type, age, and condition; and $X_{k,dam}$ values characterize the parcel’s remainder (e.g., any loss in frontage, whether the parcel’s shape changed, and ratio of remainder area to original parcel size). As

explained in Chapter 8, the error term ε accounts for unobserved attributes (such as soil quality, vegetative cover, and strength of local schools). Because these error terms tend to get larger (from under- or over-prediction) on larger, more complex, and more expensive properties, a second model was used in tandem to reflect scatter in the data in the sizes of the ε values. As described in Chapter 8, *feasible generalized least squares* (FGLS) regression (two stages of least-squares modeling) can be applied to reflect such heteroskedasticity and improve parameter estimates in the main model equation (which are the β terms shown above).

The study found that retail property costs along expanding corridors were the most consistent in value and easiest to predict with their economic equation. As expected, urban properties, especially those in downtown locations, cost much more than others, all other features constant. Multi-story office buildings were valued the highest (per square foot) and industrial use properties the lowest, everything else constant. Using TCAD data, properties in “excellent” condition were forecast to fetch \$22 more per square foot (of improved space) than a comparable property in “fair” condition. Using CoStar’s commercial sales data for all Texas metropolitan regions yielded a similar result: a property in “excellent” condition was estimated to be worth nearly \$28 more per square foot than a property in “fair” condition. CoStar data also provided information on parking spots, which were estimated to add roughly \$6,000 (each) to a (commercial) property’s value.

These types of linear regression models are helpful in predicting ROW costs using property attributes, while also identifying properties that are most challenging to assess. For example, a veterinary hospital site’s value was significantly over-predicted by the Heiner and Kockelman model application across 10 commercial properties in Fort Bend County, Texas.

In addition to acquisition costs paid directly to owners, overall project costs and project duration can be significantly impacted by the negotiation or condemnation process that DOTs go through on each property. For example, Xiong and Kockelman’s (2012) analysis of 2008 through 2011 ROWIS data suggest that condemned properties resulted in 78% higher acquisition costs for TxDOT (equivalent to an added \$14.7 per square foot) than negotiated properties, and 51% greater price uncertainty (measured as variance in the pricing model’s error term). Moreover, the process of condemnation has been estimated to add an average of 8 months to parcel acquisition duration (versus negotiation), due to court trials in place of administrative settlement. Unfortunately, lost time is lost money (and sometimes reputation). Such currency can take the form of contractor costs, congestion delays due to later capacity expansion, weakened public support, and so forth. **Econometric models help transportation planners, engineers, and policymakers make better decisions about how much to budget for a future or near-term project, which properties to purchase early, which to evaluate more deeply, and which to work hardest to acquire through negotiated settlements.**

Anticipating the Economic Impacts of Highway Projects Using T-PICS

Crucial in anticipating potential project impacts is examining past, similar projects’ costs and benefits. As a part of a research initiative by the U.S. Strategic Highway Research Program, the EDR Group and ICF Consulting assembled a large collection of economic analyses from already implemented transportation projects in an easy-to-access format called Transportation Project Impact Case Studies (T-PICS), available at <http://transportationforcommunities.com/t-pics/>.

T-PICS contains two main tools: Case Search and My Project Tool. Case Search allows users to search the database by attributes such as project type, region, motivation, class level, economic distress, keyword, or a combination of all six. This specificity allows the user to narrow the results to an existing project that is similar to a newly proposed transportation improvement. The T-PICS results page displays basic descriptions of each project, and a user can also choose to compare multiple projects.

The second important function of T-PICS, My Project, can be used to roughly predict the economic impact of a project. Due to the pure volume of entries in this database, finding and analyzing every project that relates to a newly proposed design is impractical. Instead, based on input criteria, this tool finds all projects that are similar, summarizes their economic impacts, and scales the data to the specific criteria of the proposed project. This analysis can be customized even further by specifying certain area characteristics, such as land use policies, business climate, and infrastructure type(s).

Summary

This chapter's case studies illustrate how the economic concepts introduced in this Reference weave together and can be used to enhance transportation planning, investments, and policymaking. For example, road pricing and improvement decisions along a specific corridor can have positive and negative impacts across an entire network, requiring an appreciation of latent demand, complete traveler welfare changes, travel time reliability, and sensitivity analysis to reflect analyst uncertainty.

These case studies also illustrate the value of statistical analysis, highlighting the flexibility and practical application of several econometric models using Census, land use, and agency data sets to quantify relationships. The methods of analysis developed in this Reference are powerful tools for mining existing and new data sets while exploiting a variety of practical methods. Such concepts and tools can be essential in anticipating project and policy impacts, thereby enhancing DOT decision-making, even in the presence of uncertainty.

References

- Babcock, M. & Davalos, J. (2004) Case Studies of the Economic Impact of Highway Bypasses in Kansas. Kansas Department of Transportation, Kansas State University. Available online at <http://www.ksdot.org/PublicLib/doccontent.dll?LibraryName=PublicDocs^dt00mx38&SystemType=2&LogonId=a97e035c62020933902b470f45be164e&DocId=003687790>
- Bina, M. & Kockelman, K. (2009) Location Choice vis-a-vis Transportation: The Case of Recent Home Buyers. *The Expanding Sphere of Travel Behaviour Research*, Emerald Publishers.
- Fagnant, D., Kockelman, K., & Xie, C. (2011) Anticipating Roadway Expansion and Tolling Impacts: A Toolkit for Abstracted Networks. Presented at the 90th Annual Meeting of the Transportation Research Board, January 2011, Washington D.C.
- Fagnant, D. & Kockelman, K. (2012) Transportation Project Outcomes Under Uncertainty: An Examination of Benefit-Cost Ratios and Other Impacts. Proceedings of the 91st Annual Meeting of the Transportation Research Board, and forthcoming in *Transportation Research Record*.
- Gulipalli, P. & Kockelman, K. (2008) Credit-Based Congestion Pricing: A Dallas-Fort Worth Application. *Transport Policy* 15(1), 23–32.
- Handy, S., Kockelman, K., Kubly, S., Srinivasan, S., Jarrett, J., Oden, M., & Mahmassani, H. (2001) The Impacts of Highway Relief Routes on Small Towns in Texas. Research Report 1843. Center for Transportation Research, The University of Texas at Austin.
- Heiner, J. & Kockelman, K. (2005) The Costs of Right of Way Acquisition: Methods and Models for Estimation. *Journal of Transportation Engineering*, 131(3).
- Kalmanje, S. & Kockelman, K. (2004) Credit-Based Congestion Pricing: Travel, Land Value, and Welfare Impacts. *Transportation Research Record* 1864, 45–53.
- Kockelman, K., Fagnant, D., & Xie, C. (2011) PET: A Toolkit for Anticipating and Comprehensively Evaluating Transportation Project Impacts. Available online at: http://www.cae.utexas.edu/prof/kockelman/PET_Website/homepage.htm.
- Le, T. (2009). Improving Right-of-Way Acquisition in Highway Projects through Scope Definition and Management of Inherent Factors. Ph.D. dissertation. The University of Texas at Austin.
- Rutgers Intelligent Transportation Systems Laboratory (RITS) (2010) Cost/Benefit Analysis of NJDOT Route 18/Hoes Lane Improvement Project. Available online at: http://www.state.nj.us/transportation/works/studies/rt18_i287connect/pdf/cb_analysis.pdf
- Srinivasan, S. and Kockelman, K. (2002) The Impacts of Bypasses on Small- and Medium-Sized Communities: an Econometric Analysis. University of Texas at Austin. Available online at http://www.ce.utexas.edu/prof/kockelman/public_html/TRB01Bypasses.pdf.
- Ten Siethoff, B. and Kockelman, K. (2002) Property Values and Highway Expansions: An Investigation in Timing, Size, Location, and Use Effects. *Transportation Research Record No. 180*. TRB. National Academy Press, Washington, D.C.
- Thompson, E., Miller, J., & Roenker, J. (2001) The Impact of a New Bypass Route on the Local Economy and Quality of Life. Kentucky Transportation Center, University of Kentucky. Available online at http://www.ktc.uky.edu/Reports/KTC_01_10_SPR_219_00_2I.pdf.
- Vadali, S. & Sohn, C. (2001) Using a Geographic Information System to Track Changes in Spatially Segregated Location Premiums. *Transportation Research Record* 1768, 180–192. TRB. Washington, D.C.
- Williams, K. & Frey, R. (2004) Corridor Preservation: Best Practices for Local Government. *Transportation Research Record No. 1895*, 156–162.
- Xiong, X. & Kockelman, K. (2012). The Cost of Right-of-Way Acquisition: Recognizing the Impact of Condemnation via a Switching Regression Model. Proceedings of the 91st Annual Meeting of the Transportation Research Board in Washington D.C., and forthcoming in *Transportation Research Record*.

Yeh, D., Gannon, M., & Leon, D. (1998) The Economic Impacts of Highway Bypasses on Communities. Wisconsin Department of Transportation, Economic Planning and Development, Madison, Wisconsin. Available online at <http://www.dot.wisconsin.gov/library/publications/topic/plans/bypass.pdf>.

