US Department of Transportation
Federal Transit Administration

MEASURING THE ECONOMIC DEVELOPMENT BENEFITS OF TRANSIT PROJECTS

PROCEEDINGS OF AN EXPERT PANEL WORKSHOP

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SUMMARY AND RECOMMENDATIONS

On October 17, 2007, the Federal Transit Administration (FTA) convened an expert panel to discuss methods for evaluating the economic development benefits of transit projects. FTA hopes to develop, to the extent possible, a standardized, empirically-based, and rational method for evaluating the potential economic development benefits of project proposals in the FTA Section 5309 Major Capital Investment Program ("New and Small Starts"). Members of the panel were charged with recommending one or more methodologies for further research, development, and testing that could be applied to forecast the economic development impacts, and the associated benefits, of major transit capital investments.

Panelists provided input on a number of key issues related to how economic development benefits are defined and measured.

- **Definition of economic development vs. land use –** FTA defines economic development resulting from transit investments as *the impact of the transit project on land use patterns and the benefits associated with these changes.*[1] Panelists noted that economic development and land use are closely related and difficult to evaluate separately, and suggested that *economic development includes land use changes that generate economic value.* This definition generally supports FTA's approach of considering land use and economic development simultaneously.
- **Valuation of economic development benefits** – A number of panelists suggested that the best way to measure the economic benefits of transit-induced land use changes is through land values, which capture benefits resulting from transportation accessibility, economies of agglomeration, and other impacts.[2] One panelist, however, cautioned that transportation benefits are not always fully capitalized into land values, and therefore changes in land values may not reflect the project's full economic benefits. A complete accounting, according to economic theory, would define the total economic benefits as the sum of changes in consumer surplus, producer surplus, and tax revenue; but as a practical matter these changes may be hard to estimate.
- **Factors affecting economic development** – Panelists noted that three primary factors affect the magnitude of development and related economic impacts created by the transit investment: (1) the benefits of the transit project itself, particularly accessibility benefits; (2) supportive land use plans and policies that create the framework for development; and (3) the local and regional economic climate and growth. These are generally consistent with the indicators that FTA has proposed to apply in its August 3, 2007 Notice of Proposed Rulemaking (NPRM).[3]

[1] "Economic development" benefits, as defined here, should be distinguished from "economic" benefits, which more broadly encompass the full range of benefits of a project, including those which do not result from land use changes.
[2] Land value changes capture economic benefits not related to land use change as well; however, there are analytical ways of distinguishing the contributions of each effect.
[3] Federal Register Vol. 72, No. 149, 43328-43377; http://www.fta.dot.gov/planning/newstarts/planning_environment_5615.html.

- **Contribution of economic development to total project benefits** – Panelists suggested that in most cases additional economic development benefits are likely to be less, and usually considerably less, than the magnitude of transportation user benefits (including travel time and cost savings). Some panelists speculated that economic development benefits might range from 0 to 20 percent or more of a project's total benefits, with greater benefits in larger, more congested cities; others were reluctant to speculate on this topic in the absence of supportive research. Panelists noted that while economic development benefits alone are unlikely to fully justify the costs of the project, they may be substantial enough to make noticeable distinctions among projects.

The panel discussed various methodologies that could potentially be applied to assess economic development benefits. The panel recommended that the following activities could be beneficial next steps in furthering FTA's objectives of improving the measurement of these benefits:

1. Identify state of the art integrated transportation-land use models being used in practice and identify the strengths and weaknesses of each model for forecasting transit-induced land use changes and economic benefits. Pursue a limited number of case studies using these models, to evaluate the impacts of different types of transit investments on economic development under different policy and market conditions.
2. Review existing research on the impacts of transit on property values to identify the more robust studies, methodologies used, and the extent to which such studies can be used to identify the magnitude of economic benefits under different conditions.
3. Develop hedonic price models that use historical data to evaluate the impact of transit on property values for a limited number of additional case study projects, including recently-built streetcar systems. These models should 1) be capable of distinguishing the transportation accessibility benefit from other benefits; 2) account for a range of factors, including spatial and temporal variations, that affect property values; and 3) consider a broad enough geographic scale to capture the full regional benefits and disbenefits of a project.
4. Use the findings from actions 1, 2, and/or 3 to develop a plausible range of economic development benefits of transit, taking into account the basic factors that affect development (economic conditions, zoning and policy environment, population demographics, local transit demand); and combine this information with project-specific indicators to rate the expected impacts of different types of projects in different contexts.
5. In the short term, while research in support of actions 1 through 4 is being conducted, continue to use a qualitative rating approach using indicators such as those proposed in the August 3, 2007 NPRM. Consider adding additional indicators that relate to development potential, such as station area crime statistics and school district ratings.
6. To support long-term improvements to transportation project evaluation practices, sponsor additional research and model development work to advance the state of the practice in integrated transportation/land use modeling among Metropolitan Planning Organizations (MPOs).

It should be noted that panelists did not reach a clear consensus on whether transportation-land use modeling or hedonic price analysis of land values would be a more appropriate and useful approach. Most panelists felt that the application and advancement of transportation-land use models (recommendations #1 and #6) would be valuable for a range of planning purposes, including transit economic impact analysis, but also cautioned that the time and level of effort involved in properly applying these models would be significant. A number of panelists felt that hedonic price modeling (recommendations #2 and #3) was an appropriate approach, and noted some practical advantages over the application of transportation-land use models (especially time and cost); some theoretical advantages were noted as well. However, one panelist disagreed that hedonic models were even an appropriate method for valuing economic impacts for a variety of methodological reasons; and economic theory suggests that these concerns may be warranted. This panelist nevertheless felt that research into the land value impacts of transit would be useful by providing data to assist in the development and calibration of transportation-land use models.

Regardless of which approaches are pursued, clarity will be required with respect to the specific types of benefits that are being captured by each approach, and in distinguishing the contributions of each type of benefit (direct user benefits, economic productivity, changes in land use patterns, environmental externalities, etc.)

1. INTRODUCTION

On October 17, 2007, the Federal Transit Administration (FTA) convened an expert panel to discuss methods for evaluating the economic development benefits of transit projects. Members of the panel were charged with recommending one or more methodologies for further research, development, and testing that could be applied to forecast the economic development impacts, and the associated benefits, of major transit capital investments. The panel was convened as an all-day workshop at the U.S. Department of Transportation (DOT) headquarters in Washington, D.C. The panel was selected for its expertise in various aspects of the measurement and valuation of the economic benefits of transportation investment, including transit. Panel members included:

- Prof. Alex Anas, State University of New York at Buffalo;
- Prof. Robert Cervero, University of California at Berkeley;
- Prof. Elizabeth Deakin, University of California at Berkeley;
- Prof. Genevieve Giuliano, University of Southern California;
- Andreas Kopp, World Bank;
- David Lewis, HDR Decision Economics;
- Prof. Eric Miller, University of Toronto;
- Elena Safirova, Resources for the Future; and
- Prof. Simon Washington, Arizona State University.

Biographies of the panel members are presented in Appendix A. Also in attendance were various FTA and other U.S. DOT staff, Congressional staff, representatives from the Government Accountability Office (GAO), consultants to FTA, and other invited observers. A full list of workshop attendees is included in Appendix B.

Members of the panel were requested to:

- Help FTA answer the following questions:
  - Do transit projects, by themselves, cause changes in economic development patterns?
  - If so, what methods are available to forecast those changes and the associated benefits, and what are the advantages and disadvantages of each?
- Which of those methods meet FTA's goals that the measure a) is technically sound; b) does not double count existing benefit measures; c) can be incorporated into FTA's cost-effectiveness measure; and d) is technically feasible for every major capital project?
- Identify qualitative approaches that might be taken to assessing potential impacts, in case no quantitative approach proves workable; and
- Recommend a method or methods for further development, testing, and potential implementation.

The workshop agenda is presented as Appendix C. Prior to the workshop, briefing materials were distributed to panel members. These materials described FTA's objectives for the current work, provided background on the Section 5309 New and Small Starts project evaluation process for major capital investments, described previous research sponsored by FTA on measuring economic impacts of transit, and discussed various methodological options for measuring these impacts. A report was also distributed summarizing previous FTA research on measuring economic impacts.[4]

The remainder of this report describes the issues discussed at the workshop and presents the findings of the panel. The single-day format of the workshop was such that it was not possible to review and determine whether a consensus existed on all of the topics discussed. This report attempts to summarize the general conclusions and findings from the panel's discussion, and has been reviewed individually by panel members to determine their level of concurrence with these findings. In some cases, opinions among panel members on any particular point varied, and subsequent communication with individual panelists was unable to fully resolve the differences of opinion.

The report covers the following topics:

- Section 2.0 – Background information, including FTA's objectives for the economic development benefits measure and how it would relate to the New and Small Starts project evaluation process;
- Section 3.0 – Key issues addressed by the panel;
- Section 4.0 – Review and discussion of the various methods considered for evaluating economic development benefits; and
- Section 5.0 – Panel input on various other questions that arose during the workshop.

[4] Cambridge Systematics, Inc. *Methodologies for Evaluating the Economic Development Impacts of New Starts Projects.* Interim report, prepared for the Federal Transit Administration, February 2006.

2. BACKGROUND

2.1. Definition of Economic Development

For purposes of this work, FTA defines economic development resulting from transit investments as *the impact of the transit project on land use patterns and the benefits associated with these changes*. Changes in land use patterns may include increases in the density of development in station areas (including reuse of existing buildings), as well as any redistribution of growth that occurs elsewhere in the corridor or region. Changes in land use patterns also may include changes in the *character* of development (e.g., pedestrian- vs. auto-oriented, mixed-use vs. segregated-use, high- vs. low-density) as well as in its location. The benefits associated with such changes may include travel efficiencies (e.g., shorter and/or fewer vehicle-trips, consumer benefits from additional modal options), as well as other benefits such as economies of agglomeration made possible by higher densities, reduced environmental impacts, or reduced costs for other types of infrastructure.

The term "economic development" benefits, as defined here, should be distinguished from "economic" benefits (as the term is used by economists), which more broadly encompass the full range of benefits of a project. These economic benefits may include:

- Direct user benefits resulting from the transportation improvement;
- Additional economic growth and productivity resulting from the portion of transportation benefits that accrues to businesses (e.g., from shorter commuting or on-the-clock travel times);
- Externalities (benefits or disbenefits to others), such as amenity value, noise, and air pollution; and
- Additional user benefits, economic growth, and externalities resulting from any re-allocation of land uses induced by the project, which is FTA's definition of economic development benefits. (These additional externalities from land use change would include agglomeration benefits to businesses.)

Furthermore, these benefits may ultimately accrue to varying degrees to consumers (individuals), producers (businesses and landowners), or government (through tax revenues).

2.2. FTA's Objectives

FTA's stated goal of this work is to develop, to the extent possible, a standardized, empirically-based, and rational method for evaluating the potential economic development benefits of project proposals in the FTA Section 5309 Major Capital Investment Program ("New and Small Starts"). FTA's ideal measure of economic development benefits would:

- Represent a comprehensive, quantitative measure of net regional benefits over the evaluation period timeframe;

- Reflect the benefits of the transit project alone – i.e., capture economic development effects independently of changes in density that occur due to changes in policy or zoning alone; and
- Meaningfully distinguish among different projects with different impacts.

Furthermore, FTA wants to continue using its current measures of effectiveness for mobility benefits and cost-effectiveness. Therefore, the new measure also should:

- Not double-count what is already being valued with the transportation system user benefits measure (whether it is a separate measure or bundled with the current measure); and
- Be additive (i.e., expressed in the same units as other measures).

Furthermore, FTA desires an approach that can be feasibly implemented by every project sponsor at a reasonable cost.

2.3. Relationship to the Transportation System User Benefits and Cost Effectiveness Measures

Project sponsors that seek New or Small Starts funding from FTA must calculate the project's benefits in terms of user mobility. User mobility benefits are measured in units of time saved, considering the relative values of in-vehicle travel time, out-of-vehicle time, travel costs and other attributes as measured using the coefficients of the mode choice model.

Cost-effectiveness is also an important measure in FTA's existing rating system. Cost-effectiveness is calculated as the annualized capital and operating costs (in dollars) divided by the transportation system user benefits (in hours). FTA has argued that transportation system user benefits are only a subset of the total benefits of a transit project. The total user mobility benefits measure in the cost-effectiveness evaluation is then increased by 100 percent to account for potential economic development, environmental, safety, and other non-mobility related benefits that are not accounted for in current transportation models. This multiplication factor is arbitrary and is also applied uniformly to all projects, meaning that it does not provide a basis for distinguishing projects based on economic development or other benefits not directly measured.

FTA's ideal outcome is to obtain a measure of economic development benefits that can be expressed in the same measure as transportation system user benefits, and therefore added to these benefits to more accurately reflect the full benefits of any particular project, including economic development. This would replace some or all of the current 100 percent multiplier and allow project-specific economic development benefits to be reflected in the cost-effectiveness rating.

3. KEY ISSUES

During the course of the workshop, a number of key issues were raised that relate to the definition and measurement of economic development benefits. The panelists' viewpoints on these issues are summarized below.

3.1. Distinction Between Economic Development and Land Use

The panel was requested to comment on the extent to which economic development and land use benefits and impacts can be distinguished, and on FTA's proposed definition of economic development. Panelists noted that economic development and land use are closely related and difficult to evaluate separately because changes in physical stock are a common means of producing economic development. Panel members suggested that *economic development could therefore result from land use changes that generate economic value*. Land use changes *per se* have no value of themselves, but such changes may generate benefits that can be measured. This viewpoint generally supports FTA's definition of economic development as the benefits associated with the changes in land use patterns as a result of the transit project, although it also suggests that economic development could be defined more broadly if FTA chose to do so.

3.2. Nature and Valuation of Economic Development Benefits

Most panelists stated during the discussion that the best way to measure the economic development benefits of transit-induced land use changes is through land values.[5] Benefits that may result to properties located near transit, and therefore are likely to be reflected in land values, include:

- Transportation accessibility improvements, and the resulting transportation system user benefits (e.g., travel time or cost savings) – including benefits not only to transit users, but also to highway users as a result of reduced congestion;
- Agglomeration benefits resulting from increased densification;[6] and
- Other benefits of proximity to transit (e.g., positive image, additional travel options).

To the extent that transportation user benefits accrue to businesses (e.g., for commuting or on-the-clock travel), they result in additional economic benefits (as measured through net economic output or wages) as a result of decreased business costs and/or greater business productivity.

Transit projects also may have localized disbenefits (e.g., as a result of noise, vibration, aesthetic impacts, severance, or displacement) that will be reflected in decreases in land values near the alignment and/or individual stations. In addition, property values may fall in areas that do not directly benefit from the investment, at least somewhat offsetting some or all of the gains to those properties that directly benefit. (Any decreases in property values are likely to be small in

[5] *Land* values are distinguished from *improvement* values, which reflect the value of buildings on the property in addition to the inherent value of the land itself. The term *property values* is commonly used to refer to the sum of land and improvement values.

[6] While densification might occur with or without the transit project, in areas that are already very densely developed and existing transportation capacity is constrained (such as the central business district of a major city), additional development might not be possible without investment in transit.

magnitude but spread over a large area, in contrast to the very localized but significant increases in value.)

Finally, land use changes may result in broader environmental benefits (e.g., from more compact development patterns and reduced transportation emissions) that are difficult to value but nevertheless may have an economic impact. Examples of the environmental benefits of compact development may include reduced urbanization of land, and corresponding reductions in impacts on wetlands, watersheds, and key natural habitat.

Land values reflect not only the benefits resulting from land use change, but also the benefits of the project that would be realized even without any changes to land use patterns. Therefore, they should be considered as a measure of economic benefits that is broader than FTA's definition of economic development benefits. Panelists noted that while changes in land value reflect transportation user benefits as well as a variety of other benefits and disbenefits, there are ways to distinguish these effects, as discussed in Section 4.2, in order to avoid double-counting with the current user benefits measure.

One panelist disagreed with the viewpoint that land values are a good way to measure transportation benefits. He stated instead that transit benefits should be measured as the sum of consumer surplus, producer surplus, and additional tax revenue, which may not be fully captured in land values. (Changes in consumer and producer surpluses and tax revenue can be measured through appropriately-specified transportation-land use models that are based on both demand and supply functions.) This panelist made the observation that it was possible that aggregate land values could actually *fall* as a result of a transit investment, and cited a reference to a transportation-land use modeling study, using the CATLAS model to evaluate rail transit investments in the Chicago metropolitan area, that actually showed such a result.[7]

The viewpoint that land values do not necessarily reflect the benefits of the transportation investment is consistent with economic theory. For example, Mills and Hamilton, in a text on urban economics,[8] state that land value changes cannot be used as measures of the value of transport improvements because there are two offsetting effects. First, transport improvements improve the accessibility of individual sites, increasing their value. But second, transport improvements also increase the total supply of accessible land, thus diminishing the value of access. It is therefore possible that total land value could actually decrease as a result of the investment.

The authors note an important exception to this rule. If transport improvements do not extend to the edge of the urban area and therefore do not increase the supply of accessible sites, land value changes will reflect the full value of the improvements. This is because the supply of affected land is fully constrained; or in economic terms, the supply curve is perfectly inelastic. Therefore, it would appear that to the extent to which a transit project serves existing urbanized, developed locations as opposed to undeveloped locations on the urban fringe, increases in land values will more fully reflect the net economic value of the project. (This does not imply that an urban

[7] Anas, Alex and Liang Shyong Duann. "Dynamic Forecasting of Travel Demand, Residential Location and Land Development." In *Papers of the Regional Science Association* (Eighth Pacific Congress) Vol. 56, 1985.

[8] Mills, Edwin S., and Bruce W. Hamilton. *Urban Economics.* Fourth Edition, Scott, Foresman and Company, Glenview, IL, 1989. See pp. 119-120.

project is more valuable than a suburban one – simply that the value will be reflected in a different way.)

Regarding the question of the value of hedonic modeling vs. direct measurement of benefits through consumer and producer surplus, two other panelists responded in subsequent comments noting some advantages of hedonic price modeling from a practical, and perhaps even theoretical, perspective. One wrote, "In theory, both hedonic and regional economic models should produce similar and reinforcing results, however I think land markets more directly capture accessibility and agglomeration benefits (if properly specified and modeled), [and are] less fraught with the difficulties of parameterizing and operationalizing multi-step regional models." Another commented that it is very difficult to gather data on all of the variables needed to measure consumer and producer surplus, and therefore it may be preferable to look at variables that are easily observed, such as property values.

3.3. Factors Affecting Economic Development

Panelists noted that three primary factors affect the level of economic development impacts created by the transit investment:

- The benefits of the transit project itself, particularly accessibility benefits;
- Supportive land use plans and policies that create the framework for development; and
- The local and regional economic climate (e.g., growth rates, land scarcity, demographic conditions that support transit-oriented development).

3.4. Contribution of Economic Development to Total Project Benefits

The FTA Administrator asked the panel to speculate on approximately what percentage of a transit project's total benefits resulted from economic development impacts. Panelists suggested that in most cases additional economic development benefits are likely to be less, and usually considerably less, than the magnitude of travel time savings. Some panelists speculated that economic development benefits might range from 0 to 20 percent or more of a project's total benefits. Others, however, were reluctant to speculate on this topic in the absence of supportive research. Panelists noted that while economic development benefits are probably never enough to fully justify the costs of the project, they may be substantial enough to give certain projects a definitive edge over other projects. The greatest benefits would occur in the largest, most congested cities, while smaller metropolitan areas with less congestion would experience smaller (and possibly no) economic development benefits.

3.5. Geographic Scale of Impacts

One issue that arose repeatedly was the geographic scale at which economic development benefits would occur and should be measured – e.g., station area, corridor, region. Panelists noted that it was important to establish a regional perspective when measuring and valuing economic development benefits. Additional development in station areas may simply reflect a re-allocation of development from elsewhere in the region, rather than a net generation of

development.[9] Land value impacts – positive or negative – may occur well outside of station areas. As a result, any measurement of benefits using land values must be performed at a regional level.

At the same time, localized changes in development patterns are capable of generating net regional impacts, as a result of increased travel efficiencies as well as the economies of agglomeration that may result from the increased densification permitted by the transit project.[10] Valuation methods should take these net regional benefits into account. Changes in land use patterns may also result in environmental benefits, although these may be difficult to capture and quantify in an economic evaluation.

[9] Some might consider such reallocation a benefit (e.g., shifting growth from suburbs to central city), but FTA views this only as a redistribution of benefits unless the changed growth patterns can be traced to specific net benefits to the region through reduced travel times, increased economic growth, etc.

[10] Such travel efficiencies would be captured in a full accounting of user benefits that included changes in trip patterns.

4. PROPOSED METHODOLOGIES

4.1. Integrated Transportation/Land Use Modeling Approach

4.1.1. Summary of Approach

This approach represents FTA's "ideal" approach and was described in a workshop presentation by FTA staff. It relies on the use of integrated transportation and land use models to forecast the regional land use impacts of a project and the resulting transportation system impacts as well as user and economic benefits. If a method were available to produce defensible forecasts of future development patterns, economic development benefits could be measured in part by the incremental user benefits that would occur under the new land use pattern compared to the land use pattern under the FTA's required Baseline Alternative. Furthermore, a modeling approach that included a location choice component incorporating a wide range of factors that influence residential and business location decisions would be able to produce estimates of the consumer and producer benefits of the new land use pattern.

4.1.2. Panel Response

Most panelists agreed – although with significant caveats – that integrated transportation-land use models provide an ideal approach to measuring benefits. The more sophisticated integrated models have a number of advantages, including:

- They forecast land use changes at a regional scale, avoiding the need to make assumptions about how to reallocate development from other parts of the region;
- Land use changes can be fed back into transportation models to measure the resulting second-order impacts on the transportation system and net user benefits, thus avoiding the limitations of working with a fixed trip table that assumes no change in trip making despite changes in the transit network and levels of service;
- The models incorporate interactions among different economic sectors affecting business location and benefits;
- The use of a model represents a "cleaner" approach where the effects of factors that are not immediately affected by the transit project (such as zoning and changes in local land use regulation, changes in regional development climate, etc.) are much easier to separate in the course of the analysis than in other methods; and
- Such models, if properly specified, are capable of measuring changes in consumer and producer surplus as well as tax revenues, and therefore of estimating the full economic benefits of the investment.

The advantages of these models, however, must be tempered with a number of practical and technical considerations, which are discussed below. Furthermore, some panelists expressed a broader skepticism about the use of even the best of these models for analyzing the impacts of transit investments. Some concerns include:

- Even the best models rely on many simplifying assumptions, and it may be difficult to gather all of the data needed for a properly-specified model that can measure economic benefits;
- The data used to develop and calibrate models may be a decade or more old;
- Transit projects are small relative to the region being modeled, and transit impacts will typically be within the error range of the model;
- Models must be well specified, and regardless, still generally produce large forecast errors between predictions and outcomes; and
- Many (perhaps most) of the models in existence are not well-grounded in economic theory; instead, they take prices (e.g., land and building stock) into account through ad-hoc relationships, or not at all.

One panelist noted that, "Their value lies in providing platforms to test and trace out sets of assumptions and scenarios among competing plans, not so much end-state, bottom-line forecasts – i.e., they aid comparisons more than providing accurate estimates. To use these models as *ex ante* evaluation tools, in my view, is dubious. I have more confidence in actual market responses (as reflected by hedonic price models) than simulations from macro-scale models based on empirical relationships established (quite often) a decade or more earlier."

4.1.3. Practical Considerations

Panelists cautioned that integrated models of adequate sophistication exist for only a few regions in the country, and that the state of the practice needs to be advanced considerably before this approach could be applied on a widespread basis. They further observed that the scale of a transit project's economic development benefits, by itself, is insufficient to justify the considerable investment that would be required to adequately advance the state of the practice. However, they did feel that pursuing the advancement of such models was a worthwhile endeavor because of their broader value as a transportation and land use policy analysis tool. They further felt that the development of "case studies" using a small number of existing models is a worthwhile approach to estimating the potential range of impacts from different types of transit projects in different contexts.

The panel further noted that additional Federal research funding would be required in order for FTA to assist Metropolitan Planning Organizations (MPOs) with developing better transportation-land use models. Given the cost and technical challenges associated with model development, most areas are not likely to make significant advancements in this area without additional Federal assistance. Some panelists further suggested that all large MPOs should be required to develop and use integrated transportation-land use models, although they acknowledged this would not be feasible for smaller MPOs because of the costs and human capacity requirements of such modeling.

4.1.4. Technical Considerations

Panelists cautioned that not all of the existing transportation-land use models are equally suited for evaluating the land use and economic impacts of transit investments, and that some (perhaps most) may be inappropriate for this purpose.

One panelist noted that "…it is extremely important to use, in practice, models that are solidly grounded in the economic theory. Rents and property values are determined by real estate markets…" Models that ignore prices, or that do not correctly model prices (e.g., assuming that they are fixed and do not adjust to clear markets) are inappropriate. This panelist further noted that, "What is needed is not "hedonic analysis" but demand-supply analysis in a general equilibrium framework… what are needed are models… in which the demand-side and supply-side effects of certain variables are separately identified and the real estate market is re-equilibrated following an accessibility change induced by a transit project which shifts the demand curves and possibly the supply curves as well."

A second panelist essentially echoed this viewpoint, stating that "…models that are based on a disequilibrium concept should not be used for this task. The disequilibrium-based models rely on an ad-hoc processes for describing how the decisions (e.g. land-use decisions) are made. If one ad-hoc process were replaced with another, the simulation results would change."

The first panelist made the following observations on the extent to which various known model applications (see Briefing Materials, Section 7 for a list) adhere to these principles:

- CUFM: Although the model allocates land use according to a bidding process, the way the bidding process is modeled is not consistent with the theory of bidding in urban economics and follows ad-hoc specifications.
- DRAM/EMPAL: The model does not recognize real estate prices or rents.
- MEPLAN/TRANUS/UrbanSim: These models recognize prices, but they do not properly capture the underlying economic processes. MEPLAN and TRANUS have not been fully documented and are therefore difficult to evaluate. In the case of UrbanSim (which is open-source), prices are fixed and relationships can be specified by users in ad-hoc ways.
- MetroSim and CATLAS[11] use the general equilibrium approach, and the equations of the model were derived from underlying economic principles.

This panelist also suggested that research and development of integrated models should be done through universities, or through university-MPO partnerships, to ensure the soundness of technical methods, and that economists should be consulted in the development of such models.

Without providing any analysis of their respective strengths or weaknesses, panelists noted a number of models or applications that should be added to the list in Section 7 of the Briefing Materials:

- CATLAS and RELU-TRANS (developed by Alex Anas);
- DELTA/START suite (developed by the MVA consultancy in the United Kingdom);
- ILUTE (developed by Eric Miller);
- LUSTRE (developed by Elena Safirova and colleagues);
- MUSSA (developed by Francisco Martinez);

[11] These models were developed by the panelist who provided these comments.

- PECAS – also being implemented in Baltimore, Southern California and Montgomery, Alabama; and
- TRANUS – statewide applications in Ohio and Oregon.

Finally, panelists suggested that the case studies must be carefully structured in order to ensure the validity of the models used and the robustness of results. For example, it is desirable to evaluate multiple models, but these models would need to be tested on the same project(s) and policy scenarios in order to evaluate the consistency of results. This will ensure that differences among measured impacts are actually due to scenario differences, rather than different behavior of the underlying models. The case studies should also include validation using historical data, to assist in assessing the models' accuracy.

4.2. Historical Analysis of Transit Investment, Development and Land Values Using Econometric Methods

4.2.1. Summary of Approach

This approach would continue to investigate the use of econometric methods to analyze historical patterns of transit investment and development. A preliminary application of such methods was conducted in the initial phase of this work. That research used building permit data from Portland, Oregon and Baltimore, Maryland to devise an econometric model that would measure the impact of proximity to rail stations on actual development. The findings of this work were described in a presentation to the panel by FTA's consultants, as well as in the February 2006 interim report of findings distributed in advance of the workshop.

Continuation of this work would involve expansion to additional cities, inclusion of additional key variables, and potentially the application of more sophisticated econometric methods. After completing roughly a half-dozen case studies, the range of results generated could be used to develop a "generic" forecasting approach that could be applied to proposed New and Small Starts projects in other cities, based on factors such as system characteristics, land use context, regional economic indicators, etc. The option of using hedonic methods to forecast changes in property values or rents, as opposed to changes in the absolute magnitude of development, was also proposed.

4.2.2. Panel Response

Overall, the panel members felt that the quantity of development (e.g., square footage, number of units) is not an ideal measure of economic development, since in itself it does not represent an economic benefit. Panel members expressed a much stronger preference for a model that explicitly predicts property values.[12] Property values can be measured with hedonic price models. Such models predict the sales price or rent of a property, controlling for variables such as parcel size, characteristics of the building stock, zoning classification, transportation

[12] Panelists noted that changes in *land* values are the true measure of generated economic value, rather than *property* values which include the value of buildings and any other improvements made to the land. However, land values are very difficult to observe in areas where most of the land has already been developed. Property values generally track land values, and hedonic modeling (as discussed below) can be used to identify value created by improvements as opposed to the underlying value of the land itself.

accessibility, economic trends, and any number of other variables that the analyst chooses to include.

Panelists suggested that hedonic models could be used to develop elasticities or other factors relating different types and levels of transit investment to changes in property values. However, they did not feel confident that such analysis could be used to develop a model to forecast, in a quantitative manner, the actual property value or economic development impacts of proposed transit projects. Instead, the more appropriate use of historical analysis would be to bound the potential range of impacts that different projects might be expected to produce under different circumstances.

The panel further noted that a significant amount of research has been done on the property value impacts of transit, especially on residential property values. A "meta-analysis" of this literature could be conducted to extract findings relevant to FTA's purposes. Panelists suggested that additional research would be worthwhile, particularly on the impacts of streetcars (which have received little rigorous quantitative analysis), and also applying more sophisticated statistical methods to better account for other spatial and temporal factors affecting land values.

4.2.3. Technical Considerations

The panel provided a number of suggestions regarding the technical aspects of performing historical analysis of land values.

The basic methodology that FTA's consultants applied in Portland and Baltimore[13] would be improved by using a system of equations instead of developing an area typology that is based in part on density, then using this typology to predict density. Endogenous relationships among transit investment, zoning, and density need to be considered. The approach to considering these relationships would be somewhat different if land values are being predicted, rather than built densities.

Hedonic price modeling is a common method of assessing property value impacts, and is the approach recommended by most panelists for historical analysis purposes. Reasonably specified hedonic price equations tend to generate meaningful measurements of the importance of parcel distance from a transit station. Likewise, dummy variables can capture agglomeration effects or other qualitative effects.

On the other hand, hedonic modeling has a number of limitations for the purposes of FTA's work, as well as other issues which need to be recognized and addressed to the extent possible. These limitations are in addition to the theoretical question discussed above of whether land values actually reflect the value of the transportation improvements. These are discussed further below and include:

- Transferability issues;
- Geographic scale, including the measurement of net regional impacts;
- Limitations of data sources, especially for non-residential property; and
- Controlling for a full range of explanatory variables, and using appropriate statistical methods.

[13] As described in Cambridge Systematics, Inc., 2006

Transferability

One major limitation of hedonic models is that of transferability, both spatial and temporal. Hedonic models are well-suited for evaluating past impacts (e.g., of increased transit accessibility). However, they cannot predict how changes in particular variables will affect property values in the future. Furthermore, the results are context-specific (providing a snapshot of impacts at a particular location and point in time) and the coefficients or elasticities from such models cannot be transferred to other areas in a technically correct manner.

Good hedonic models have only been reasonably and robustly developed in a few areas. To generalize impacts to other cities, some panelists suggested using "elasticities" (e.g., a percent change in land values with respect to a percent increase in transit accessibility) for different conditions and applying these to property values in the study locations. Others felt that elasticities developed in one context should not be applied to others. Instead, they suggested using an ordinal scale (e.g., five point rating from low to high, based on percent increase in values), describing the range of impacts as observed across various projects. The purpose of hedonic analysis, therefore, would be to establish bounds on expected impacts of different types of projects in different contexts (economic, demographic, land use, etc.) Expert judgment could be used in conjunction with the hedonic analysis results to identify an appropriate range of impacts.

Regardless of which approach is used, one particular challenge for this work will be to conduct an adequate number of case studies to ensure that a broad enough spectrum of transit project types and project contexts is represented, so that results can be generalized to any project applying for New Starts funds.

Some panelists further noted that if percentage changes in property values are applied to estimate aggregate future benefits, it is unclear as to what land use scenario these resulting property value premiums should be applied. One panelist suggested a methodology described in a recent Transit Cooperative Research Program report that addresses this issue.[14] This methodology applies percentage increases in value to individual parcels based on distance from transit. This issue is not a concern if the hedonic results are used only for developing an ordinal scaling factor.

Geographic Scale

Most hedonic analysis of transit impacts has focused on the areas in direct proximity to the transit station, where the most significant impacts occur. Panelists cautioned, however, that to measure net regional benefits – as well as to capture general movements in land values occurring for reasons unrelated to the transit project — the hedonic analysis should include a broader area than just the immediate station vicinity. Land values may fall in locations not directly benefiting from the transit investment, offsetting some – or perhaps even all – of the increase in land values in station areas.

Some panelists expressed skepticism, however, about the feasibility of such regional-level hedonic price analysis. Any decreases in land values away from station areas are likely to be quite small on a percentage basis (because they are spread out over a larger area) and therefore

[14] Cambridge Systematics, Inc., R. Cervero, and D. Aschuer. *Economic Impact Analysis of Transit Investments: Guidebook for Practitioners.* Washington, D.C.: National Academy Press, Transit Cooperative Research Program Report 35, National Research Council, 1998. See Appendix.

extremely difficult to measure empirically. Furthermore, one cannot compare regional land values with vs. without the transit investment – a basic limitation of empirical analysis, as compared to modeling. A method that would at least partially address the question of redistribution of land use and benefits would be to take a "control" corridor that has similar characteristics to the new transit corridor (but already has transit) and compare price changes in the two corridors over time. This could possibly show whether the construction of a new transit facility has led to relocations from the old transit area and therefore to redistribution rather than generation of the new value.

Panelists further observed that properties, especially in direct proximity to the transit line and/or stations, can experience decreases in value (or lower increases) due to disamenities such as noise, vibration, aesthetics, and traffic. These decreases can and should be captured in the hedonic analysis.

Data Sources

The preferred data source for hedonic modeling is from actual sales of real estate and/or appraisals based on full market value. In general, sales data for residential properties are reasonably good in medium- and fast-growing areas where significant turnover is taking place. Slow-growth areas, however, may suffer from a lack of sufficient data. Residential sales prices such as those maintained by the Multiple Listing Service are excellent datasets and can frequently be obtained for public agency or research purposes, although five to 10 percent of the records are typically not usable. In contrast, commercial rent data can be difficult to interpret. Rent may or may not include utilities, janitorial services, parking, and other services, and retail rent deals may include a percentage of gross or net sales. Furthermore, one must distinguish asking rents from brokered rents. Commercial sales transaction data are typically quite sparse, and prices may vary considerably depending upon the characteristics of the property.

Building permit data represent a potential source to evaluate development activity, but have some limitations. These data are usually not georeferenced in electronic format, and are often available only at the municipal level. In addition, there may be a significant time lag between permitting and actual construction, or the permitted project may never actually be built.

The panel does not recommend translating property values into amount of development or vice versa. Building permits and densities can serve as proxies for value, especially if used in conjunction with vacancy rates. However, for a variety of reasons (such as speculation and overbuilding), they may not be directly correlated. Land prices alone will convey the underlying value of the location.

Explanatory Variables and Statistical Methods

To accurately distinguish the impacts of transit from other factors, hedonic models must include a full range of significant explanatory variables. While most of these will be exogenous (i.e., independent of the transit investment), some may be considered partially or fully endogenous. For example, properties may be rezoned (e.g., for higher density or a change in use) in response to the transit investment. The amount of development should be considered as an endogenous variable when modeling property values.

Some analysts have expressed the concern that in some situations, spatial variations in property values (e.g., due to school quality, proximity to open space, or other factors affecting

neighborhood desirability) may be correlated strongly enough with the location of transit stations that transit may appear to be causing a property value impact, when in fact other factors are at work. Issues of spatial and temporal correlation confounding the results can be reduced, if not fully eliminated, through the use of sophisticated statistical methods, such as simultaneous or structural equation models. Furthermore, the models should attempt to include lagged response of prices to take into account possible multi-stage and indirect effects of transit investment on land values and rents. Examples of studies that attempt to address these issues are described in two recent references.[15] If models are built from scratch, it is important to maintain as much uniformity in modeling approaches as possible.

One panelist noted that a transit investment may lead to agglomeration benefits (i.e., economic benefits resulting from a high concentration of business activity) or disbenefits, and that these can be captured through a dummy variable. However, another commented that agglomeration economies are an example of an externality that will not, as a rule, be correctly reflected in market values of land.

Key variables that should be considered in hedonic modeling – in addition to those listed in Section 8 of the Briefing Materials – include:

- Types, conditions, and ages of buildings around station areas;
- Floor space and floor space per unit of land (structural density);
- Presence of vacant land;
- Average all-day parking cost;
- Amount of development (endogenous to land values modeling);
- Environmental variables (e.g., open space in close proximity, air quality, proximity to noise-generating activities);
- Proximity to social, cultural, and recreational opportunities;
- School quality; and
- Proximity to airports or business districts (for commercial uses).

4.3. Regional Economic Simulation Modeling

4.3.1. Summary of Approach

The regional economic simulation modeling approach uses an economic simulation model, such as the Regional Economic Models, Inc. (REMI) model, to measure economic benefits at a regional level. These benefits are typically measured in terms of gross regional product (GRP) and/or personal income. These models require inputs such as reduced business costs and/or increased productivity that are derived from transportation system user benefits. They are primarily set up to analyze those components of user benefits that flow directly to businesses,

[15] *c.f.* Redfearn, C., "Urban Complexity & Parameter Instability: Assessing Amenity Capitalization in the Presence of External Homogeneity," METRANS project #04-18, University of Southern California, 2007; Haider, M. and Miller, E., "Effects of Transportation Infrastructure and Location of Residential Real Estate Values: Application of Spatial Autoregressive Techniques," *Transportation Research Record* 1722, Transportation Research Board, 2000, pp. 1-8.

through truck travel, on-the-clock passenger travel, and to a lesser extent, commuting. To measure net economic impacts, such models also require cost inputs, e.g. added taxes and fees to finance and operate the new project. The purpose of such models is *not* to analyze land use changes and their impacts (per the definition of economic development provided above). Rather, it is to capture another type of economic benefit – the "multiplicative" economic benefits that result from reductions of costs to users of the transportation system.

In previous research conducted for FTA, as described in the February 2006 interim report distributed to the panel, FTA's consultants tested the use of simulation models in Salt Lake City and West Central Florida to analyze the benefits of a package of regional transit investments. In both cases, it was determined feasible to distinguish economic benefits above and beyond the transportation system user benefits accruing from the investment. The methodology and results of this research were presented to the expert panel.

4.3.2. Panel Response

Overall, the panel felt that this approach has its merits, as it measures some economic benefits that are not accounted for in other methods, and it is focused on measuring net benefits at a regional scale. However, the panel did not recommend it as a stand-alone method for achieving FTA's objectives of a comprehensive measure of economic development benefits. Instead, panelists felt that regional economic simulation would best be suited as a supplement to other analysis methods, or incorporated as a part of an integrated transportation/land use modeling framework that also accounted for economic effects (i.e., by modeling industry location decisions, as well as flows of goods among industries and analysis zones).

Specific limitations noted by the panel included:

- The method, by itself, is not capable of predicting the land use changes induced by a transit investment, or measuring the economic benefits that result from this redistribution of land uses;
- The extent to which commute or non-work travel time savings result in business cost savings will vary from region to region, depending upon factors including the tightness of the labor market. In a very tight labor market, businesses may capture most or all of the benefit from the time savings related to a home-based work trip (i.e., commute travel), whereas with high unemployment, businesses will capture little or no benefit. The percentage of commute travel time savings that should accrue to businesses (and therefore be reflected in economic impacts) can be changed by the user but there is no clearly established method to determine this percentage for a particular region;
- The models require monetizing and allocating costs and benefits by industry. However, in many cases, the data required to allocate transportation system user benefits to different industries may not exist, so general assumptions need to be made.

Furthermore, as with all forecasting methods, there is considerable uncertainty in assumptions that are fundamental to the analysis, e.g., the effects of fuel prices and technological change on the production function.

4.4. Project-Specific Market Assessment

4.4.1. Summary of Approach

This approach would use standard real estate market assessment techniques to develop projections of potential station area development impacts. Market assessment typically includes data-gathering such as:

- An inventory of developable or redevelopable station area land and conditions in station areas;
- Indicators of the local real estate market, such as lease rates, vacancy rates, absorption rates, and growth forecasts; and
- Interviews with developers, property owners, and others knowledgeable about the local real estate market, to identify what types and level of development might be expected, as well as the potential impact of the transit investment on developers' decisions.

Experts familiar with the local real estate market then apply their judgment to project the short- and/or long-term development potential in station areas by type of land use (office, retail, industrial, residential).

4.4.2. Panel Response

Panelists suggested that a market assessment approach, if properly structured, might have value as a supplement to other methods. Some of the more valuable uses of market assessment methods might include:

- Characterizing particular areas based on factors that affect the potential impact of transit on development (fast-growing, high-crime, school quality, neighborhood amenities, etc.);
- Assessing the capacity of the local development community to implement transit-oriented development (for example, it was noted that there are very few mixed-use developers, who tend to focus their development efforts regionally rather than nationally); and
- Gathering other local knowledge regarding particular factors that relate to potential development impacts, especially those that cannot readily be quantified from other data sources.

The panel agreed with FTA's assessment that this approach has the significant weakness that it is highly subjective and affected by the personal experience and bias of the analyst. Although it can be used to produce quantitative forecasts, it is not mathematically rigorous as compared to hedonic price modeling or other analytically-based approaches. Furthermore, most developers and other real estate experts are very short-term focused, e.g. one to three years, and would be unlikely to accurately predict how markets might evolve over 10 to 20, much less 30 years.

The panel recommended that this approach not be used by itself due to its short-term and highly subjective nature. However, an assessment by national professionals under contract to FTA – as opposed to local professionals working for the project sponsor – could potentially provide an unbiased (although still subjective) assessment of different projects. A rigorous, structured approach for conducting interviews with local developers, real estate analysts, planning officials,

and other experts would help standardize and maintain consistency among the results. With a clearly defined protocol applied by unbiased experts, the market assessment approach could provide a useful complement to quantitative models.

4.5. Qualitative Approach

4.5.1. Summary of Approach

Other, largely qualitative assessment techniques could be envisioned that attempt to develop an overall indicator of the likely *relative* impacts of the proposed transit investment, rather than an actual forecast of the magnitude of development. The approach currently being developed by FTA to assess economic development impacts, as described in the NPRM of August 3, 2007, is one example of such an approach. This approach relies on five factors that relate to the likelihood that the transit investment will stimulate additional changes in development patterns:

- Amount of land with development or redevelopment potential (vacant or underutilized);
- Strength of plans and policies (e.g., minimum and maximum densities, design guidelines or requirements, provisions for enforcement, other tools to promote development);
- Indicators of the corridor economic climate (e.g., growth projections, asking rents, vacancy rates);
- Increase in transit accessibility caused by the project; and
- Permanence of the transit investment, as measured by the economic lifespan of the project.

4.5.2. Panel Response

In general, the panel agreed that a qualitative approach, utilizing various indicators of potential impact, is a reasonable interim approach while a more rigorous quantitative method is being developed and validated, or even may be used in conjunction with the results of additional quantitative research. In particular, information gained from modeling case studies may be used to bound the range of potential impacts of projects under different conditions, and then project-specific economic indicators used to scale the economic development benefits within this range.

Preliminary Screening Process

The panel suggested a two-stage approach to evaluate New or Small Starts projects. In the first stage, a qualitative screening process could be used to eliminate projects that do not meet the basic conditions that are needed for significant economic impacts. General criteria for this screening process might include:

- Strong economic growth (e.g., at least two percent annually) must be anticipated both regionally and in the corridor;
- Transit-supportive zoning and regulations must be present in station areas;
- The city must have a noticeable market for higher density development, and the stations must lie in areas where the market would support higher density development; and

- Other local factors must be present that support development potential in station areas, such as the availability of land and compatibility with existing development.

The criteria should be defined in unambiguous and, ideally, quantitative terms. If these criteria are met, then a more detailed analysis could be performed to estimate the general magnitude of project benefits.

Economic Development Benefit Valuation

A qualitative assessment could be incorporated into the user benefits measure by increasing this measure by a certain percentage, based on the approximate magnitude of benefits anticipated. For example, economic development benefits could be bounded between 0 and X percent of the calculated transportation user benefits. (This bound could be set based on other research, such as hedonic price modeling or integrated transportation-land use modeling.) Projects that meet all criteria for economic development impacts would receive the highest rating, which would translate into a percentage of benefits (e.g., 0/5/10/20/30 percent) to be added to the total user benefits that have already been calculated.[16]

Elasticity analysis can help FTA evaluate the historical response of land market values to transit projects under different conditions. Elasticity can be used to compute the sensitivity of land value (or location choice, which would be more complicated) to transit accessibility. Existing research using location models and hedonic price models demonstrates how to relate land values or location choice to transit accessibility. These relationships could then be applied to project-specific indicators (e.g., regional growth rates, accessibility benefits) as described.

The panel cautioned that the elasticity of housing or commercial floor area supply with respect to price varies enormously because of land use regulations, industry category and location. Analysis methods should account for these factors.

Using the Indicators to Rate Projects

The main difficulty with using a mix of indicators, rather than developing a quantitative, predictive model, is how to develop a consistent and objective rating scheme that combines these different indicators. Panelists suggested that establishing stringent guidelines to obtain comparable information for each project, then using a small core of FTA staff to rate each project based on this information, was a reasonable approach. Analogous approaches include the British model for transportation project evaluation or the National Science Foundation model for awarding research funds.

Enhancements to Current Indicators

FTA's current proposed indicators (as listed above) are generally the right ones relating to economic development potential. However, they might be enhanced by including additional information (such as neighborhood crime rates, school quality, socioeconomic and demographic

[16] One panelist commented that it did not make sense to make an estimate of economic benefits a percentage increase in user benefits because the relationship between user benefits and economic development is not likely to be consistent between projects. This panelist believes that benefits should be measured separately in the same units ($) and summed together as in a cost-benefit analysis.

information, or the likelihood that different types of existing land uses could be redeveloped) that may affect development potential.

5. OTHER ISSUES

During the course of the workshop, a number of additional issues arose on which the panel provided input. These questions were not part of the panel's initial charge, but nevertheless are related to the measurement and valuation of economic development benefits.

5.1. Improvements to Current Methods to Measure User Benefits

In the course of the discussion, members of the expert panel suggested a number of improvements to the current methodology for measuring benefits of New and Small Starts transit projects, including:

- MPOs should use dynamic trip tables instead of fixed trip tables, to account for changes in travel and land use patterns as a result of the transit investment. Dynamic transportation/land use models can be employed to avoid the problems that are associated with using a fixed trip table. The location choice component should explicitly measure the impacts on agglomeration, productivity, travel time, etc. Models that are widely used today rarely have this degree of sophistication. Panelists recommended that FTA seek Congressional funding to assist MPOs in developing the modeling tools that are needed to perform this relatively sophisticated analysis.
- MPOs can introduce a dummy variable into their mode choice models to account for the advantages (such as reliability) of fixed guideway transit over bus transit (although models already include a "modal constant" that captures the value of these unmeasured attributes).
- Fixed geographic boundaries can be problematic for analysis in sprawling metropolitan regions, where growth impacts may spread beyond current model boundaries.
- Network effects of system-wide investment should be considered. Because the current approach is incremental (i.e., evaluating only individual transit projects), additional benefits resulting from a network of transit investments are not accounted for. For example, if a project is a link to what will eventually be a five-branch network, the benefits of each branch individually may be less (when added together) than the benefits of all five branches evaluated at once. Likewise, some increments of the network will have bigger impacts on mobility than other increments. Some panel members speculated that network benefits begin to be realized starting with the third or fourth branch.[17] Furthermore, peripheral investments are extremely important additions to traditional hub-and-spoke networks. One panelist noted that experience has shown that major land use changes begin to occur when the transit network starts to mimic the connectivity of the highway network.
- In regard to units of measurement, panel members suggested that dollars are a much more relevant measure than time for any approach that includes an economic

[17] FTA notes that if the entire network is financially feasible, MPOs are welcome to include network effects. However, transit projects are usually funded on an incremental basis, so network effects are not normally considered for funding evaluation purposes.

development component. Panel members find it intuitively more reasonable to convert time into monetary units than to view money in terms of time.

5.2. Use of Cost-Benefit vs. Cost-Effectiveness Measures

Some panelists raised the question of whether FTA should use a cost-benefit measure that includes an accounting of benefits that is as comprehensive as possible, rather than cost-effectiveness. They noted that cost-benefit analysis could represent an approach to incorporating all benefits and valuing them in the same terms, as well as comparing the net benefits vs. the costs of the investment to society. FTA responded that they have avoided full cost-benefit analysis for a number of reasons. Most importantly, many of the benefits (e.g., environmental) are difficult to value in monetary terms. Instead, FTA is working to incorporate as many benefits as possible into the cost-effectiveness measure. However, FTA does encourage project sponsors to perform cost-benefit analysis for their own project evaluation purposes. Despite noting that it represents an ideal end goal for project evaluation, other panelists agreed that cost-benefit analysis currently has significant limitations.

5.3. Importance of Transit-supportive Policies and Zoning

Zoning constraints are extremely important to determining station area economic development impacts. Studies have shown that supportive zoning and regulations have a positive impact on the development effects of transit facilities. Explicitly including zoning in the analysis is difficult, however, because a predictive model of development or land values must gauge how zoning might change under different circumstances. Frequently, local governments will condition zoning changes on the investment being made. In contrast, FTA's viewpoint is that zoning should be the same (presumably allowing higher densities than the existing policy setting) in both the baseline and the build alternatives, since it can be changed (at no significant cost) regardless of whether or not the transit investment is made and it has an independent effect on user benefits of the transportation system. FTA believes that allowing variable policy settings between the baseline and build alternatives provides an easy way to manipulate estimates of project benefits that are not caused by the proposed project itself and can cause major quality control problems in the evaluation process.

A number of panelists suggested that it was unrealistic to require that zoning and other land use policies be held constant and that only the incremental impacts of the transit project itself be evaluated. They noted, for example, that local governments can find it difficult to justify high-density, mixed-use zoning in the absence of transit. In such situations, the question of what would have happened if transit-supportive zoning policies were adopted but the transit project not implemented would therefore be moot. One panelist further noted the possibility of interactive, synergistic effects – for example, if market-responsive zoning combined with enhanced accessibility yields proportionally bigger land value benefits than either factor in isolation.

5.4. Impacts of Private Sector Finance on Project Evaluation

The FTA Administrator also asked the panelists to comment on how FTA should consider private contributions to project costs when evaluating the appropriate Federal contribution to the project. He noted that private development interests are especially interested in streetcar projects

and in some cases have offered to contribute private funds to the construction and/or operation of a project. In particular, when calculating cost-effectiveness as the basis for providing Federal funding, should FTA subtract the private sector contribution from the total cost of the project?

Panel members expressed substantial confidence in the private sector's valuation of the project – if the private sector sees the project as a benefit, then they are likely to benefit at least in relation to what they are willing to pay. Furthermore, since much of the private interest in streetcars is generated by the amenity value of the project rather than actual travel time savings, hedonic price modeling may be a more appropriate means of capturing the project's benefits than transportation system user benefit modeling alone. Panel members also suggested that dummy variables be used to account for the relative appeal of different technologies such as streetcars.

Panel members also warned that even though real estate professionals and local officials in many cities may believe that streetcars will provide significant economic development benefits in their region, the reality is that we have little evidence to support this belief. For example, the Pearl District in Portland, Oregon – which has seen a significant amount of high-density development concurrent with the introduction of streetcar service to the area – represents a unique set of circumstances that included supportive zoning changes, other supportive investments, and a strong local market. The development impacts associated with most streetcar projects are probably small, and these projects often do not result in significant travel time benefits either.

APPENDIX A: EXPERT PANEL BIOGRAPHIES

Dr. **Alex Anas** is Professor of Economics at the State University of New York at Buffalo since 1991. From 1975 to 1991 he was on the faculty at Northwestern University. He has also taught on a visiting basis at Stanford University (1981-82) and the University of Illinois at Urbana-Champaign (1986-88). He obtained BA and BS degrees from Carnegie-Mellon University and MA, MCP and Ph.D. degrees from the University of Pennsylvania. He has published three books and over one hundred scholarly journal articles and book chapters. He has won numerous awards from the USDOT, HUD, Fannie Mae, NSF and USEPA to develop models such as CATLAS (for the evaluation of transit investment effects and benefits) published in 1983 and RELU-TRAN a general equilibrium model of regional economy, land use and transportation published in 2007. In 2006, he was selected a Fellow of the Regional Science Association International, an interdisciplinary association of urban scholars from economics, geography, engineering and urban planning, for distinguished scholarly contributions to regional science.

Dr. **Robert Cervero** is Professor and Chair of the Department of City and Regional Planning, University of California, Berkeley. He is the author of numerous articles and research monographs in sustainable transportation policy and planning, including *Transit Oriented Development in the United States: Experiences, Challenges, and Prospects* (2004, National Academy Press) as well as six books, including *The Transit Metropolis* (Island Press, 1998); *Informal Transport in the Developing World* (UN Press, 2000); *Transit Villages for the 21st Century* (McGraw-Hill, 1997) and *Paratransit in America* (Praeger, 1997). In recent years, Professor Cervero has been an advisor and consultant on transport projects in China, Colombia, Brazil, Ireland, and numerous U.S. cities. His current research includes studies on neighborhood impacts of freeway removal projects, travel behavior impacts of suburbanization in large Chinese cities, infrastructure decentralization in Indonesia, transit value capture in megacities of Asia, and trip degeneration impacts of transit-oriented development. In 2004, Professor Cervero was the first-ever recipient of the Dale Prize for Excellence in Urban Planning Research and also won the 2003 Article of the Year award from the *Journal of the American Planning Association.* Professor Cervero presently serves on the editorial boards of *Urban Studies, Journal of the American Planning Association*, and *Journal of Public Transportation*, chairs the National Advisory Committee of the Active Living Research Program of the Robert Woods Johnson Foundation, and is a Fellow with the Urban Land Institute and World Bank Institute.

Dr. **Elizabeth Deakin** is Director of the University of California Transportation Research Center and Professor of City and Regional Planning at UC Berkeley, where she also is an affiliated faculty member of the Energy and Resources Group and the Master of Urban Design group. She is co-director of UC Berkeley's Global Metropolitan Studies Initiative, which involves nearly 70 faculty members from 12 departments. Deakin's research focuses on transportation and land use policy, the environmental impacts of transportation, and equity in transportation. She has published over 100 articles, book chapters, and reports on topics ranging from environmental justice to transportation pricing to development exactions and impact fees. She has been appointed to a number of government posts including city and county commissions and state advisory boards. She has taught at universities in Australia, Germany, Sweden, France, and China, and has served as an adviser to the Organization for Economic Cooperation and Development, the European Council of Ministers of Transport, and MISTRA (the Swedish sustainable development foundation). She chairs cooperative research agreements with

universities in China, Japan, and the E.U. Deakin holds degrees in political science and transportation systems analysis from MIT as well as a law degree from Boston College.

Dr. **Genevieve Giuliano** is Professor and Senior Associate Dean of Research and Technology in the School of Policy, Planning, and Development, University of Southern California, and Director of the METRANS joint USC and California State University Long Beach Transportation Center. She also holds courtesy appointments in Civil Engineering and Geography. Professor Giuliano's research focus areas include relationships between land use and transportation, transportation policy analysis, and information technology applications in transportation. Her current research includes analysis of regulatory policies aimed at reducing impacts of freight in metropolitan areas, development of metropolitan freight flow models, and analysis of changes in metropolitan spatial structure. Prof. Giuliano has published over 130 papers, and has presented her research at numerous conferences both within the US and abroad. She serves on the Editorial Boards of *Urban Studies* and *Journal of Transport Policy*. She is a past member and Chair of the Executive Committee of the Transportation Research Board. She was named a National Associate of the National Academy of Sciences in 2003, received the TRB William Carey Award for Distinguished Service in 2006, and was awarded the Deen Lectureship in 2007.

Dr. **David Lewis** is a Senior Vice President with HDR Decision Economics and serves as the firm's National Director for Economics and Financial Services. He served previously as President of HLB Decision Economics and prior to that as Principal Economist of the U.S. Congressional Budget Office. Trained at the London School of Economics, he is the recipient of several professional awards, including the Saltzman Prize for Economic Literature; the Transportation Research Board's Bell Award for Services to Transportation Research; and the Elmer Staats Award of the Journal of Policy Analysis and Management. He was elected a Fellow of the Institute of Logistics and Transport in 2003 and an Emeritus Member of the Transportation Research Board in 2006. Under contract with the Federal Highway Administration, his present work includes extension of the conventional Cost-Benefit Analysis process to accommodate the productivity effects of private investment in advanced logistics when such investments are induced by improvements in transportation infrastructure. His 1999 book, "Policy and Planning as Public Choice: Mass Transit in the United States" (co-authored by Dr. Fred Williams) is a quantitative accounting of the benefits of passenger transportation in relation to mobility, congestion management and economic development.

Dr. **Eric Miller** has B.A.Sc. and M.A.Sc. degrees from the University of Toronto and a Ph.D. from M.I.T. He has been a faculty member in the Department of Civil Engineering, University of Toronto since 1983, where he is currently Bahen-Tanenbaum Professor, Director of the Joint Program in Transportation and Interim Chair of the Department of Civil Engineering. He is co-chair of the U.S. Transportation Research Board's (TRB) Sub-Committee on Integrated Transportation – Land Use Modeling, and a member of the TRB Transportation Demand Forecasting Committee and the TRB Task Force on Moving Activity-Based Approaches to Practice. He was also a member of the US National Academy of Sciences Committee for Determination of the State of the Practice in Metropolitan Area Travel Forecasting. He will become Chair of the International Association for Travel Behaviour Research in January 2008. He recently chaired travel demand modelling peer review panels for magnetic levitation demonstration projects in Pittsburgh, Baltimore and Las Vegas, as well as is a member of the technical advisory group for the *Transims* implementations in Portland, Oregon and Burlington,

Vermont. Recent travel demand peer review assignments include Baltimore, Cincinnati, Salt Lake City, Denver, Vancouver and Waterloo, Ontario. His research interests include: integrated land use-transportation modelling; activity-based travel demand modelling; microsimulation modelling; analysis of the relationship between urban form and travel behaviour; and modelling transportation system energy use and emissions. He is the developer of *GTAModel*, a "best practice" regional travel demand modelling system used by the City of Toronto and others to model travel demand in the Greater Toronto Area. He is the principal investigator of the research team developing *TASHA*, a household-based microsimulation modeling system for daily activity/travel scheduling, and *ILUTE*, a microsimulation, agent-based integrated land use – transportation modeling system. He is co-author of the textbook *Urban Transportation Planning: A Decision-Oriented Approach*, the second edition of which was published in 2001.

Dr. **Elena Safirova** is a fellow at Resources for the Future, a think-tank in Washington. In her current research, she focuses on economic modeling and policy analysis related to transportation and urban land use. In particular, Safirova is analyzing transportation policy alternatives with respect to outcomes for transportation demand, location decisions, urban sprawl, interaction with other policies, as well as the effects on economic welfare and environmental quality. She also is interested in the impacts of technological change on urban spatial structure, labor markets, industrial organization, and the environment. Her work has appeared in the Journal of Urban Economics, Transportation Research A, Transportation Research D, Transportation Research Record, among others. Safirova has obtained her undergraduate degree in Economics from Moscow State University and a PhD in Economics from State University of New York at Buffalo.

Dr. **Simon Washington**, Professor of Civil Engineering at Arizona State University, has conducted research related to transportation planning for about 15 years. He was co-principal investigator of SMARTRAQ—a project in Atlanta Georgia that aimed to measure the travel behavior impacts of land-use densities, land-use mix, and transit accessibility on transit use. He has served on a US EPA Federal Clean Air Act Federal Advisory Subcommittee: Transportation, Land-Use, and Air-Quality. He is coauthor of the textbook "Statistical and Econometric Methods for Transportation Data Analysis", which has been adopted nationally and internationally for applying analytical techniques for the assessment of transportation projects. He is currently involved in travel behavior research—focused on issues related to obtaining reliable information on non-chosen mode attributes such as transit travel times and costs. He has been PI or Co-PI on over $9 million in externally sponsored research related to transportation planning and has authored or co-authored about 50 peer-reviewed technical articles.

APPENDIX B: OTHER WORKSHOP ATTENDEES

B.1 Presenters and Discussants

- James Simpson, Administrator, Federal Transit Administration
- Sherry Little, Deputy Administrator, Federal Transit Administration
- Rich Steinman, Federal Transit Administration – Office of the Administrator
- Steve Lewis-Workman, Federal Transit Administration – Office of Planning and Environment
- Ron Fisher, Federal Transit Administration – Office of Planning and Environment
- Jim Ryan, Federal Transit Administration – Office of Planning and Environment
- Chris Porter, Cambridge Systematics, Inc.

B.2 Recorder

- Monique Urban, Cambridge Systematics, Inc.

B.3 Observers

- Susan Borinsky, Federal Transit Administration
- Charlie Goodman, Federal Transit Administration
- Christy Grier, Federal Transit Administration
- Kate Mattice, Federal Transit Administration
- Severn Miller, Federal Transit Administration
- Sherry Riklin, Federal Transit Administration
- Chris van Wyk, Federal Transit Administration
- Matt Welbes, Federal Transit Administration
- Fred Williams, Federal Transit Administration
- Ed Weiner, Office of the Secretary of Transportation
- Chris Cherry, University of Tennessee
- Vidhya Ananthakrishnan, Government Accountability Office
- Kyle Browning, Government Accountability Office
- Susan Zimmerman, Government Accountability Office
- Joyce Ross, Professional Staff, US House of Representatives, Transportation and Infrastructure Committee

- Amy Scarton, Counsel, Subcommittee on Highways and Transit, US House of Representatives, Transportation and Infrastructure Committee

APPENDIX C: AGENDA

ARRIVAL, COFFEE, AND PASTRIES (8:30)

- Welcome and Introductions (9:00)
- Overview (9:15)
    1. FTA's objectives from this work
    2. Today's agenda
- Background (9:30)
    3. New Starts project evaluation process
    4. Transportation system user benefits measure and its calculation
    5. Previous FTA-funded research on economic development impacts
    6. Questions and comments

BREAK (10:30)

- An Ideal Approach to Measuring Economic Development Benefits: Integrated Transportation and Land Use Models (10:45)
    7. FTA presentation
    8. Discussion

LUNCH (11:45)

- Alternative Approaches to Evaluating Economic Development Impacts of Transit (12:30) – Discussion
    9. Historical analysis of transit investment, development, and land values using econometric methods
    10. Non-land use model approaches to regional re-allocation of land use
    11. Project-specific market assessment
    12. Qualitative assessment techniques
    13. Other methods

BREAK (3:00)

- Wrap-up (3:15)
    14. Recap of panel recommendations
    15. Final comments and questions from the panel
    16. Next steps