A RESPONSE TO THE PICKRELL REPORT ON RIDERSHIP AND COSTS OF URBAN RAIL TRANSIT PROJECTS

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"Urban Rail Transit Projects: Forecast versus Actual Ridership and Costs"[1] is a continuation of Don Pickrell's critique of urban rail. Pickrell has produced a report that states that rail projections of ridership and costs tend to be grossly wrong, resulting in capital investments that might never have been made. The report is presented as a technical analysis of why rail forecasts about costs and patronage have been so grossly in error.

Pickrell makes hundreds of data selection and transformation decisions that individually seem plausible but which systematically exaggerate forecast error when looked at as a whole. The picture painted deviates substantially from the operating efficiencies found in most rail systems.

The framing of questions and comparisons seems partisan. Comparisons of operating costs for similar size all-bus and bus/rail transportation systems were not made; these would have undermined the argument. Comparisons of projections to actual outcomes were made instead; but even there Pickrell chose the *earlier* published estimates (which were part of a series of increasingly realistic estimates) that led to final funding proposals. Again, he suggested a plausible reason for his choice of early rather than later estimates but the impression of partisanship remains.

Pickrell's attack is more effective in this most recent of his writings on rail, mainly because of his choice of target: projections that really were both theoretical and wrong. In his previous work he labeled his theoretically derived data as "actual" while labeling the empirical data he attacked as "theoretical". In this more recent work he again labels his data as "actual", but both the projections he attacks and the data he uses for comparison are highly interpreted. And both can be shown to be wrong. This paper will argue that, despite his choice of targets, Pickrell has not proven his point about the inefficiency of rail choices.

Pickrell's Earlier Writing on the Inefficiencies of Rail.

"Urban Rail Transit Projects" is posed as an objective accounting of rail project failure. The presumption of objectivity is based on the reader's faith that the hundreds of data selection decisions involved in the statistical presentations were impartial rather than strategic. A glance at Pickrell's earlier writing gives credence to a different view.

[1] Donald Pickrell, "Urban Rail Transit Projects: Forecast versus Actual Ridership and Costs", UMTA, 1989.

In 1985 Don Pickrell authored a critique[2] of Boris Pushkarev and Jeffrey Zupan's 1980 study of travel volume and rail investment.[3] Their study, also sponsored by UMTA, had been frequently used to support rail funding decisions. Pushkarev and Zupan had concluded that 6 cities were good candidates for heavy rail start-ups and a dozen more were good candidates for light rail start-ups. Their conclusion was based on existing rail system operating and capital costs, energy and land use requirements, operating speed and patronage. All of these were compared to analogous factors in bus and auto based systems.

Pickrell positioned Pushkarev and Zupan's data as theoretical, his own as actual, in order to show how their theoretical model fell short of his reality-based model. He then speculated at length as to why the theoretical model may have failed. Anyone not in possession of Pushkarev and Zupan's highly empirical findings (they were data based and not very theoretical) would be impressed by the purported shortcomings.

Pickrell's model was not reality-based but based on many incomplete, incorrect or faulty assumptions. What he consistently did was to underestimate the efficiency of rail systems and overestimate the efficiency of auto systems:

1) Pickrell rejected Pushkarev and Zupan's speed estimates for local bus, express bus and auto travel (8-12 mph, 20 mph, and 25 mph). His "more realistic" assumptions were 12-15 mph, 22-25 mph and 25-35 mph. Our own data for Los Angeles, the archetypal auto-based city, show that Pushkarev and Zupan were, if anything, conservative, and Pickrell to be wrong: Local RTD buses are scheduled to go 11.3 mph (and, given their frequency of lateness, they often fail to travel that fast), express buses are scheduled for 16.4 mph, and autos had an average speed of 24 mph in 1984 in Los Angeles County (the speed probably has gone down with the increase in auto trips since then).

2) One of Pickrell's key changes was his rejection of Pushkarev and Zupan's average auto occupancy of 1.4 in favor of 1.8.[4] This 22% increase in occupancy is important because he discounted the costs of auto driving by this factor when comparing them to rail costs. Again, local statistics from a variety of large cities show that he was wrong: For example, the Southern California Association of Governments (the regional MPO) reported that the average vehicle occupancy was 1.39 in Los Angeles in 1984. Considering the faster increase of autos in the region than population, this figure has probably declined. Although they proved to be correct, here is one of the few places that Pushkarev and Zupan weren't even being empirical. They were simply assuming that auto occupancy would be at the same level they found for rail transit: an all day load factor of 23.3%. Here, Pushkarev and Zupan were being kind to the auto by using all-day figures. During peak hours, when the transportation system is most congested, transit seems a much more efficient alternative. In Los Angeles, the average peak hour auto occupancy falls toward the mean work trip occupancy (a decline of about 19%) but the bus occupancy increases by 50%. Since the decision to increase either road capacity or alternatives to the road is related to peak carrying capacity, the advantage of transit during the peak should be emphasized.

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[2] Donald Pickrell, "Urban Rail in America: A Review of Procedures and Recommendations From the Regional Plan Association Study", USDOT, 1985.

[3] Boris Pushkarev and Jeffrey Zupan, "Urban Rail in America: An Exploration of Criteria for Fixed Guideway Transit", UMTA, 1980.

[4] Apparently, the 1.8 figure was taken from the Nationwide Personal Transportation Study. Unfortunately, it was the wrong aggregate statistic. In city centers of SMSAs the average vehicle occupancy was reported as 1.6; and on weekdays the averages approach, or are lower, than the 1.4 estimated by Pushkarev and Zupan. Dieter Klinger and J. Richard Kuzmyak, "Personal Travel in the U.S., Volume II: Nationwide Personal Transportation Study", USDOT, 1986, Tables E-121 and E-123.

3) Not only did Pickrell divide auto costs by too many passengers, he also ignored some important auto costs: insurance, licenses and fees (which add up to 15¢ a vehicle mile in L.A., and half that most other places), fuel and services (6¢ a mile), and maintenance and repairs (5¢ a mile). He also underestimated interest rates by over 2 cents a mile. Since all of these costs are included as transit costs it is important to include them in auto/transit comparisons. Pickrell also ignored many indirect auto system costs. Many city and county services support our roadway system (e.g. 40% of police costs are auto related). These costs amount to several cents per vehicle mile yet were ignored simply because they were hard to isolate (in contrast, all guideway costs for rail systems are highly public and were therefore included).

4) Pickrell was very concerned with the parking costs saved by replacing auto trips with rail trips. Small wonder considering his past work on parking issues. He went to great lengths to undercut his previous findings that the storage of autos is a large, usually unrecognized, cost of auto usage. Pickrell rejected using land prices as an indicator of the cost of parking because in congested areas multi-storied parking structures allow autos to be stacked on small areas of land. Instead, he used the market price of parking as a better indicator, even though he conceded that a floor on parking requirements in local land use ordinances, investment tax credits, and accelerated depreciation credits, reduce the price by artificially increasing the supply of parking. Pickrell would have done better to use commercial floor space lease rates (the opportunity cost to the builder because he has to provide parking) instead of parking prices. Using this would have made a 325 square foot space dramatically more expensive than the figures he uses (by a factor of 10). Pickrell further discounted the all day price by two-thirds because spaces are typically used by more than 1 vehicle per day. This simply is not the case in most commercial lots along the major rail corridors of Los Angeles. First, the real problem is the all day parker, a very common phenomenon. Second, prices quickly rise to the all day maximum in Los Angeles, usually in just over an hour, resulting in the full all-day price for each vehicle. (This is a typical rate escalation; exceptions are in areas, such as Downtown San Francisco, where this kind of pricing is forbidden). This means that the price paid per customer would approach the all-day rate, not cut it by 2/3.

5) The lack of attention to the opportunity costs of parking are interesting in light of Pickrell's use of them to discount potential rail savings by discounting the price of labor. He used $25,000 per job saved versus Pushkarev and Zupan's $32,000. This represented his estimate of what transit workers made in the private sector in 1983, as opposed to the public sector. He said that "the correct benefits measure is the value to society of the labor services thereby freed, which can be approximated by the highest competitive earnings level of those workers in their most highly valued <u>alternative</u> occupation." In other words, he discounted labor savings because public sector transit employees make too much.

6) What Pickrell chose to ignore in Pushkarev and Zupan's report is as revealing as what he contested. For example, he ignored their point that the reduction of auto travel is much greater in rail-served regions than in other areas. Auto travel per capita is 30% lower even though rail ridership could only account for 6% to 7% of this reduction. Pushkarev and Zupan believe that, "The principle reason for the suppression of both auto ownership and auto use is high density of development, especially in and near large downtowns, which are simultaneously made possible and stimulated by rail access."

Pickrell's omissions, assumptions and calculations did not lead to marginal differences. Taken together they led to estimates that differ by an order of magnitude from more realistic ones.

Taking Aim at Easier Targets: Projections That Proved Wrong.

"Urban Rail Transit Projects: Forecast vs. Actual Ridership and Costs" is a continuation of Pickrell's earlier attacks on rail. Here again, he labeled his carefully molded data as "actual" and compared it to what was projected in Environmental Impact Reports when the rail projects were first proposed. After indicating that the projections were wrong he developed a model to explain their failure. His conclusion was predictable: the rail starts were not justifiable; busways (his pet alternative) might have been better candidates because he believes that they are not subject to the same capital cost estimation errors he found in the rail projections.

Document Selectivity: Targeting Early Estimates

A critical problem for Pickrell was to justify using projections from draft documents which were circulated as *draft* documents, subject to criticism and refinement. As Pickrell, himself, indicated, the typical sequence in refining estimates began with a Draft Environmental Impact Statement (DEIS), proceeded to a Final Environmental Impact Statement (FEIS), and then to a Federal funding request. Estimates from each of these would typically become more conservative with each version.

A Federal study on the appropriateness of Federal funding decisions should be based upon the projections in the documents upon which the Federal decisions were made. But this would have eviscerated Pickrell's argument. For example, Portland's projected ridership in the funding document was 18,000 per day. Its current patronage of over 20,000 a day would reflect favorably on the initial investment. The FEIS estimate was 30,000 per day, and the DEIS estimate was 42,000.

Pickrell had to come up with a way to use an early, less critical estimate. He did this by defining it as the most critical to *local* decision makers, thereby biasing all subsequent outcomes. As Pickrell put it, "This study evaluates the ridership and cost forecasts that led local officials to select ten rail transit projects that have been constructed with federal financial assistance during the past two decades, by comparing those forecasts to each project's actual costs and ridership." Reference to the bases of Federal decisions is elegantly avoided.

Of course, the documents to which Pickrell refers do not always provide the data he wished to present. They had to be interpreted. It will be shown that he interpreted them in a way that serves his general argument. His interpretations are even more strategic in his presentation of "actual" ridership and costs.

Unfortunately, by allowing ourselves to argue with the details of Pickrell's comparisons we have fallen into a trap: the argument gives some legitimacy to Pickrell's choice of estimates. These never were the most logical nor the most critical estimates to compare to actual outcomes. The test of whether a project met the Federal criteria for funding would best lie in comparing the estimates in the final funding requests to actual outcomes. Some rail projects, such as Miami's, have failed this test, but the majority did well. The Federal Government generally invested wisely, according to its own criteria.

Comparing Forecast and Actual Ridership

Rail projects in ten cities were chosen for study, four heavy rail projects (Washington, Atlanta, Baltimore and Miami), four light rail projects (Buffalo, Portland, Pittsburgh and Sacramento) and two people movers (Miami and Detroit). Miami, the one city in which rail investment has been widely recognized as a failure is the only city represented twice. San Diego's highly successful projects, for which early local decisions really were crucial because negligible Federal funds were involved, are unrepresented. Other than Pittsburgh, none of the several rail rehabilitations were included (these were mostly undertaken in densely developed cities with demonstrably efficient rail systems). The rail projects chosen do not represent the universe of rail projects in which early local decisions influenced outcomes; they do not even represent the universe of projects with Federal involvement.

Pickrell found that the actual rail patronage for 9 of his 10 chosen projects were 28% to 83% lower than projected. Total transit patronage (bus + rail) fared slightly better, with actual transit patronage 8% higher to 74% lower than projected in 7 of the 8 non-people-mover projects (with most toward the lower end).

Choosing the year labeled "actual". Comparing projections to actual data is almost never as straightforward as it may seem. The projects Pickrell chose, as typical of many large capital projects, were not completed in the year anticipated. Unanticipated construction problems and funding delays can postpone completion for years. Rather than use either the year for which the projection was made, or the most recent year for which data was available, Pickrell picked a year in which the project approximated the system scope described in the documents. The year chosen was usually one to three years after that scope was achieved.

Pickrell admitted that there were problems with his chosen years. His admissions were virtually ignored in his concluding condemnation of rail investment even though the problems cited were serious; they should have eliminated most of his chosen years from the comparisons. For example, Portland's projection was supposed to be of a system 5 years after it was in full operation, but the actual data came from a 2 year old operation. Similarly, the Buffalo and Sacramento forecasts were for 1995 and 2000, yet 1989 data was used in the evaluations. 1986 data was used to evaluate Washington patronage projections because, after that year, the project went beyond the scope projected in the report Pickrell chose to criticize. But this meant that patronage levels were evaluated only a half year after operation at that scope of service. Similar criticism could be applied to the choice of 1987 data for Atlanta and 1988 data for Detroit.

What's wrong with choosing too early a year? The fundamental problem with choosing too early a comparison year is that it does not evaluate a mature rail system. Pickrell would be right to say most rail projections assume too instantaneous a response to incentives, but this is a criticism that can be directed at many economic models. These models are not cognizant of the barriers to change (which could variously be called habitual or cultural or social factors) that lead to delayed response to incentives and unanticipated spurts of change once the barriers are overcome.

Nevertheless, the models often prove correct in the long run, even though the lag time to maturity is miscalculated. BART, to take an extreme example, prior to the disappointing results from Miami, had been the whipping boy for rail critics. Yet it now is achieving the patronage originally predicted for it (a trend relatively unaffected by the spike of patronage resulting from last year's earthquake). BART's achievement is taking place over a decade after it was supposed to; even a few years ago patronage was still disappointing. Most significantly, BART is still experiencing an upward trend. For a variety of reasons BART could not be termed an unmitigated success, but it certainly has attracted the patronage that critics thought impossible.

One of the main reasons for the slower than anticipated growth in patronage is the cost of fuel in the 1980s. The documents used by Pickrell were written before the precipitous fall in the price of gasoline from March 1981 to January 1989 (according to Bureau of Labor Statistics data, this was a 50.3% decline controlling for inflation). Seven of them were written between 1977 and 1981, shortly before or after the second gas crisis and only a few years after the 1973 gas crisis. Prices were already above the rate of inflation at the beginning of that period and well above it at its end. The projections anticipated continued high gasoline prices for auto drivers. Most anticipated increasingly higher prices, not their precipitous fall. As will be shown, this slowed patronage growth but it did not stop it.

Adopting a Model to Explain the Forecasts' "Failure"

Pickrell's next step was to see why the estimates were so wrong. He assigned elasticities to various indicators used by the estimation models (headway, speed, fare, feeder bus headway, auto operating cost, parking cost) in order to see if these accounted for the error in prediction. He found that, outside of Buffalo and Portland, they only accounted for half the error.

Of course, the elasticities Pickrell assigned might be argued with, but to do so would turn attention away from the issue of inappropriate comparison (as stated before, there are significant problems with his choice of document, comparison year and project). Without focusing on them, let it at least be said that the elasticities assigned led to a very limited discussion of estimation error. Certain variables (because of the elasticities chosen) were found to be poor predictors. Inconvenient factors, such as the price of fuel, were dismissed; and some factors, such as the reduction of external costs and the influence of local zoning decisions, were ignored.

Appropriate Patronage Comparisons

Pickrell's charts are full of negative numbers. They show how much lower the actual patronage was than was projected. They tend to overshadow a stubborn fact. In most cases (especially if Miami's failure is left out of the picture) systemwide patronage was up. It was up during a decade of transit patronage decline in comparable bus-only cities.

Some examples of success. This can be illustrated by comparing the patronage figures of 3 non-rail investing cities which initially had bus systems similar to 3 of the 4 cities that invested in heavy-rail. (Again, Miami is left out. Pickrell's argument is that rail is generally a poor investment. Miami's failure leads to a much more useful set of questions: Why had Miami failed when others had succeeded? Under what circumstances will rail be more likely to succeed?[5])

Using Section 15 data, the pre/post-rail systemwide patronage for Washington, Atlanta and Baltimore was matched against the patronage for Minneapolis, Milwaukee, and St. Louis, the three largest transit systems in cities that have not opted for rail (matching on the basis of the "pre-rail" and "post-rail" years selected by Pickrell, with the most comparable systems in a given pre-rail year matched). Table 1 shows that total transit patronage increased in the rail start-up cities by 96% compared to a 8% decrease in the bus-only cities. It would be hard to convince a local transit system or city administrator that the rail capital investments (mostly funded by non-local sources) which doubled the size of the system, while non-rail investing operations were struggling (and usually failing) to stay even, are demonstrations of his bad judgement ten to fifteen years earlier.

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[5] It should be noted that some analysts believe that it may be premature to count Miami as a failure. While Miami's recent statistics are disappointing, Pickrell's choice of criterion year made them seem worse. In that year Miami bus fares went up 50%, resulting in a 15% decline in systemwide patronage. The inability of rail to increase overall patronage was decisively influenced by price. The increase in that year's rail patronage could also be said to be caused by the change in price structure, but this would not explain the rail patronage increases in the prior and subsequent years. If the rate of change in rail patronage in Miami persists then the picture currently painted would have to be reinterpreted. The system that has been built could not be duplicated at twice the cost today.

Reconfiguring Annual Systemwide Boardings into Weekday Linked Trips: Inflating "before" and discounting "after" estimates.

Table 1 also brings to light another problem with Pickrell's comparisons. His statistics tend to show a smaller growth in patronage than indicated by the raw Section 15 data (upon which they were ostensibly based). He converted the annual data to weekday equivalents, and further refined them into linked passenger trips. His reasons for doing so were not implausible, but the statistical operations themselves left room for manipulation. Instead of a 157% increase in patronage in D.C. Pickrell's refined data only show a 67.6% increase. Even more dramatically, instead of a 103% increase in patronage in Atlanta Pickrell's data show a mere 18% increase.

The reasons for the Pickrell's before/after data convergence are obscure. Some of convergence can be explained by his choosing different weekday equivalents to divide the annual before and after data. For example, he divided the 1975 D.C. data by 295 and the 1986 D.C. data by 310. This example is especially interesting: 1) The use of two different numbers is buried in separate sections of the appendix, where two different planning documents are cited as sources. 2) Instead of taking them at face value, Pickrell's analysis could have benefitted from an investigation of what such differences might mean. The later figure of 310 presumed that rail patronage would be more uniform by day of week, with more weekend, non-work travel. The overall amount of travel by transit would increase, a fact that would be masked by focusing on weekday trips.

A larger amount of the convergence is probably derived from the calculation for linked trips. Pickrell assumed that the number of multiple transit vehicle trips (i.e. the proportion of transit trips involving one or more transfers) would be larger in a rail/bus system than in an all bus system. This would allow him to divide the boardings by a higher number for the rail/bus system. He would be correct about the transfer rate to a marginal degree, but Pickrell's method probably resulted in wholesale discounting. While this is an empirical question, it would be up to him to defend the proposition that most of the rail-to-bus trips are something other than the functional equivalent of the previous express-to-local bus trips, occurring at largely the same rate. This would be especially difficult for him to do since he rejected some projections' claims that rail savings would result in increased bus feeder service. He claims that, if anything, rail start-ups result in decreased bus service in order to make up for rail's cost inefficiencies. How could one plausibly state that there was a gross increase in transfers to buses if the bus service was being made less available than before, not increased as anticipated?

We infer that Pickrell double discounted rail boardings by first discounting all boardings by the bus transfer rate and then further discounting rail boardings by a rail-to-bus rate. Regardless of method, the dramatic differences between the before/after raw data and his linked trip comparisons indicates that Pickrell has hypothesized extreme differences between rail/bus and all-bus systems.

Inflating Capital Costs

Pickrell developed his forecast versus actual cost comparisons for the ten rail projects in much the same way he developed his forecast versus actual patronage comparisons. Again, he sidestepped the issue that Federal funding decisions were based on the last of an increasingly realistic series of planning documents. He targeted the earlier, more optimistic documents. Not satisfied that these could, in their own right, be portrayed as inaccurate, he found ways to enhance the differences between forecasts and outcomes. Finally, he tried to discover why the projections were so wrong, dismissing such conventional explanations as inflation, delays and construction changes as failing to explain very much.

Pickrell found that, in constant dollars, actual costs ranged from 11% below to 106% above the forecasted capital costs. The more expensive heavy rail projects, in particular, ranged from 33% to 83% above estimated capital costs.

Although he had construction cost inflation indices to work from (he used them in subsequent analyses) Pickrell chose to use economy-wide indices to construct forecast/actual constant dollar comparisons. This choice resulted in an exaggeration of the differences between forecast and actual costs for the heavy rail projects started in the 1970s. It would be hard to allocate how much of the difference is exaggerated because the construction cost inflation interacted with the inflation due to delays in start-up (an average of 1.3 years) and building delays (construction took an average of 5 years longer than anticipated for the heavy rail projects and 2.2 years for the others).

One reason that the delays, changes in project scope, and construction costs account for so little of the difference between forecast and actual costs is because Pickrell inflated the difference. He added estimates of non-cash expenditures to the recorded expenditures. Pickrell added such things as rights-of-way donated to the project and staff assistance in project management provided by local government agencies. In a different kind of exercise this might be appropriate -- a theoretically complete cost accounting that would include all the costs and savings of railway projects. In that kind of exercise the author would have to carefully delineate the costs and savings, since the conclusion would be based on what is included. Pickrell's study has no such detail. The additional costs and their magnitude are not listed. All that is known is that Pickrell was interested in including additional non-cash costs but excluded such non-cash savings as increased passenger comfort and reduced travel time because they are too difficult to measure. The idea that certain ignored costs and savings should be part of an accounting has merit, but it is a matter of controversy worthy of extensive treatment.

Why "Which Projection" is Important: The Salience of Capital Costs to Different Investors

Pickrell also exaggerated the forecast/actual divergence by choosing projections that preceded the final Federal funding requests. He defended this choice by saying that the early projections were important to local decision makers; they determined which project would eventually become the "locally preferred alternative". The question becomes, how important was the capital cost component to these local leaders?

It certainly was important to the Federal Government, which paid 50% to 80% of the capital costs; but the Federal investment decisions were based on the later, more conservative, documents.

Pickrell, himself, noted that the maximum amount of local contributions to 5 of the 10 projects was $18 million, 5% or less of the total. As he put it, it was "a surprisingly modest level of local government support considering the highly localized nature of benefits from transit investments". The "highly localized" assertion was a gratuitous salvo because rail investments can have significant regional impacts. Nevertheless, Pickrell was right to indicate that these 5 localities (and the others to a lesser extent) had less of a vested interest in capital costs than in patronage and operating costs.

What the Local Leaders Wanted

It is apparent that Pickrell did not really choose the early documents because they were important to local decision makers: he never really paid attention to what they wanted.

Pickrell was concerned that busway options, even where one was estimated to be cheaper than the chosen option, were not picked as the locally preferred alternative. But consider the local decision makers' rationale. Portland leaders rejected a busway alternative when it was found that it would generate over 500 buses an hour in a Downtown transit mall that had a capacity of 260 buses. They were also disturbed about the potential noise and exhaust impacts of the diesel buses. Sacramento leaders felt that UMTA's technical evaluation process was biased against rail because it did not give adequate consideration to less quantifiable positive effects, such as environmental quality (e.g. the aforementioned diesel exhaust and noise) and rail's superior ability to guide growth. Pickrell's own criteria, his heaping of additional costs onto recorded capital costs, miss these points; if he was sensitive to local decision making he would also have included what were considered important savings to local leaders.

The local leadership played by Federal rules in undertaking alternatives analyses. The Draft and Final Environmental Impact Statements were the result. Generally speaking, several rail and one or two non-rail alternatives were considered. The documents served the localities in two ways. First, they demonstrated to local leaders, as well as to Federal authorities, that non-rail options were worse, or at least not significantly better, than the rail options. Second, they allowed the localities to project the capital costs, operating costs and patronage for each rail alternative. In these early documents absolute accuracy was not imperative, since each estimate for the rail options was likely to contain the same degree of error.

Pickrell rejected this argument. He stated that the forecast/actual patronage and capital cost discrepancies were so much greater than the estimated differences between rail and non-rail options that non-rail options were shortchanged. Pickrell felt that non-rail options were less likely to actually attain the inflated cost levels as the capital intensive rail options.

Pickrell has not proven his point. Only by deeply discounting patronage and inflating capital costs has he been able assert that the estimates were so grossly in error. Patronage has not reached mature levels, and the projects took longer to build, costing more in the process. But busways and other options are subject to the same problems. Furthermore, busways and other options do not provide the amenities, land use benefits and environmental savings left out of Pickrell's calculations.

The rail options also provide more patronage growth and energy savings capacity than the other options. Pickrell admitted that at full capacity rail outperforms other options in terms of unit cost. Local leaders were not remiss in anticipating gasoline shortages in their future; according to oil industry projections their expectations will be met in the next decade.[6] In retrospect, this, in combination with proposed urban restrictions on auto usage to control congestion and pollution, makes their decisions seem quite responsible.

A key failing of Pickrell's analysis is its short-term orientation. Pickrell's analysis is not set up to deal with the long-term implications of patronage and energy saving capacity. As long-term investments, it is most economical to build rail systems large enough to accommodate potential growth over many years. If ridership is near full capacity in the early years of operation then there is little room for growth.

Considering that the rail options performed reasonably well according to contemporary Federal criteria, that local leaders saw additional benefits to rail, that rail has a greater potential capacity than other options, and that local leaders were not the major absorbers of capital costs and capital cost overruns, it is very hard to second-guess the reasonableness of local decisions for a particular rail option.

The documents that Pickrell targeted served an entirely different local purpose than he posited. They

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[6] Recent events in the Middle East may shorten the decade "leeway" anticipated in the projections.

performed reasonably well in determining which rail option was best, after they determined that non-rail options, according to external criteria, did not perform any better. As one local official (from a city not chosen by Pickrell for review) put it, the rail option had a higher capital cost than a busway, and its operational savings did not promise an immediate payback. The rail option prevailed because "there was a realization that we're probably building this system for our children and grandchildren. ... future generations would look back and thank us for the foresight and vision we had." [7]

Operating Costs

By all conventional accounts operating efficiency is the key to rail's success or failure. It is generally assumed that rail's high capital costs must be offset by operating efficiency or else the decision to build rail is unwise.

Pickrell painted a dismal picture for operating costs. His figures indicate that rail operating expenditures ranged from 10% lower to 205% higher than projected for eight systems, and that operating expenses per rail vehicle hour ran 14% to 356% higher (all of his statistics were in constant dollars).

Almost as dismal were his figures for total transit system operating expenses. These ranged from 52% lower to 117% higher than predicted for the 6 systems for which predictions had been made. He suggested that in cities where the systemwide operating expenses were lower to slightly higher (4 of the 6) the results might be masking real cuts in bus service levels rather than savings resulting from replacing bus service with rail service. He supported this argument by subtracting how much rail service costs exceeded their estimates from how much alternative bus service was projected to cost over the projected costs of the chosen rail option. (Pickrell put these hypothetical figures in a column labeled "actual".) He found that, depending on the transit property, rail increased operating costs from $1.4 million to $228.5 million.

Pragmatic Considerations About Relative Efficiency: Why Transit System Operators See Things Differently

Pickrell's statistics are the outcomes of many data manipulations, most of which are obscure. As argued before, however plausible his decisions seem individually, they consistently reflect an anti-rail bias. For example, Pickrell decided to include bus feeder costs in the operating cost of his two People Mover systems. A plausible move, but one that is not usually taken. The proof is in his results. They do not reflect the obvious operating efficiencies shown by the systems that opted for rail in comparison to those systems which did not.

This can be shown in several ways. Pickrell noted that it is a significant finding that the systemwide operating expenses for Washington, Atlanta and Miami represent a substantial increase over pre-rail levels. Looking at the system with the largest increase, Washington, it becomes apparent that its increase is due to service expansion. The system carries more passengers for more miles. Since service expansion is a goal, the question becomes did it expand efficiently? An excellent measure of service efficiency, one that sidesteps controversial methods of converting boardings to linked-trips, is cost per passenger mile. Table 2 compares Washington's operating cost per passenger mile to those of bus operations with 500 or more in-service vehicles.

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7 Cited in: M. Euritt, M. Hoffman, and C. Walton, "A Conceptual Model of the Fixed-Guideway Decision Process", paper presented to 69th annual meeting of the Transportation Research Board, 1990.

Table 2 shows that, from 1984 to 1987, D.C.'s operating cost per passenger mile went down as patronage moved to rail, not only in terms of inflation (from 36 cents to 33 cents) but nominally as well (32 cents to 31 cents). (The increase to 34 cents in 1988 was entirely due to increases in bus operations costs, the nominal rail cost remained the same as the previous year's: 25 cents per passenger mile.) At the same time, the cost of large scale bus operations went up faster than inflation (from 32 cents to 41 cents). The table indicates that timing is important in showing success or failure. In 1984 D.C.'s bus/rail system could be said to be less successful than large scale bus operations in general. In 1985 it was performing at an equal level. In 1986 it finally achieved the level of patronage that allowed it to be more efficient. The secular trend is especially encouraging. Criticism of rail/bus systems at *this* point in time may well be a last stand: bus/rail operating savings may prove to become more strongly apparent over time in comparison to bus operation costs, especially as the bus/rail system patronage grows to maturity.

In addition to year-to-year comparisons, contemporaneous comparisons show that bus/rail systems are doing better than bus-only systems. Table 3 compares Atlanta's and Baltimore's systemwide costs to those of the four comparably sized systems that did not opt for rail. The table shows that even Houston, under the brilliant leadership of Alan Kiepper (who used extensive private contracting and gainsharing incentives), did not do as well as the rail/bus cities. Table 3 shows that Baltimore's cost per passenger mile was 12% to 45% lower than the bus-only cities', and Atlanta's cost per passenger mile was 42% to 85% lower. Analogous figures for cost per trip are even more consistent. Baltimore's cost per boarding was 24% to 76% lower and Atlanta's was 39% to 97% lower.

Table 3 also includes aggregate data from transit systems in the 29 largest cities of the United States. At 36.5¢ per passenger mile bus operation costs were 35% higher than rail operation costs of 27.0¢ a mile.

In spite of Pickrell's attempt to say the opposite, the difference between Pickrell's dismal picture and the one painted above is the difference between a theoretical model and transit reality. Pickrell's conclusion that rail/bus systems have higher operating costs than bus-only systems is based on the premise that somehow the bus alternatives would be more able than the rail alternatives to deliver what they promised. The reality has been that transit has just survived an unexpectedly rough decade; a decade in which transit costs have outpaced inflation, while patronage was lost to auto competition. Table 3 shows that bus-only cities usually did not perform as well as the cities with a rail component: a reality that speaks louder than any theoretical construct.

Cost Effectiveness in Terms of a Stacked Deck

Adding annualized capital costs to operating costs and dividing by annual passenger trips obtains a total cost per passenger trip. Pickrell found that the forecasts averaged $2.35 per passenger trip while the actual costs were from $5.19 to $16.77. The bias involved in these figures have already been documented: Pickrell was selective in his choice of forecast; and his "actual" figures overestimated capital and operating costs while grossly underestimating current and future passenger levels.

Exaggerating rail inefficiency in this manner did not suffice for Pickrell. He further stacked the deck by presenting a cost per *new* passenger trip (i.e. the capital and operating costs of the transit facility added to the original system, divided by the increase in riders on the entire system). He found that these costs ranged from $9.49 to $34.64 per new trip. Assuming all else remains constant, this is the marginal productivity of the investment, a figure of great interest to economists. Unfortunately, nothing else actually remains constant, and the calculation which assumed constancy is thereby rendered almost meaningless. Suppose, for instance, that the rail project gets built and is used at the expected rate, but bus ridership declines more than the ridership increases on the new rail project. (Considering the decrease in bus ridership during the 1980s in many cities that did not invest in rail, this example is plausible). This gives a negative marginal product. In two of his cases, Pickrell claims such a result, and acknowledges that they are meaningless by not giving a figure at all. So why, with all of the same unknown external factors at work in the other cases, are the results meaningful merely because the numbers are positive? They *aren't* meaningful of course. Pickrell understood the severe limitations of the new trips statistic but by not carefully pointing them out, anyone with an inclination to exaggerate the cost of rail can cite his report to claim that rail costs $34.64 per trip.

This fundamental problem in the calculation of marginal products is intensified by the use of figures which grossly underestimate the number of new passenger trips, as detailed above.

Who Benefits from Rail Investment?

Calculating the average cost per rider, or per new rider, is further complicated by basic questions about beneficiaries of transportation improvements. It has already been shown that the question of who benefits is obscured in Pickrell's analysis. He stated that his choice of early estimates was predicated on his concern about local decision making processes, yet from the start he emphasized the size of the Federal capital outlays. As already indicated, Federal and local concerns are not necessarily the same when one entity is the major provider of capital while the other is more involved with operating subsidies. Funding decisions for alternative proposals were determined at different times by the different levels of government. The rationales reported by local entities seem quite logical, given both their concerns and the Federal alternatives analysis guidelines. The final funding rationale by the Federal Government was not really touched upon by Pickrell: suffice it to say that it was based upon successive administrations' adherence to both the idea of local self-determination and the principle of relative cost-effectiveness.

Focusing on cost per new transit trip also confuses the question of benefits, especially if it implies that the benefits of building a new rail system accrues to the new users only. The benefits may not only accrue to the new user but also to the existing transit user, the general transportation system user, the corridor in which the rail line lies, and the region. Parcelling out the degree of benefit to each constituency is controversial but it cannot be summarily ignored. New users save money that might otherwise be spent on an additional automobile for commuting. Existing transit users benefit from faster point to point travel time, better on-time performance, and a higher frequency of service. Other transportation system users benefit from lessened congestion and alternative means of travel during personal or general emergencies. The corridor benefits from increased retail sales and focused property development. The region benefits from lessened pollution. (To be fair, Pickrell's analysis does not necessarily imply that the benefits only go to new transit users. One could even say that his analysis at least implicitly deals with the benefits going to new and existing users. Nevertheless, it does not adequately consider the other beneficiaries and no attempt is made to quantify their benefits.)

Calculating the average cost per rider, or per new rider, is further complicated by basic questions about beneficiaries of transportation improvements.

The aforementioned benefits (as well as others) may also be viewed as the opportunity costs of other options. Here, the question of cost to whom becomes very important. Pickrell would limit his analysis to direct transit expenditures, but there are also indirect costs and savings to both government and private sectors. Saying that the governmental cost per new transit trip is very high ignores these indirect savings. For example, the auto dependent transportation system of Los Angeles costs a family in that area 20.7% of its weekly expenditures: the less auto dependent transportation system of San Francisco only costs its families 18.3%. The per capita governmental expenditure and the weekly family expenditure for transit are much higher in San Francisco but these are more than compensated for by total travel savings.

A cost analysis restricted to governmental transit expenditures would not do justice to the overall picture. If cost cutting for the sake of cost cutting is the goal then this would be appropriate: but the Federal Department of Transportation states that its mandate is to fulfil its constitutional responsibility of providing for the general welfare. Under that mandate it continues to be reasonable to consider capital investments that allow local authorities to provide efficient transportation systems.

A real problem with the cost per new transit trip as a statistic is that it exists in isolation from other modal costs. If compared to the full costs of auto dependence, rail is competitive. To presume otherwise would defend the proposition that it is cheaper to move millions of vehicles, along highways wide enough to accommodate them, to and from areas large enough to store them. The vehicular capital and operating costs, the real estate costs, and the highway and parking operating and capital costs would have to be less than the costs of providing, moving and storing many times fewer mass transit vehicles.

Pickrell's Conclusions and Suggestions: A Program That Would Preclude Further Rail Investment

According to Pickrell the evidence is clear: the Federal investment in rail was unwise and the fault, in part, lies in how forecasts have been evaluated.

Several of his suggested improvements to forecasting are not controversial in themselves but may prove to be so in their implementation. These include required reference to empirical outcomes of similar projects, systematic variation of inputs to isolate impacts, and review by experts. Choice of comparable project, interpretation of data, and even choice of expert is likely to affect the evaluation of the forecast. For example, follow-up studies of 1987 data were cited by Pushkarev as proving the soundness of Zupan and Pushkarev's original findings. One can safely assume that Pickrell would disagree.

Two other of Pickrell's suggestions would preclude investment in rail. The first is to require that models assume current demographic and auto travel conditions (i.e. today's transportation environment). He said that forecasted levels of auto expense and travel speed often fail to materialize. The second is related: bring the forecast horizon closer to the present.

In today's environment, with fuel industry forecasts of fuel shortages in the late 1990s, with population and vehicle miles of travel growing, with increased congestion, and with increased government discouragement (and possibly restriction) of auto travel in specified urban areas, it would be difficult to justify models that assume the status quo. It would be tantamount to denying that transit demand is the result of a multitude of forces that can be expected to change over a number of years.

The one thing short term modeling is guaranteed to do is to preclude rail investment. If there is general agreement on the weakness of the earlier forecasts it is that the models presumed faster reaction to input forces. Patronage growth has taken place at a slower pace than projected.

To some degree non-rail transit options, such as busways, are subject to the same forces mentioned above. But an integrated bus/rail system solves some incipient transportation problems better than the other, more limited, options. Rail is less polluting, more fuel efficient, than other options -- it is an electric mode of travel. It is less congesting -- it uses fewer vehicles and it allows for travel outside of the general stream of vehicles. It is associated with longer walking distances at trip-ends. And it promotes denser, more economic development at portals, which, in turn, promotes less polluting forms of travel, such as walking.[8]

Generally speaking, Pickrell's restrictive view of costs and his concern with short-term horizons do not allow for a big picture, long-range view. His approach would lead to lower Federal expenditures, but at the expense of our future.

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8 The association of dense development and rail is not inevitable. We suspect that wherever rail has failed it was undermined by lack of local regulatory support concerning land use in rail corridors, especially near rail portals. In his explanation of lower than expected rail patronage Pickrell should have also looked at the Federal government's failure to follow up on its own requirement that funded localities have in place such things as "Zoning policies and development incentives to stimulate high density private real estate development around selected transit stations; Land use plans that support or reinforce the developmental impact and shaping influence of the rail transit system; Station area improvements...,...Pricing, regulatory or traffic control measures aimed at managing the peak period use of automobiles with[in] rail corridors (e.g. traffic metering, tolls, higher parking fees, elimination of employer-subsidized parking)." DOT, "Policy Toward Rail Transit", Federal Register, March 7, 1978.

Table 1: Systemwide Boardings

Year	Rail/Bus City	Boardings	% diff	Bus-Only City	Boardings	% diff
1975	Washington	122,841,700		Minneapolis	77,291,600	
1986		315,906,400	157.2%		74,455,100	-3.7%
1979	Atlanta	73,708,200		Milwaukee	79,062,000	
1987		149,903,000	103.2%		73,346,100	-7.2%
1983	Baltimore	98,654,500		St. Louis	56,544,100	
1987		111,739,900	13.3%		47,751,700	-15.5%
Bef.	Sample Total	295,184,400		Sample Total	212,897,700	
Aft.		577,549,300	95.7%		195,552,900	-8.1%

Table 2: Operating Cost per Passenger Mile

	1984	1985	1986	1987	1988
Washington	36¢ *(32¢)*	35¢ *(32¢)*	34¢ *(32¢)*	33¢ *(31¢)*	34¢ *(34¢)*
Bus Operators (≥ 500 vehicles)	32¢ *(29¢)*	35¢ *(32¢)*	39¢ *(37¢)*	39¢ *(38¢)*	41¢ *(41¢)*

(Figures in regular type are adjusted for inflation: unadjusted figures are in *italics*)

Table 3: Operating Costs for Comparable City Transit Systems (500-999 Vehicles)

City	System Type	Cost/Psgr. Mile	Cost/Boarding
From 1988 Section 15 Data:			
Atlanta	Bus & Rail	$0.26	$0.99
Baltimore	Bus & Rail	$0.33	$1.11
Denver	Bus Only	$0.46	$1.92
Houston	Bus Only	$0.37	$1.85
Minneapolis	Bus Only	$0.40	$1.38
St. Louis	Bus Only	$0.48	$1.95
From 1987 Regional Plan Association Data:			**(29 Largest Cities)**
	Rail	$0.27	
	Bus	$0.36	