Predicting the Conditional Viability of Build-Operate-Transfer Contracts for Transportation Facilities without Forecasting Revenues

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I. Introduction

The growing cost of roadway construction and right-of-way acquisition, coupled with the political impracticalities of raising gasoline taxes, have inspired public agencies to implement nontraditional methods of financing transportation infrastructure.[1] At both the state and national level, public agencies are coming to accept public-private partnerships as a remedy to shortfalls in public funding for new projects.[2] However, establishing an equitable alliance between the public and private sectors for the delivery of infrastructure can be quite a challenge, and history suggests that the identification of truly viable public-private projects remains illusive.[3] Perhaps of greater concern than the issue of an equitable partnership are the assumptions under which a privately-led transportation project has been validated, the transparency of the validation process

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1. *See generally*, Fed. Highway Admin., Dep't of Transp., Report to Congress on Public-Private Partnerships, Ch. II.B. (Dec. 2004).

2. *Id.*

3. B. Flyvbjerg, N. Bruzelius, & W. Rothengatter, Megaprojects and Risk: An Anatomy of Ambition 142 (Cambridge University Press 2003).

when relying on proprietary forecasting models, and the ethical and legal ramifications of contractual conditions required for project viability (e.g., eminent domain for private gain, subjecting the public to non-compete clauses, etc.).

Differences in public and private motives create significant obstacles to the efficient use of partnerships between these sectors, particularly with regard to the construction of large transportation facilities. The rational expectation for each sector to manage its own risk can in fact lead to actions that are adversarial to a successful partnership. For example, transportation agencies may solicit proposals for privately-led infrastructure projects intending to avoid the expenditure of public funds, a process that inadvertently encourages private firms to: a) minimize costs prior to the award of a contract, and b) maximize the chance of recovering these costs by submitting attractive proposals. Unfortunately for most stakeholders, these firms incur most of their risk through the cost of preparing proposals that might not be selected, so it is not uncommon for concessions to be awarded to construct and operate a transportation facility that never meets expectations.[4] In the event that a private transportation project is unsuccessful and faces foreclosure, the sponsoring agency may either purchase the facility outright or broker its sale in order to preserve the operating functions of the system. Though assets such as track and right-of-way might be easily reclaimed from a failed rail project, roadways (toll roads) are less likely to be abandoned and will inevitably be sold at a significant loss to the original investors.

The potential for the developer – often a group of construction and financial companies – to be the only winner in a failed transportation venture presents a significant weakness to public-private partnerships. After all, these projects may largely be financed with debt instruments such as toll revenue bonds,[5] whereby real project risks are passed along to investors unable to profit from construction of the facility. The sale of these bonds is frequently promoted based on revenue projections prepared with proprietary forecasting models by subcontractors to or members of the development team.[6] Therefore, stakeholders whose primary interest is in the successful operation of a transportation facility (i.e., transportation agencies, bondholders, financial lending institutions, etc.) must often rely on feasibility studies prepared by companies that may benefit more from project implementation than from facility operations.

4. Shih-Ping Ho, Real Options and Game Theoretic Valuation, Financing and Tendering for Investments on Build-Operate-Transfer Projects, pages 4-5 (Dec. 2000) (unpublished Doctor of Philosophy dissertation, University of Illinois at Urbana-Champaign Graduate College) (on file with ProQuest Information and Learning, Ann Arbor, Michigan).

5. Fed. Highway Admin., Dep't of Transp., *supra* note 1, at Ch. III. B. i.

6. FLYVBJERG, BRUZELIUS, & ROTHENGATTER, *supra* note 3, at 45.

This paper has been prepared to highlight considerations for the implementation of privately financed transportation projects, and to provide stakeholders in these projects with the ability to assess the long-term viability of facility operations without needing access to proprietary forecasting models. The following sections establish the need for a simple, upfront method of assessing project viability, then develop this method using basic engineering economics concepts, and then demonstrate its application to some relevant projects in Texas.

II. Project Participants versus the Project

Public agencies have become encouraged by the prospect of concession financing, whereby a private partner is awarded a franchise for transportation infrastructure under a Build-Operate-Transfer (BOT) agreement.[7] The award of a BOT contract usually requires competing consortiums – development teams comprised of construction/financial firms for example – to demonstrate the viability of their respective proposals through, among other things, the submission of cost estimates and revenue forecasts within a voluminous franchise application.[8] The sponsoring public agency often prescribes particular conditions under which these proposals are to be assessed, such as project life, inflation rate, revenue growth rate, or even vehicle operating speeds.[9] In effect, project viability is demonstrated to the agency by outlining an acceptable rate of return based on annual cost and revenue cash flows over the project's life.[10]

A. Differentiating between the Developer and the Project

Consortiums are usually assembled to pursue the award of a specific franchise, with the project development team comprised of construction/financial firms as founding stockholders.[11] As a component of BOT franchise applications, the developer has usually created a new company to finance, build, and operate the project, with initial capitalization represented as founding shares owned by the developer in exchange for project development services such as producing cost estimates, travel forecasts, preliminary geometric designs, environmental studies, etc.[12] In fact, de-

7. *See, e.g.*, U.S. Gen. Accounting Office, Highways and Transit: Private Sector Sponsorship of and Investment in Major Projects Has Been Limited 10 (Mar. 2004).

8. *See* Fed. Highway Admin., Dep't of Transp., Manual for Using Public-Private Partnerships on Highway Projects 35 (2006).

9. *Id.* at 36.

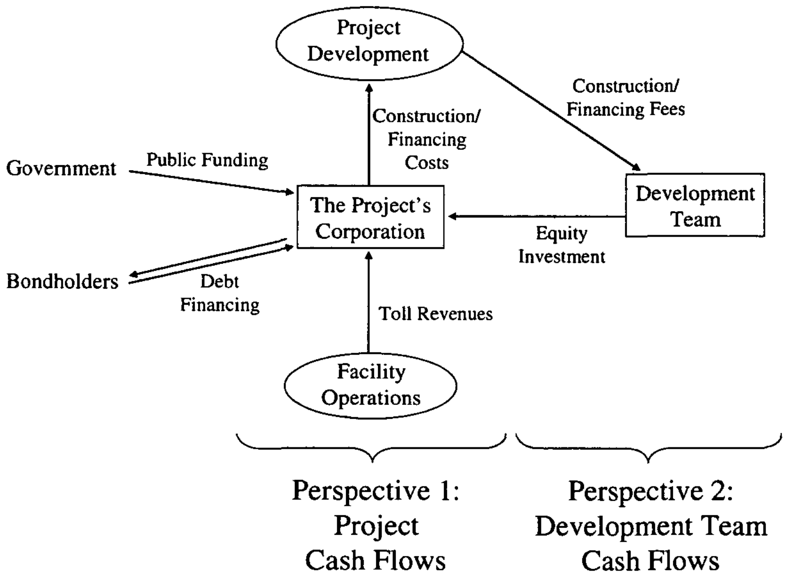
10. Ho, *supra* note 4, at 85.

11. Flyvbjerg, Bruzelius, & Rothengatter, *supra* note 3, at 93.

12. Maury Klein, Union Pacific: Birth of a Railroad 1862-1893 34-36 (Doubleday & Co. 1987).

velopers of risky transportation projects have historically used ownership of the construction firms which serve as prime contractors to these projects as a means of insuring the profitability of these ventures[13] – a perfectly legitimate arrangement. However, when reviewing proposals, the public sponsor tends to overlook the development team's vested interest in the award of a franchise to their consortium. In particular, the sponsor often fails to consider that the financial risk of the development team in a BOT contract is limited to their equity investment (founding shares), which coincidently happens to insulate them from most risks associated with cost overruns or revenue shortfalls of the project.[14] To illustrate, Figure 1 contrasts the cash inflows and cash outflows of the project to those of the developer.

FIGURE 1. A PERSPECTIVE ON PROJECT CASH FLOWS IN BOT PROJECTS.



BOT franchise applications report project viability as a rate of return based on a multi-year forecast of cash inflows and cash outflows (Perspective 1 in Figure 1), which in large part consist of construction costs paid and toll revenues earned by the project.[15] What is not reported, however, is the rate of return development team members receive based on their own equity investment and earnings from construction and fi-

13. *Id.*

14. *See infra* Part IV.

15. Klein, *supra* note 12.

nancing fees (Perspective 2 in Figure 1).[16] The developer can begin earning fees in Perspective 2 early into the implementation phase and with reasonable certainty once the BOT contract is awarded and financing is arranged by the project's corporation. On the other hand, investors in the project's corporation in Perspective 1 are faced with large up-front expenses and uncertain toll revenues in later years, with the hope that their return on investment will sufficiently reflect the risk of this predicament. Public-private partnerships in large transportation projects are somewhat unique because the magnitude of fees earned by the development team are quite large relative to the team's equity investment in the project, and thereby minimize the significance of devaluations in their founding shares in the event that cost estimates and revenue forecasts for the project were wrong.

Advantages of a BOT Contract

To understand the relevance of cash flows to the developer during the implementation of a transportation project, consider a hypothetical transportation project that costs $6.0 billion to build and five years to complete, and earns the development team net profits equal to five percent of project costs.

FIGURE 2. RATE OF RETURN TO THE DEVELOPMENT TEAM AS A FUNCTION OF EQUITY INVESTMENT IN A HYPOTHETICAL PROJECT.

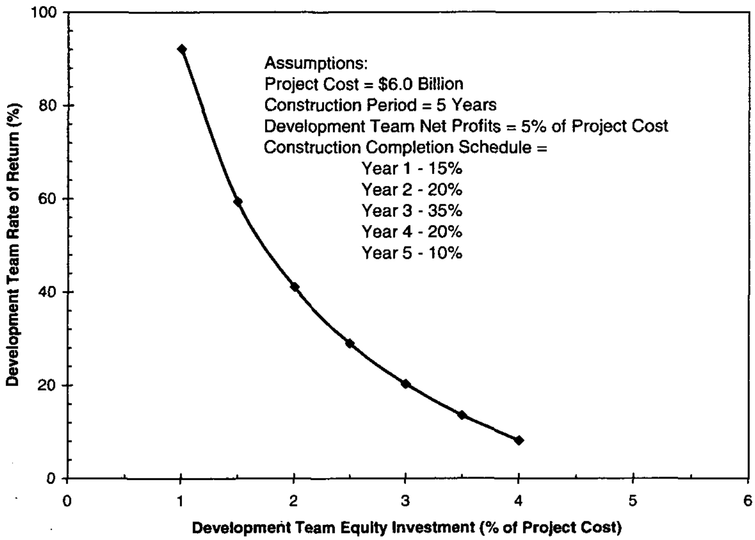


Figure 2 plots the development team's rate of return as a function of their equity investment (founding shares) in the project's corporation. As

16. *See infra* Part IV.

Figure 2 shows, the developers of this hypothetical BOT project can earn high rates of return from fees by minimizing their own equity investment in the project, regardless of the financial performance of the transportation facility throughout its operating life. In other words, developers can earn attractive rates of return even if their founding shares in the project become worthless, though the size of this investment, as examples will show, often represents less than one percent of the total project cost. Thus, developers primarily expose themselves to risk by incurring the up-front expense of preparing franchise applications under the possibility of not being awarded the BOT contract, which may explain why the proposals are often based on unreliable information and overly optimistic financial projections.

B. Investment Performance of the Channel Tunnel

The Federal Highway Administration (FHWA) recently pointed to the Channel Tunnel project between London and Paris as a project that exemplifies the emerging trend in public-private partnerships for transportation facilities in the U.S., and compared the project to plans in Texas for the privately-funded Trans Texas Corridor system.[17] Unfortunately, while the Channel Tunnel is indeed a high profile example of financing large transportation facilities with private investment, the FHWA failed to note how those investments have performed over the life of the project.[18] Figure 3 contrasts the original stock price of Eurotunnel – that is, the Channel Tunnel project's corporation – to the price of shares from January 1998 to December 2005.[19] The recent price of £0.18 per share is merely five percent of the original offer price of £3.50 per share, indicating that Eurotunnel has been a financial failure despite the project's status as an engineering marvel.

Financing Eurotunnel

The winning Channel Tunnel proposal (Eurotunnel) was prepared by a team of English and French developers, consisting of ten large construction companies and five banks, for the construction and operation of a 50-kilometer rail tunnel under the English Channel.[20] British Prime Minis-

17. J. Richard Capka, *Financing Megaprojects*, Public Roads, Jan./Feb. 2006, Vol. 69, No. 4.

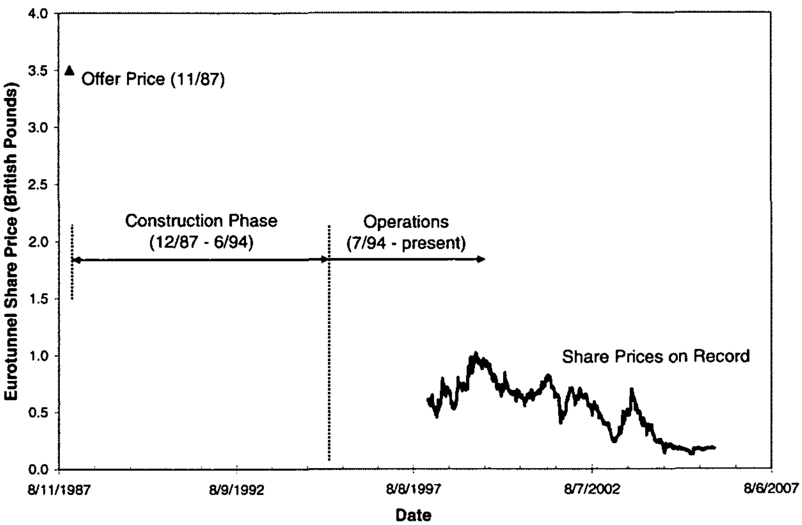
18. *See id.*

19. Carmen Li & Bob Wearing, The Financing and Financial Results of Eurotunnel: Retrospect and Prospect 16-17 (Dep't of Accounting, Fin. and Mgmt, University of Essex, Working Paper No. 00/13, 2000) available at http://www.essex.ac.uk/AFM/Research/working_papers/WP00-13.pdf.

20. Michael Grant, *Financing Eurotunnel*, Japan Railway & Transport Review, Apr. 1997, at 46, 46-48.

ter Margaret Thatcher would only approve of the project under the stipulation that financing would involve no government funds or government guarantees, making this project the largest privately financed transportation project in history.[21] Following award of the concession in 1986, the development team established Eurotunnel as the corporation to operate as concessionaire, staffed with personnel coming from this same team.[22] The consortium of ten construction companies then formed TransManche Link (TML) to serve as the design-build contractor to Eurotunnel.[23]

FIGURE 3. SHARE PRICE HISTORY OF THE EUROTUNNEL CORPORATION.



TML and the team of five banks contributed £47 million to the project in September 1986 as the founding shareholder equity in Eurotunnel.[24] However, this £47 million represented only 0.96 percent of the original £4.8 billion project cost (construction, financing, and other indirect costs) and, with a private placement of £206 million in October 1986 followed by subsequent public equity placements, the development team was quickly reduced minority shareholders.[25] For such a large, privately financed project, it seems reasonable that sufficient detail would have been given to the construction cost estimate, yet the estimate stated in Eurotunnel's 1987 prospectus was based largely on conceptual designs

21. *Id.* at 46-47.
22. *Id.* at 48.
23. *Id.* at 47.
24. *Id.*
25. *Id.* at 48; Ho, *supra* note 4, at 137-38.

prepared by the English and French governments in the early 1970s.[26] Eurotunnel's co-chairman admitted after financing had been sold that no one had any idea in 1986-1987 what the project would cost, which apparently was true considering that the final project cost was roughly twice the cost presented in the prospectus.[27] As operations began, investors who were confronted with the huge cost overrun then found that the revenue forecasts similarly lacked any accuracy, as the predicted first year revenue exceeded actual revenue by 151 percent.[28]

C. Considerations for Stakeholder Risk Mitigation

Concessions for privately-led transportation facilities, such as the Channel Tunnel project, are often vastly underperforming investments. Flyvberg et al. note that some BOT contracts now require approval from the public partner before developers can sell their equity investment in a concession as a means of protecting the long-term operating interests of the project.[29] However, the rates of return shown in Figure 2 were calculated by treating the developers' equity investment as a sunk cost, or lost investment, indicating that constraints placed on the sale of equity may be immaterial when a development team earns high rates of return from construction and financial services. And while construction fees may buffer developers against risk, other stakeholders need a simple risk mitigation measure – particularly with regard to overly optimistic cost and revenue estimates.

Rationalization of a Simple Assessment Method

Flyvbjerg et al. report that, rather than cost estimates improving over time as a result of experience, underestimation in transportation projects today occurs as regularly and at the same order of magnitude as they have over the last seventy years.[30] This and other findings led the authors to conclude that cost estimates used for decision making in transportation infrastructure development are systematically deceptive.[31] With regard to revenue forecasting, Muller found the consistent and substantial overestimation of toll road revenues troubling and, similar to Flyvbjerg's work, noted that there has been little improvement in the accuracy of

26. *Under Water, Over Budget*, Economist (U.K. Edition), Oct. 7, 1989, at 73.

27. *Id.*; Ho, *supra* note 4, at 137.

28. Li & Wearing, *supra* note 19, at 10.

29. Flyvbjerg, Bruzelius, & Rothengatter, *supra* note 3, at 97.

30. Bent Flyvbjerg, Mette Skamris & Soren Buhl, *Underestimating Costs in Public Works Projects*, 68 J. Am. Planning Ass'n 279, 286-90 (Summer 2002).

31. *Id.* at 290.

traffic and revenue studies over time.[32] Whether by a lack of diligence or through deception, evidence suggests that these errors will continue to prevail in BOT contracts.

Franchise applications for multi-billion dollar BOT projects usually require millions of dollars in up-front costs, which most stakeholders or potential investors cannot afford. Consequently, stakeholders usually base the investment potential of transportation facilities from cost and revenue estimates produced by the development team or their subcontractors, illustrated in Figure 4a. However, an alternative process can be used that transforms the project's revenue cash flows from input parameters to a computed result. As Li and Wearing noted about the financial difficulties of Eurotunnel, the primary revenue uncertainties prior to the opening of a transportation facility consist of the initial traffic volume plus the traffic growth rates, whereas revenue uncertainty following the commencement of operations is essentially only a function of traffic growth rates.[33] Also, past research on toll road feasibility studies found that the most successful revenue forecasts relied on growth rates of less than five percent per annum and did not assume periodic toll increases over the project life.[34] In summary, these observations help define the most important parameters in revenue forecasts; namely, first year revenue is of prime importance, and revenue growth rates should be fairly constant and modest. Because first year revenue is the product of traffic volume and toll price, the first year traffic volume (or ridership) shown in Figure 4b can be expressed as first year revenue divided by a unit price (the toll price).

As an example, assume that a large capitalized corporation requires a rate of return of approximately fifteen percent, and that the historic cost of a project under consideration averages $12 million per mile. If the project length is thirty miles, then the fifteen percent return and the capital cost of $360 million can be used as illustrated in Figure 4b to assess project feasibility on the basis of the required first year traffic volume. This method eliminates the time and expense of preparing a ridership study and provides a quick measure of financial viability by comparing the required first year traffic volume to the traffic volume available for diversion to the new facility. Stakeholders may decide to pursue a transportation project further when the required first year traffic volume is no greater than some benchmark percentage of existing traffic – in the past, Bear, Stearns & Company has required that revenue projections for toll

32. Robert Muller & Kristin Buono, *Start-up Toll Roads: Separating Winners From Losers*, MUN. CREDIT MONITOR, May 10, 2002, at 12.

33. LI & WEARING, *supra* note 19, at 14.

34. Robert Muller, *Examining Tollroad Feasibility Studies*, MUN. MKT. MONITOR, March 22, 1996, at 2.

road projects be based on traffic volumes no greater than twenty-five percent of existing traffic.[35] The effect of cost overruns might be examined by adjusting the original cost upward; a cost overrun of fifty percent would essentially inflate the required first year ridership by fifty percent. Of course, this simplistic approach omits operating and maintenance and, therefore, presents an optimistic scenario.

FIGURE 4A. TYPICAL FEASIBILITY FEASIBILITY ANALYSIS METHOD.

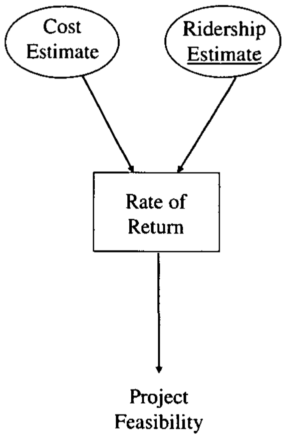
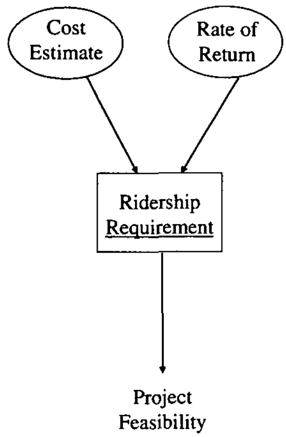


FIGURE 4B. ALTERNATIVE ANALYSIS METHOD.



III. AVOIDING REVENUE FORECASTS

The Internal Rate of Return (IRR) is a widely accepted means of measuring corporate-sector investments, and can be determined by solving for the interest rate at which the present worth of cash inflows equals the present worth of cash outflows.[36] This method of economic evaluation can be expressed as:

$$\sum_{k=0}^{N} R_k(P/F, i_{IRR}, k) = \sum_{k=0}^{N} E_k(P/F, i_{IRR}, k) \qquad (1)$$

Where R_k = net revenue in year k,
E_k = net expenditures in year k,
N = project life
k = year in which revenues and expenses are realized,
i_{IRR} = internal rate of return.

35. Thomas L. Glenn, *Procedures and Criteria Used to Evaluate the Financial Viability of Private Toll Road Projects by States and Private Entities Involved in the Approval, Financing and/ or Evaluation of Private Toll Road Projects*, TEX. TRANSP. INST., Apr. 1998, at 22.

36. WILLIAM G. SULLIVAN, ET AL., ENGINEERING ECONOMY 164 (12th ed., Prentice Hall 2003).

Each summation, or Net Present Value (NPV), of the cash flows in Equation 1 are determined by discounting revenues and expenditures to a beginning point in time (k = 0), or the "present." The special case of discounting by a rate equal to the IRR yields the condition in Equation 1, where the NPV of revenues ($NPV_{IRR(rev)}$) equals the NPV of expenditures ($NPV_{IRR(exp)}$). This relationship can be stated more succinctly as:

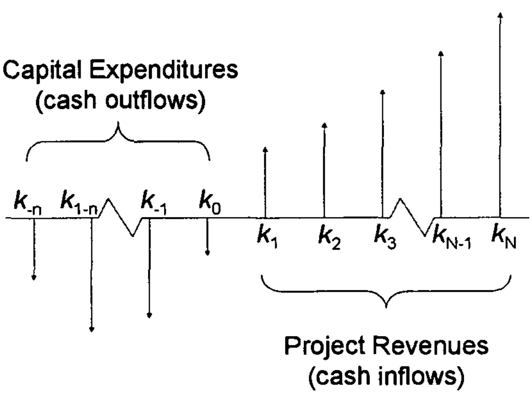
$$NPV_{IRR(rev)} = NPV_{IRR(exp)} \tag{2}$$

A. Incorporation of Engineering Economics

A preliminary and simple assessment of privately financed transportation projects can begin by assuming that the initial capital investment is the *only* project expense. In doing so, the viability of the project is assessed under the most optimistic of circumstances, and the need to define operating and maintenance costs can be postponed until a more detailed assessment is justified. For example, operating and maintenance costs of passenger rail service are a function of the numbers of cars per train and trains per day required to serve a customer base, which are not easily predicted, though there is no need to establish these costs if the project is found to be infeasible without including them.

The methodology presented herein also redefines the beginning point in time (the present) as the year that revenue service begins, so passenger rail or toll road operations begin at k = 0 in the subsequent time-value equations. Using this time convention, k is negative in years that capital expenditures occur prior to the start of operations, a near certainty, leading to the general cash flow schedule depicted in Figure 5.

Figure 5. Cash Flow Schedule with Time Beginning at Start of Operations.



For simplicity, Figure 5 represents a project scenario where all capital costs are incurred by the time operating revenues begin to accrue (i.e., at

k=0). However, the calculation of $NPV_{IRR(exp)}$ in Equation 3 accounts for capital expenditures in any time period ranging from $-n$ through N.

$$NPV_{IRR(exp)} = \sum_{k=-n}^{N} \frac{E_k(1+i_{\inf})^k}{(1+i_{IRR})^k} \qquad (3)$$

Where n = number of years over which capital expenses are incurred leading to start-up,
N = project operating life (beginning at $k = 0$),
E_k = net capital expenditures in year k,
i_{inf} = inflation rate (decimal),
i_{IRR} = interest rate equal to the IRR (decimal).

The need to calculate $NPV_{IRR(exp)}$ using Equation 3 is usually not necessary since project capital costs are commonly reported in some base year or as the overnight cost (i.e., what the project would cost if it could be built overnight). Therefore, if the capital cost of a project is stated in a base year equal to the year that the facility opens, then $NPV_{IRR(exp)}$ simply equals this stated cost.

In the case that Equation 3 is used, yearly expenditures are discounted for inflation so that market interest rates can be used to define a reasonable i_{IRR}. For example, investors expect risk-based assets to earn a return from three sources: compensation for the opportunity cost of not investing elsewhere, compensation for the lost purchasing power of dollars due to inflation, and compensation for the risk associated with the investment.[37] Since market interest rates on government bonds consist of a risk-free rate and an inflation premium, a reasonable return on risk-based assets can be determined by adding a risk premium to a bond rate of appropriate maturity. An investment's risk premium can be thought of simply as the difference between historic returns on common stock and government bonds (about 7.5 percent), times a risk factor (β) that adjusts this difference in historic returns for the specific risk condition.

Representing Multi-Year Revenues

Similar to capital expenditures, annual project revenues must also be discounted to the present to determine $NPV_{IRR(rev)}$, but with a unique time-value relationship that accounts for monetary growth over the operating life of the project. Engineering economics uses a geometric gradient series to relate the time value of cash flows that grow at a constant annual rate, which provides the necessary means of determining $NPV_{IRR(rev)}$ in the proposed methodology.[38] This annual growth in revenue

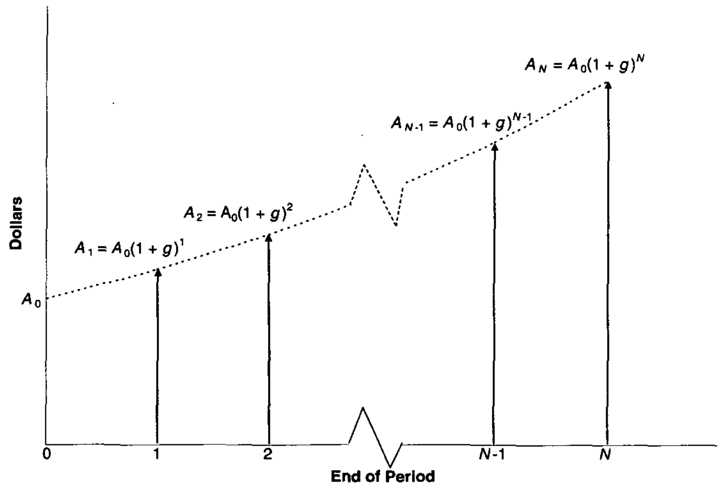
37. Robert C. Higgins, Analysis for Financial Management 234-35 (Irwin/McGraw-Hill 6th ed. 2001) (1984).
38. *See* Sullivan, et al., *supra* note 36, at 106-07.

(g) will be due to an increase in sales of a unit revenue volume (s) and the inflation of sales prices (i_{inf}). Figure 6 diagrams the sequence of cash flows in a geometric gradient series having the following parameters:

A_0 = cash flow at the *beginning* of period 1 (i.e., at $k = 0$),
g = annual growth rate of A_0, or $(1 + i_{inf})(1 + s) - 1$,
i_{inf} = inflation rate (decimal),
s = annual sales growth rate (decimal),
N = project operating life (beginning at $k = 0$).

Depending on the BOT contract, transfer of the facility to the public sector in year N may or may not include an exchange of cash. If this type of transaction will occur, a salvage value can be included in Equation 3 as a negative expense in year N. However, the identification of a reasonable salvage value might be quite difficult, and will diminish in significance to the analysis as the required interest rate and the project operating life becomes larger.

FIGURE 6. GRAPHIC FORM OF A GEOMETRIC GRADIENT SERIES.



The sum of end-of-period cash flows in Figure 6 ($k = 1$ through $k = N$) gives the NPV at the beginning of period 1 ($k = 0$) when discounted at a specific interest rate and growth rate.[39] When applied to the method presented herein, this NPV gives $NPV_{IRR(rev)}$ when using the IRR as the interest rate, as shown in Equation 4.[40]

$$NPV_{IRR(rev)} = \sum_{k=1}^{N} A_k(1+i_{IRR})^{-k} = \sum_{k=1}^{N} A_1(1+g)^{k-1}(1+i_{IRR})^{-k} \qquad (4)$$

39. *Id.* at 107.
40. *Id.*

Equation 4 can be reduced to a more convenient form:[41]

$$NPV_{IRR(rev)} = \frac{A_1}{1+g} (P/A, i_{CR}\%, N) \tag{5}$$

Where the convenience rate (i_{CR}) is defined in Equation 6 and (P / A, $i_{CR}\%$, N) is simply the uniform series present worth factor.[42]

$$i_{CR} = \frac{i_{IRR} - g}{1+g} \tag{6}$$

B. Assessing Project Viability

The previous developments can be used to determine either the required first year revenue or the required first year traffic volume. In order to determine the required first year revenue, combining Equations 2 and 5, and solving for the first year cash flow (A_1) gives:

$$A_1 = \frac{(1+g)NPV_{IRR(exp)}}{(P/A, i_{CR}\%, N)} \tag{7}$$

Equation 7 provides stakeholders a simple means of assessing privately financed transportation projects, where A_1 represents the required first year revenue that is necessary to provide the IRR at an assumed capital cost, rate of inflation, annual sales growth rate, and project life. The financial viability of a transportation project can be determined by comparing this revenue to cash flows that can be reasonably expected during the first year of a facility's operation (see Evaluation of Selected Projects – Case 3).

In order to determine the required first year traffic volume, Equation 7 can be further extended by considering that annual revenues from transportation projects such as high-speed rail or toll roads are the product of traffic volume times the fare or toll price. Equation 8 expresses A_1 in terms of these volume-price measures, and assumes that units are consistent – that is, when traffic volume (V_{T1}) is expressed in vehicle-miles, the toll price (P_V) must be expressed in $/vehicle-mile; and when traffic volume measures the number of passengers, the fare price must be in $/passenger.

$$A_1 = V_{T1} P_V \tag{8}$$

Where V_{T1} = volume of traffic in year 1 (i.e. passengers, vehicle-miles),
P_V = price per unit volume ($/passenger, $/vehicle-mile, etc.)

Combining Equation 7 with Equation 8 allows for the required first

41. *Id.* at 108.
42. *Id.* at 107.

year traffic volume to be determined for a specific project scenario. Equation 9 solves for V_{T1}, giving a mathematical relationship that determines the first-year traffic volume necessary to provide the IRR at an assumed capital cost, rate of inflation, annual sales growth rate, and project life.

$$V_{T1} = \frac{(1+g)NPV_{IRR(exp)}}{(P/A,i_{CR}\%,N)P_V} \tag{9}$$

Similar to the use of Equation 7, the financial viability of a transportation project can be determined using Equation 9 by comparing the required first year traffic volume to the current volume of traffic in the transportation corridor (see Evaluation of Selected Projects – Case 1 and 2). If the required traffic volume is a modest percentage of existing traffic, then the study should progress to a more detailed level of analysis. Otherwise, it may be worthwhile for stakeholders to spend their scarce resources redefining the project scope, or on pursuing other projects altogether. In summary, either Equation 7 or 9 can be used to provide transportation agencies, private investors, and lending institutions a simple assessment method that avoids the need to rely on proprietary forecasting models, and instead bases the assessment of financial viability on current (i.e., proven) transportation data.

IV. Evaluation of Selected Projects

Travel patterns between cities are fairly predictable due to a limited number of corridor options, whereas urban travel usually presents multiple route options. Therefore, intercity transportation projects may offer the most reliable application of the proposed assessment method given that existing corridor traffic is used to evaluate project viability. Three examples of how this method can be applied to evaluate the financial viability of BOT contracts are described below.

Case 1: Texas TGV High-Speed Rail (1991-1994)

Serious consideration of high-speed rail in Texas began when a German consortium's 1985 proposal for high-speed rail between Houston and Dallas/Fort Worth was revised and submitted to the 70th Texas Legislature in 1987.[43] The legislature acted on the unsolicited proposal by sponsoring a study on the feasibility of operating high-speed rail within the Houston-San Antonio-Dallas/Fort Worth corridors.[44] This study con-

43. *See generally* Parsons Brinckerhoff/DEConsult, Feasibility Report: Intercity Express, Dallas-Houston (1985).

44. Lichliter/Jameson & Associates, Inc., et al., Texas Triangle High Speed Rail Executive Summary 2 (Texas Turnpike Authority 1989).

cluded two years later with a recommendation that high-speed rail was in fact a public need,[45] prompting the state to create the Texas High Speed Rail Authority (THSRA) through legislation known as the Texas High Speed Rail Act,[46] wherein the THSRA was authorized to pursue privately-financed high-speed rail projects capable of operating in excess of 150-mph.[47] The time and expense of these efforts resulted in the state awarding a high-speed rail franchise to Texas TGV Corporation in 1992, which by 1994 had negotiated the termination of its franchise due to a lack of financing.[48] After almost a full decade of pursuing the development of high-speed rail in Texas, the state concluded its efforts in 1994 with new legislation that abolished the THSRA and repealed the Texas High Speed Rail Act.[49]

Project Development

Proposals for a high-speed rail system in Texas were solicited by the THSRA in August 1990, resulting in the receipt of two franchise applications by the January 1991 deadline, and finalized by a contract with Texas TGV Corporation in January 1992.[50] Texas TGV, originally known as the Texas High Speed Rail Corporation, was a project corporation created by a development team led by Morrison Knudsen Corporation, a large construction firm based in Boise, Idaho.[51] Advisors to the THSRA Board of Directors had found that neither franchise application complied with the Request for Proposals (i.e., a complete financing plan, support of ridership estimates, and the avoidance of public funding);[52] though the Texas TGV proposal was apparently selected when Morrison Knudsen abruptly committed to a project completely financed by the private sector.[53]

The initial Texas TGV proposal called for the design, construction, and operation of a 180-mph high-speed rail network, illustrated in Figure 7.[54] The 256-mile Houston-Dallas segment was to be completed and operational by 1998 at an estimated cost of $2.5 billion in fourth quarter 1990 dollars.[55] The development team showed that Texas TGV would

45. *Id.* at 16.

46. S. 1190, 71st Leg., Reg. Sess. (Tex. 1989).

47. *Id.*

48. Marc H. Burns, High-Speed Rail in the Rear-View Mirror: A Final Report of the Texas high-Speed Rail Authority 10, 24, 33-36 (1995).

49. *Id.* at 63.

50. *Id.* at 18, 19, 24.

51. S.G. Warburg Securities, Preliminary Offering Circular: Texas TGV Corporation, $200,000,000 3% Convertible Equity Notes due 2000 F-8 (Nov. 29, 1993).

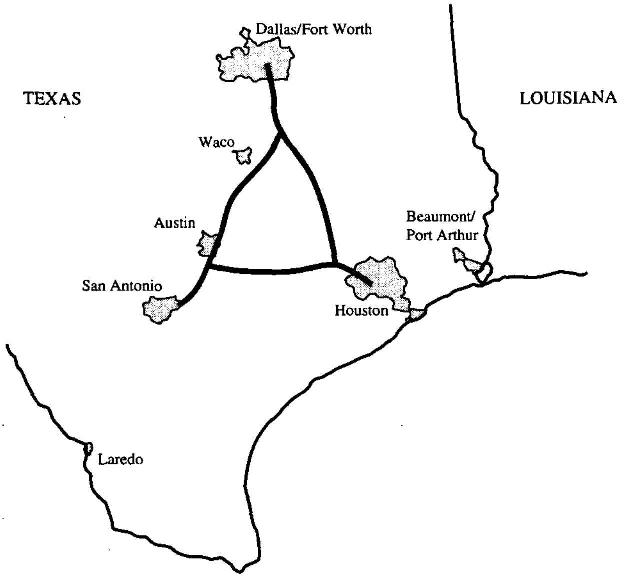
52. Burns, *supra* note 48, at 21 n.69.

53. S.G. Warburg Securities, *supra* note 51, at F-8.

54. *Id.*, at 30.

55. Texas TGV Corporation, Franchise Application to Construct, Operate, Maintain and Finance a High-Speed Rail Facility Volume III 8-4 (1991).

FIGURE 7. ORIGINAL TEXAS TGV PROPOSAL FOR A HIGH-SPEED RAIL NETWORK.



earn a return of sixteen percent,[56] based on a twenty-year ridership forecast with average fares of $40-42 per trip and a large revenue annuity in the remaining twenty years.[57]

The development team made two noteworthy modifications to Texas TGV's original proposal following the award of a franchise: the network shown in Figure 7 was shortened to require the construction of fewer track miles,[58] and the financing plan outlined in Texas TGV's 1993 public offering was modified to call for the public sector to finance twenty-five percent of the project.[59]

The final form of Texas TGV's financing plan was presented in their preliminary public offering (November 1993), which made available $200 million in three-percent convertible equity notes.[60] By that time $30 million in founding shares were held by the development team as compensation for initial design and engineering studies, preparation of the Environmental Impact Statement, and general corporate development costs – these shares, representing Phase I of the financing plan, repre-

56. *Id.*, at 9-3.

57. S.G. WARBURG SECURITIES, *supra* note 51, at 32.

58. CHARLES RIVER ASSOC. INC., INDEPENDENT RIDERSHIP AND PASSENGER REVENUE PROJECTIONS FOR THE TEXAS TGV CORPORATION HIGH SPEED RAIL SYSTEM IN TEXAS: FINAL REPORT, TEXAS TGV CORP. Figure 1-2 (1993).

59. S.G. WARBURG SECURITIES, *supra* note 51, at 34.

60. BURNS, *supra* note 48, at 32-33; S.G. WARBURG SECURITIES, *supra* note 51, at 1-2.

sented 0.46 percent of the project's $6.5 billion cost.[61] Subsequent phases of the financing plan included: Phase II, sale of the $200 million in 3% convertible equity notes; Phase III, an initial public offering of Class A Common Stock expected in 1996; and Phase IV, public market debt issues from public sector transportation programs beginning in 1996.[62]

Perhaps the most transparent element of Texas TGV's original franchise application was the adequacy of a 16 percent return considering the risks inherent in this type of project. The long-term interest rate on government bonds in the early 1990s was approximately 7.5 percent.[63] Therefore, the expected return would have been:

$$\text{Return} = \text{government bond rate} + \beta(\text{average risk}) = 7.5\% + \beta(7.5\%) = 16\%$$

So, the risk factor (β) would have been considered to be:

$$\beta = (16\% - 7.5\%) / 7.5\% = 1.13$$

A risk factor of 1.13 suggests that the high-speed rail project was being promoted as less risky than security investments in the computer ($\beta = 1.18$) or banking ($\beta = 1.25$) industries).[64] While it may be hard to believe Texas TGV's claim that a sixteen percent return was sufficient for a start-up project of this scope and level of risk, the IRR remains an important standard by which corporate projects are to be judged nonetheless. However, the IRR was a relatively straight forward and predictable condition for project viability but was used as a validation measure rather than as a principal component of the analysis. Whatever a suitable threshold rate of return rate might have been, it could have been used as the IRR in Equation 9 to provide a quick assessment of project viability in lieu of a prolonged and questionable ridership forecasting processes.

Retrospective Assessment of Project Viability

The data and assumptions from Texas TGV's proposed Houston-Dallas corridor can be used retrospectively to demonstrate how to use the proposed assessment method. To begin, assume that the THSRA undertook its own feasibility analysis in January 1991, five months prior to the award of a franchise to Texas TGV. Furthermore, assume that, like Texas TGV, THSRA had assumed the following conditions:

Capital cost = $2.5 billion (fourth quarter 1990 dollars),

61. S.G. WARBURG SECURITIES, *supra* note 51, at 33-34.

62. *Id.* at 34.

63. Helen Ng, A High-Speed Rail Revolution in the US? Lessons From the French and the Texas TGV 57 (1995) (unpublished M.B.A. thesis, Massachusetts Institute of Technology) (on file with Massachusetts Institute of Technology Library).

64. ROBERT C. HIGGINS, ANALYSIS FOR FINANCIAL MANAGEMENT 309 (Michael W. Junior ed., Irwin/McGraw-Hill 2001) (1984).

i_{inf} = 4.0%,
s = 2.8%,
i_{IRR} = 16.0%,
N = 40 years.

Given these assumptions, the annual growth rate of revenues is:

$$g = (1+i_{\text{inf}})(1+s)-1 = (1+0.040)(1+0.028) = 0.06912$$

And the convenience rate is:

$$i_{CR} = \frac{i-g}{1+g} = \frac{0.16-0.06912}{1+0.06912} = 0.08500$$

Also, the uniform series present worth factor is:

$$(P/A,i_{CR}\%,N = \left[\frac{(1+i_{CR})^N-1}{i_{CR}(1+i_{CR})^N}\right] = \left[\frac{(1+0.085)^{40}-1}{0.085(1+0.085)^{40}}\right] = 11.314$$

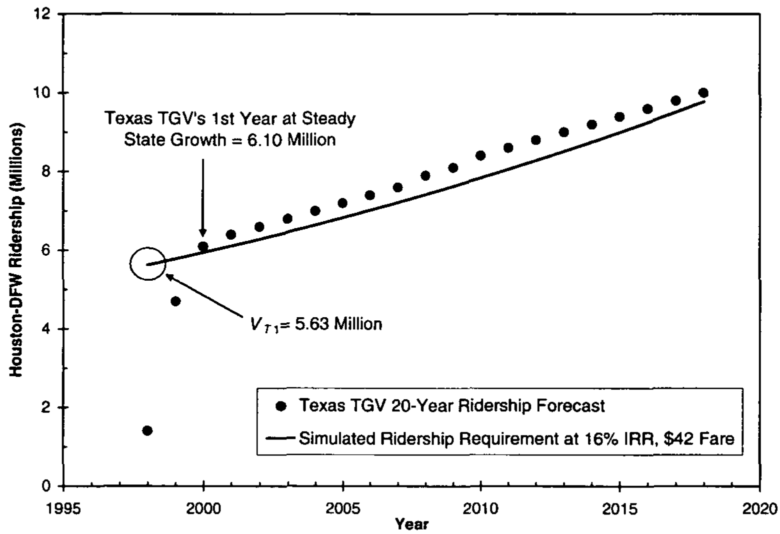
The THSRA could have determined the feasibility of this scenario by assuming in January 1991 that the Houston-Dallas high-speed rail corridor was already in place and ready to start operations in that year. By establishing January 1991 as $k = 0$, and since end-of-year 1990 is the same as beginning-of-year 1991, the present value of the capital cost is $2.5 billion. Therefore, the information above gives V_{T1} in Equation 9 as follows:

$$V_{T1} = \frac{(1+g)NPV_{IRR(exp)}}{(P/A,i_{CR}\%,N)P_{V1}} = \frac{(1+0.06912)(2.50\times10^9)}{(11.314)(42.0)} = 5.63\times10^6$$

At a fare of $42 per trip, the THSRA could have immediately predicted the ridership required at end-of-year 1991 (V_{T1}) to be 5.63 million passengers. The solid line in Figure 8 is a plot of required ridership using the proposed methodology, beginning at V_{T1} and growing at a rate of 2.8 percent annually. The data points in Figure 8 are plots of Texas TGV's 20-year ridership forecast, showing the first year of steady state growth to be 6.10 million riders. The essential parameter in assessing the project subsequent to the calculations above is the first year ridership (V_{T1}), rather than the annual ridership projections. In this simplified approach, the magnitude of V_{T1} relative to existing travel statistics should provide an early indication of whether a project might be viable. In the case of Texas TGV, the results in Figure 8 demonstrate how the THSRA could have quickly predicted the magnitude of required ridership far in advance of receiving proposals for a high-speed rail system.

After calculating V_{T1}, the THSRA could have compared the result to the traffic available in corridors from which the high-speed rail line could generate revenue. For example, historic records from permanent Texas Department of Transportation (TxDOT) counting stations indicate that there were 3.950 million intercity automobile (person) trips between Houston and DFW in 1990, and records from the American Airlines Decision Technologies ten-percent origin-destination sample database indicate that 2.316 million intercity air trips were made between Houston and Dallas-Fort Worth in 1990.[65]

FIGURE 8. RIDERSHIP FORECASTS FOR TEXAS TGV'S HOUSTON-DALLAS CORRIDOR.



Therefore, total trips in this corridor equaled approximately 5.906 million passengers and, by comparing this number to the V_{T1} of 5.63 million, the THSRA could have concluded up front that it would take approximately ninety-five percent of existing 1990 automobile plus air traffic, growing at 2.8 percent annually, in order to earn a return of sixteen percent. Of course, this conclusion would have been based on the assumption that Texas TGV's capital cost estimate of $2.5 billion was correct.

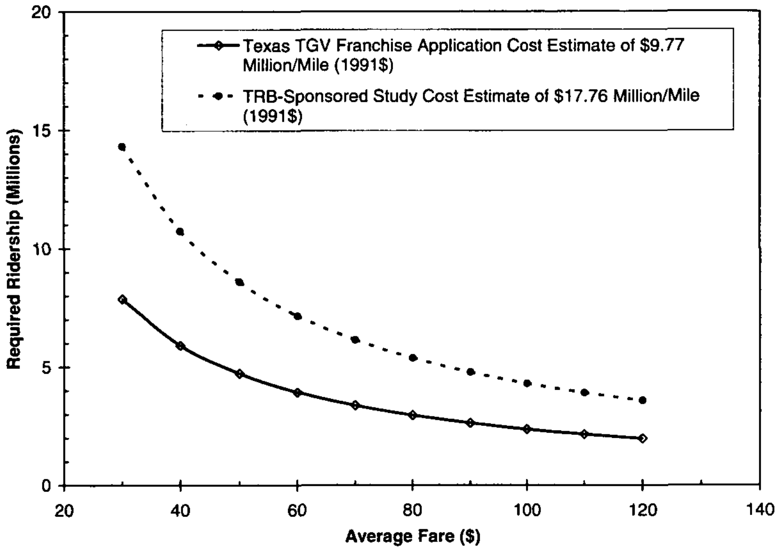
Consideration of Financial Risk

The proposed assessment method can also be used to evaluate the sensitivity of cost overruns on project viability. For example, even though Texas TGV stated their cost for the Houston-Dallas corridor as $2.5 billion, or $9.77 million per mile, the Transportation Research Board (TRB) released a study on high-speed rail at the same time that estimated the

65. CHARLES RIVER ASSOC. INC., *supra* note 58, at 2-16, 2-20.

cost of 180-mph technology at $16.44-17.76 million per mile.[66] Figure 9 contrasts the effect of Texas TGV's and TRB's cost estimate using Equation 9 to plot required first year ridership over a range of fares. Based on TRB's estimate, almost ten million passengers would have been needed in the first year at Texas TGV's anticipated $42 fare, making a sixteen percent return unthinkable.

FIGURE 9. SENSITIVITY OF REQUIRED FIRST YEAR RIDERSHIP VOLUME TO CAPITAL COST AND FARE PRICE FOR TEXAS TGV'S HOUSTON-DALLAS HIGH-SPEED RAIL CORRIDOR.



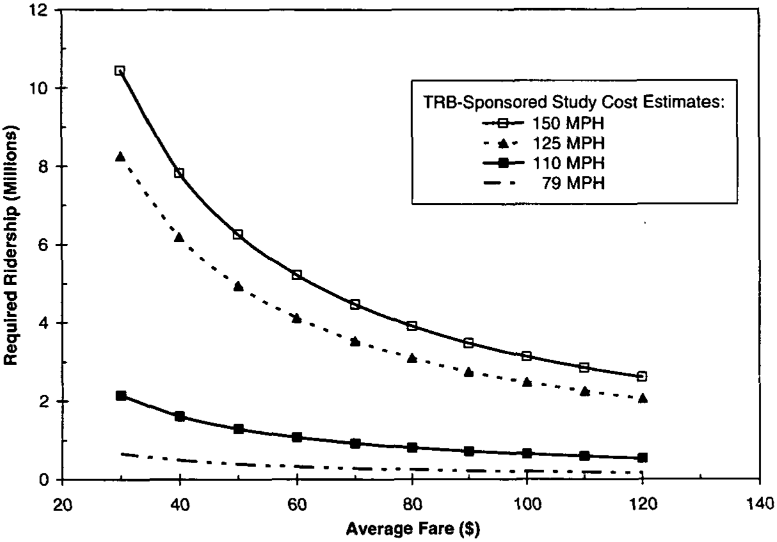
Re-examination of High-Speed Rail Policy

The Texas High-Speed Rail Act of 1989 defined high-speed rail as technology capable of operating at speeds in excess of 150 mph, which prevented franchise applicants from performing a thorough economic assessment of all available technologies (i.e., operating speeds). Figure 10 includes plots of V_{T1} versus P_V for lower-speed systems using TRB estimates as the basis for $NPV_{IRR(exp)}$ and holding all other Texas TGV assumptions constant. According to the results in Figure 10, a 110-mph high-speed rail system might have been financially viable if in-route times were acceptable to passengers, and had the Texas High Speed Rail Act allowed more flexibility in the types of technology that could have been considered. If the public sector had funded up to, say, fifty percent of the

66. NAT'L RESEARCH COUNCIL, TRANSP. RESEARCH BD., IN PURSUIT OF SPEED: NEW OPTIONS FOR INTERCITY PASSENGER TRANSPORT 91 (Special Report 233) (1991).

project, then the first year ridership requirements in Figure 10 would have been reduced by fifty percent, and then even 125 or 150-mph technology might have been worthy of further consideration.

FIGURE 10. REQUIRED FIRST YEAR RIDERSHIP VOLUMES FOR TEXAS TGV'S HOUSTON-DALLAS CORRIDOR AT SPECIFIC OPERATING SPEEDS.



CASE 2: TRANS-TEXAS CORRIDOR'S TTC-35 (2005-PRESENT)

The Trans Texas Corridor is a noteworthy plan by TxDOT to construct a new 4000-mile roadway network by awarding concessions to private companies, whereby these companies would raise financial capital through private markets and compensate investors via a return from operating revenues.[67] A comprehensive development agreement was signed in March 2005 for a private consortium to develop TTC-35,[68] the first element of the Trans-Texas Corridor, extending from Oklahoma to Mexico along a route parallel to Interstate 35.[69] The first phase of TTC-35 consists of $7.2 billion in private investment for the construction of a toll road from San Antonio to Dallas in exchange for the right to operate the toll facility over a fifty-year period.[70]

67. Antonio Palacios, *Trans-Texas Corridor*, PUBLIC ROADS, Jul./Aug. 2005, Vol. 69, No. 1.

68. *See generally* Tex. Dep't of Transp., *Comprehensive Development Agreement: TTC-35 High Priority Corridor*, March 11, 2005, *available at* http://www.keeptexasmoving.com/.

69. Tex. Dep't of Transp., *Cintra Will Invest $7.2 Billion for the Trans-Texas Corridor*, TxDOT NEWS, Dec. 16, 2004, http://www.keeptexasmoving.com/.

70. *Id.*

Assessment of Financial Viability

The basic terms of the TTC-35 agreement can be used in the proposed assessment method to determine the conditions for the financial viability of this project; and more importantly, to predict whether public funding might be needed to sustain operations at the facility. To begin, assume that the San Antonio-Dallas toll road has just been completed ($k = 0$) at a cost of \$7.2 billion – a capital cost of \$6.0 billion plus a \$1.2 billion concession payment to the state – and will start earning toll revenue immediately. Then, with long-term U.S. Treasury rates now averaging five percent, and assuming a *very* moderate risk factor of 1.6 for this type of project, a reasonable rate of return would be:

Return = government bond rate + β(average risk)=5.0% + 1.6(7.5%)=17%

If inflation remains fairly constant at 2.5 percent per year and vehicle traffic grows at 2.0 percent per year over the 50-year period, a simple assessment of this project can then be made under the following conditions:

Capital cost = \$7.2 billion,
$i_{inf} = 2.5\%$,
$s = 2.0\%$,
$i_{IRR} = 17.0\%$,
$N = 50$ years.

These assumptions result in the following parameters in Equation 7:

$g = 0.0455$
$i_{CR} = 0.1191$
$(P / A, i_{CR}\%, N) = 8.367$
$A_1 = \$0.899$ billion

For purposes of illustration, the first-year traffic requirement within TTC-35 can be evaluated using a seventy-nine mile San Antonio-Austin segment ($V_{T\ 1SA\text{-}Aus}$) and a 192-mile Austin-Dallas segment ($V_{T\ 1Aus\text{-}Dal}$). While smaller increments of distance could be used (e.g., San Antonio-New Braunfels, New Braunfels-San Marcos, etc.), localized increases in traffic, perhaps due to land development along the toll road, provide a proportionally smaller revenue base for facilities of greater total length. In this particular example, the moderate influence of increased localized revenues on financial viability might be judicious since tolls from these trips will accrue over shorter distances even though project costs will be incurred for the entire 271-mile road. Also, Interstate 35 provides a much more direct and inexpensive route between nearby towns than TTC-35, which is planned to bypass most existing urban areas.

Toll revenues will likely accumulate in a proportion similar to the mix of vehicles on Interstate 35, which should consist of about thirty percent trucks and seventy percent cars. Muller observed that accurate revenue forecasts were made for toll roads that opened between 1986 and 1995 when toll prices less than 8 cents per mile were assumed, equaling about ten to fourteen cents per mile in 2005 dollars.[71] However, an assessment of the project can be made using relatively optimistic toll prices of fifteen cents per mile for cars and forty-eight cents per mile for trucks. The relationship expressed in Equation 8 can be used to convert the required first year revenue of $0.899 billion into required first year traffic volumes on the San Antonio-Austin and Austin-Dallas segments as follows:

$$A_1 = d_{SA-Aus} V_{T1SA-Aus}(\%_t P_t + \%_c P_c) + d_{Aus-Dal} V_{T1Aus-Dal}(\%_t P_t + \%_c P_c)$$

Where $\%_t$ = percent trucks
$\%_c$ = percent cars
P_t = truck toll price ($)
P_c = car toll price ($)
d_{SA-Aus} = distance between San Antonio and Austin (miles)
$d_{Aus-Dal}$ = distance between Austin and Dallas (miles)

Substituting known values into the parameters above allows A_1 to be expressed as:

$$A_1 = (79)[(0.3)(0.48) + (0.7)(0.15)] V_{T1SA-Aus} + (192) [(0.3)(0.48) + (0.7)(0.15)] V_{T1Aus-Dal}$$

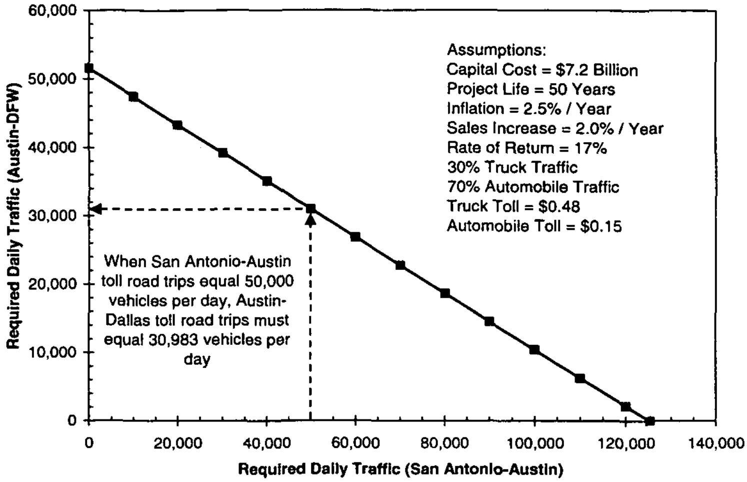
Since A_1 = $0.889 billion, the equation above becomes:

$$19.67 V_{T1SA-Aus} + 47.81 V_{T1Aus-Dal} = 8.889 \times 10^8$$

This expression plots as a linear relationship between the required first year San Antonio-Austin traffic and the required first year Austin-Dallas traffic, as shown in Figure 11, where $V_{T\,1SA\text{-}Aus}$ and $V_{T\,1Aus\text{-}Dal}$ are expressed as daily traffic volumes. Based on the simplifying assumptions in this example, the result indicates that if 50,000 daily trips (i.e., the mix of trucks and cars) are made on the toll road between San Antonio and Austin in the first year, then 30,983 daily trips will need to be made on the toll road between Austin and Dallas in the first year for investors to earn a seventeen percent return. While an analysis involving shorter distance increments can be made and presented in tabular form (see Case 3), the plot in Figure 11 demonstrates how the proposed assessment method can provide a means of predicting the viability of intercity toll roads using a limited amount of time, expense, and information.

71. Muller, *supra* note 34, at 2.

FIGURE 11. PRELIMINARY ASSESSMENT OF REQUIRED FIRST YEAR TRAFFIC VOLUMES FOR PHASE I OF THE TTC-35 TOLL ROAD.



The TTC-35 project has faced considerable resistance from rural land owners who fear the loss of their property to the acquisition of necessary right-of-way through Central Texas.[72] Also, many communities that rely on business from Interstate 35 traffic want TTC-35 to follow the existing highway as closely as possible, fearing that the new toll road would otherwise create several ghost towns.[73] State officials have offered assurance to these small-town communities by suggesting that no more than fifteen percent of Interstate 35 traffic will divert to TTC-35.[74] So, issues to study regarding the TTC-35 project include:

- The existing volume of intercity traffic on Interstate 35
- Whether sufficient revenue would be generated from approximately fifteen percent of interstate traffic to produce a financially viable project
- How the close proximity of a non-tolled interstate parallel to TTC-35 might lessen revenues from the toll road
- How the location of TTC-35 further from Interstate 35, where right-of-way is less expensive, might discourage motorists destined for towns along the existing interstate from using the toll road.

CASE 3: TEXAS T-BONE HIGH-SPEED RAIL (PROPOSED)

The Texas High Speed Rail and Transportation Corporation

72. *See* Ben Wear, *Perry's Road Revolution Could Take Electoral Toll*, AUSTIN-AM. STATESMAN, Aug. 20, 2006, at 4, *available at* http://corridornews.blogspot.com/.

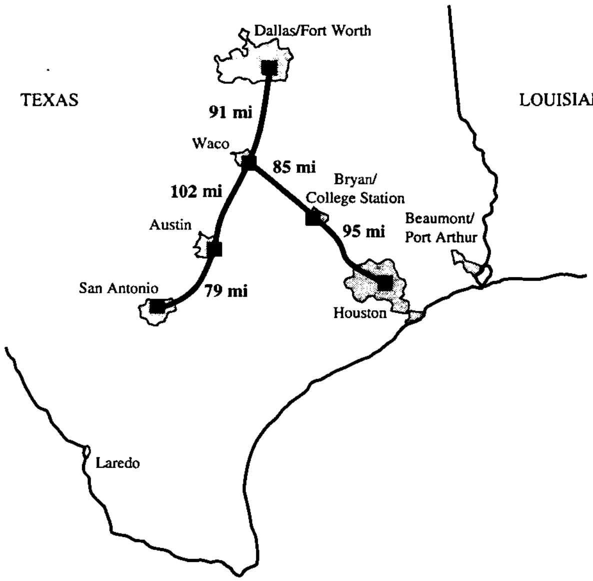
73. Ben Wear, *Path of I-35 Twin a Mystery*, AUSTIN-AM. STATESMAN, Mar. 7, 2002, at 4, *available at* http://corridornews.blogspot.com/.

74. *Id.*

(THSRTC) received a Certificate of Incorporation on October 31, 2002, established to promote and assist in linking the major population centers of Texas.[75] With support from the THSRTC, TxDOT submitted a request to the U.S. Department of Transportation the following year to extend the South Central High Speed Rail Corridor, with San Antonio-Dallas/Fort Worth as the main corridor, to include a segment connecting Temple, Bryan/College Station, and Houston.[76] Essentially, this extension matches the THSRTC's proposed alignment for a two-corridor high-speed rail system named the "Texas T-Bone,"[77] similar to that shown in Figure 12.

Equation 7 can be used to perform a quick financial assessment of the proposed Texas T-Bone system by comparing the first year cash flow (A_1) of a successful private high-speed rail venture (i.e., one that produces an acceptable rate of return) to the first year cash flow from the diversion of an assumed percentage of existing passenger travel to the high-speed rail network.

FIGURE 12. ROUTES AND DISTANCES FOR A TWO-CORRIDOR HIGH-SPEED RAIL SYSTEM IN TEXAS.



75. OFFICE OF THE SEC'Y OF STATE, STATE OF TEX., FILING NO. 800139626, CERTIFICATE OF INCORPORATION OF TEXAS HIGH SPEED RAIL AND TRANSPORTATION CORPORATION (Oct. 31, 2002).

76. Robert A. Eckels, *Chairman's Corner*, 8 FAST FORWARD: THE BIMONTHLY NEWSLETTER OF THE TEXAS HIGH SPEED RAIL AND TRANSPORTATION CORPORATION, Aug. 2003, at 1.

77. WACO METRO. PLANNING ORG., CONNECTIONS 2030: THE DRAFT WACO METROPOLITAN TRANSPORTATION PLAN, at 6-3, *available at* http://www.waco-texas.com/mpo/news.htm.

As an example, assume that the Texas T-Bone will operate at a maximum speed of 150 mph, and will be built at a cost $18 million per mile. Furthermore, assume that forty percent of the project will be funded by the public sector, resulting in a cost of $4.882 billion to the private sector for the 452-mile rail system (see Figure 12 for mileage). Assuming the same rates of inflation, revenue growth, and financial return as in Case 2, the parameters needed to evaluate the project over a twenty year life are as follows:

Capital cost = $4.882 billion,
$i_{inf} = 2.5\%$,
$s = 2.0\%$,
$i_{IRR} = 17.0\%$,
$N = 20$ years.

These assumptions result in the following parameters in Equation 7:

$g = 0.0455$
$i_{CR} = 0.1191$
$(P / A, i_{CR}\%, N) = 7.513$
$A_1 = \$0.7272$ billion

The results from Equation 7 indicate that the rail system needs to earn revenue of $727 million in the first year of operation for a seventeen percent return. A rough estimate of the rail system's capacity to earn $727 million in the first year can be obtained by preparing a spreadsheet containing all origin-destination city pairs like those shown in Table 1. In this example, a route factor is used to adjust a baseline fare of twenty-six cents per mile to reflect a competitive pricing strategy. For example, direct routes between major urban centers might be capable of diverting twenty-five percent more passengers from existing travel modes than will be achieved from travel between smaller cities. Also, instances where high-speed rail travel between urban centers involves an indirect route (e.g., Houston-Austin or Houston-San Antonio) might only be capable of diverting seventy-five to ninety percent of the passengers that will switch travel modes on direct routes. In each of these cases the high-speed rail ridership has been adjusted using the route factor. Table 1 uses projected 2005 auto and air travel volumes as the volume of travelers capable of diverting to high-speed rail; in this table, ridership is based on a traveler diversion scenario of thirty percent.[78]

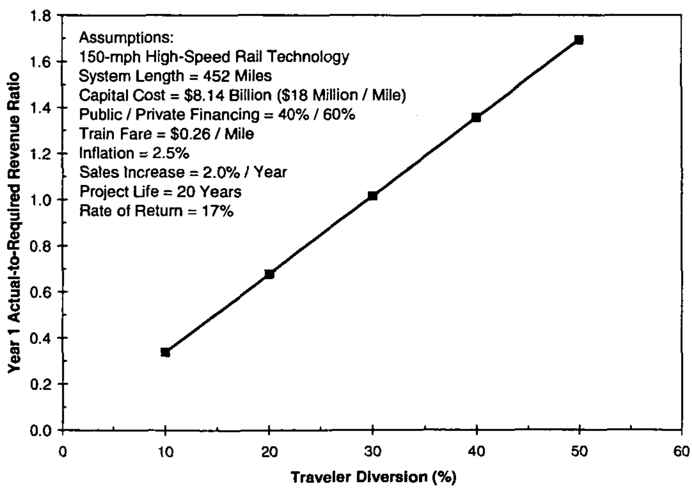
Based on the assumptions used in Table 1, diverting thirty percent of available travelers would earn revenue of $738 million in year 1, which happens to be greater than the $727 million in revenue required to earn a seventeen percent return. Figure 13 shows how this approach can be ex-

78. CHARLES RIVER ASSOC. INC., *supra* note 58, at 2-16, 2-20.

tended to observe the relationship between diversion rate and project viability by plotting actual-to-required first year revenue (e.g., $738 million / $727 million at a diversion of thirty percent) versus diversion rate. An actual-to-required revenue ratio less than 1.0 in Figure 13 produces a rate of return less than 17 percent. Since the actual-to-required revenue ratio at a diversion rate of thirty percent happens to be 1.02, then approximately thirty percent of travelers in the proposed high-speed rail corridor would in fact be needed to meet the financial objectives in this example.

A primary value of the proposed methodology is to help stakeholders avoid the time and expense of pursuing ideas that stand little chance of financial success. In the example above, basing the long-term viability of privately operated high-speed rail on diversion rates of at least thirty percent may be quite a risk – that is, a risk to investors in the project corporation and to the public sponsor who finances $3.254 billion of the project cost. On the other hand, the development team on the high-speed rail project would likely earn large fees from the construction of an $8.136 billion facility.

FIGURE 13. ACTUAL-TO-REQUIRED FIRST YEAR CASH FLOW USING VARIOUS TRAVELER DIVERSION SCENARIOS FOR THE T-BONE HIGH-SPEED CONCEPT.



V. DISCUSSION OF RESULTS

Public agencies consider BOT contracts as a means of avoiding the risks and expense of implementing new types of transportation facilities such as high-speed rail or long-distance toll road projects; what is less apparent are the risk mitigation strategies available to their private partners. Consequently, most of the financial risk in these projects, if implemented, is likely to be borne by stakeholders with the least information. This does not preclude, however, the public sector from incurring risks other than financial loss. For example, state officials in Texas foresaw high-speed rail as a long-term solution to congested corridors and the need for additional highway construction, yet the conditions under which proposals from the private sector were sought increased the likelihood that the concept would ultimately fail. If an up-front assessment method had been used to evaluate the prospects for high-speed rail, the state could have identified conditions for viability such as economic train speed technologies, the need for public financial support, and the effect of construction cost overruns on the required volume of first year traffic.

With the expectation that infeasible BOT agreements will continue to be negotiated between the public and private sectors, an up-front assessment of project viability can serve to alert third-party stakeholders (i.e., motorists, land owners, investors) in transportation projects of the need for agencies to concede special contractual provisions to project corporations as risk mitigation measures. For example, Orange County, California, entered into a contract with the California Private Transportation Company, L.P, (CPTC) for the 91 Toll Road, a ten mile toll road that opened in December 1995.[79] This agreement prevented improvements or planning for improvements of the Riverside Freeway, which paralleled the 91 Toll Road, in order to insure that sufficient volumes of traffic would use the CPTC's facility.[80] Although, Orange County purchased the toll road in 2002 so that necessary improvements to the Riverside Freeway could be made without violating the non-compete clause.[81] Other conditions for the financial viability of a transportation facility to the project corporation might involve restrictions on certain vehicle types, such as the requirement that trucks use a toll facility, or grants of land development rights to the private sector along right-of-way acquired for the project – these issues certainly justify a thorough and transparent review process at an early stage of project development.

VI. Conclusions

As far back as the pursuit of our country's first transcontinental railroad, developers of public-private transportation facilities have used ownership of the construction companies contracted to build their projects as a means of protecting themselves against the financial risks inherent in these ventures. Whereas owners of the Union Pacific Railroad franchise

79. Orange County Grand Jury, Review of 91 Toll Road Funding, Grand Jury Rep. 2004-2005, at 1, *available at* http://www.ocgrandjury.org/.

80. *Id.*

81. *Id.*; Orange County Transp. Auth., OCTA's 10 Mile Toll Road, 91 Express Lanes Fast Facts (Apr. 3, 2006).

created a construction company (Credit Mobilier of America) that would earn substantial and reliable profits from a project faced with uncertain future cash flows,[82] today's public-private contracts are characterized by well-established construction companies pursuing risky ventures. Unfortunately, modern history has shown that the sophisticated forecasting models used by developers may not provide other stakeholders in BOT projects with sufficient information to make wise investment decisions. With that in mind, this paper has sought to demonstrate that the time, expense, and accuracy of assessing project viability might be improved by opting for a more simple and transparent method. This paper is also intended to show stakeholders how the selection of a suitable rate of return can be integrated into a simple assessment method that allows for BOT proposals to be assessed in a short period of time, using a limited amount of information, and involving little expense. As a result, transportation planners or passive investors can prepare an unbiased assessment of project viability by determining the level of traffic *required* to sustain a private enterprise rather than await a prediction on the level of traffic *expected* to support its operation.

82. KLEIN, *supra* note 12.

TABLE 1. SAMPLE ESTIMATE OF 2005 REVENUE FOR THE TEXAS T-BONE.

High-Speed Rail System Features				2005 Travelers (millions)			HSR Projections	
Route	Distance (miles)	Route Factor	Fare ($)	Auto	Air	Total	Ridership (millions)	Revenue ($ million)
Hou-DFW	271	1.25	88.08	5.22	3.31	8.53	2.56	225
Aus-DFW	193	1.25	62.73	3.99	1.13	5.12	1.54	96
SA-DFW	272	1.25	88.40	2.30	1.36	3.66	1.10	97
Aus-SA	79	1.00	20.54	8.97	–	8.97	2.69	55
Hou-Aus	282	0.90	65.99	3.00	0.68	3.68	1.10	73
Hou-SA	361	0.75	70.40	3.40	0.72	4.12	1.24	87
Aus-Wac	102	1.00	26.52	1.35	–	1.35	0.41	11
Aus-BCS	187	1.00	48.62	1.55	–	1.55	0.47	23
DFW-Wac	91	1.00	23.66	3.52	–	3.52	1.06	25
DFW-BCS	176	1.00	45.76	0.85	–	0.85	0.26	12
Hou-Wac	180	1.00	46.80	0.30	–	0.30	0.09	4
Hou-BCS	95	1.00	24.70	1.69	–	1.69	0.51	13
SA-Wac	181	1.00	47.06	0.34	–	0.34	0.10	5
SA-BCS	266	1.00	69.16	0.40	–	0.40	0.12	8
Wac-BCS	85	1.00	22.10	0.70	–	0.70	0.21	5
						Year 1 Total Revenue		738