Impact of Technology on Roadway Operations and Financing

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Recent advances in electronic technology have opened the door to nothing less than a revolution in the way we operate and finance our roadway systems. For the first time, we are able to price roadway use with the same flexibility that private business firms have traditionally enjoyed in pricing access to their services.

Movie House Analogy

To appreciate what this means, let's assume for a moment that we own a five-screen movie house in a suburban shopping mall.

The whole basis for how we operate our movie house is that our customers must first buy tickets at the box office before they can enter any one of our five theaters to enjoy a movie. Since we want to generate as much revenue as possible, we try to adjust our ticket prices so that we fill our seats with customers who buy tickets at the highest prices they are willing to pay.

At the simplest level, we are obviously going to charge higher prices for evening tickets and lower prices for afternoon tickets to reflect different levels of demand at different times of day. We are also going to increase prices for both evening and afternoon tickets on Saturdays and Sundays, which are the most popular movie-going days during the average week. And we will do the same thing on holidays.

These actions reflect the fact that at any given time of day and day of the week, a certain number of people may be willing to buy tickets to see movies in our five-screen movie house. But the size of this number depends in part on how we price these tickets.

- If we charge too little on Saturday night when demand is high, we can keep our theaters full. But we may end up having to turn away potential customers willing to pay higher ticket prices than those filling our seats. So we have lost a revenue opportunity.
- If we charge too much on weekday afternoons when demand is lower, we are likely to have a lot of empty seats. But we might have been able to fill at least some of these seats if our ticket prices were lower. So we have lost another revenue opportunity.

In other words, the whole process of making ticket pricing decisions is something of a juggling act. As with all such juggling acts, the key to success is staying alert to changes in circumstances and moving quickly to exploit them, always keeping in mind that our goal is to fill as many seats as possible with customers who buy tickets at the highest price they are willing to pay.

Of course, this "highest acceptable price" often depends on the popularity of the movie being shown. All movies are not equally popular. Our ticket pricing strategies should take this into account.

For example, each of our five theaters shows a different movie on any given Saturday night. If one of these movies is significantly more popular than the others, its theater may be full and have a line of eager customers waiting outside. The length of this line can discourage some potential customers from waiting and cause them to go elsewhere. Meanwhile, our other four

theaters (showing less popular movies) may have a number of empty seats.

So why not price access to each theater in a way that reflects the relative popularity of the movie it is showing? We can raise the ticket price for the theater showing the most popular movie and drop the price for tickets to the other theaters. If we do this cleverly, we will be able to equalize demand for access to each of our five theaters.

Some of the people waiting in line for the most popular movie may be lured by lower ticket prices to the other four movies. The same is true for some of the customers we might otherwise have lost because of the long line outside the theater showing the most popular movie. Under the best circumstances (and best balance of prices), all five of our theaters will be full and no one will be waiting in line to see the most popular movie.

This idea of "price rationing" is a basic feature of free-market economies. It is regarded as the most efficient way to allocate goods and services (like access to movie seats) that cannot be supplied in unlimited quantities.

The alternative is "time rationing." This is what happens when customers have to wait in line to see a popular movie. Time rationing was a standard practice in the former Soviet Union and other Eastern European countries. Prices for consumer goods and services were kept low enough for everyone to afford, but you often had to wait in line for long periods to make purchases.

This practice favors customers who place a low value on their time and penalizes those who are short of time and who might be willing to pay a premium price to avoid waiting in line. In our movie house, we offer customers this opportunity by charging the highest admission price for the most popular movie.

Interestingly, we Americans have traditionally used the "Leninist" practice of time rationing to control access to our roadway systems. With few exceptions, we do not charge drivers to travel on them. But even on toll bridges and highways, they must be willing to endure slow trips in stop-and-go traffic if they want to use roadways during periods of high demand. We do not offer them the option of paying a premium price to avoid slow trips.

That is the whole point behind the movie house analogy. The manager of a movie house has always been able to price tickets according to demand—and give customers the option of avoiding long waits in line by paying higher ticket prices. The technology for doing this happens to be very simple. But until recently, we have lacked the advanced technology needed to price roadway access the way we price access to movie seats.

Applying Movie Ticket Pricing to Roadways

All this is finally changing. Recent advances in electronic technology greatly simplify the process of collecting tolls, monitoring traffic volumes, and sorting out different types of motor vehicles. This gives us the kind of flexibility that a movie house manager enjoys in how we charge motorists for access to roadways, and not just on bridges or limited-access highways. Today's technology allows us to charge for access to every kind of roadway—even local streets.

This paves the way for a total revolution in how we finance our roadway systems and improve their operating efficiency. Here are some examples:

- We can now charge motorists according to the distance they travel on a particular roadway.
- We can also charge different toll rates for use of the roadway at different times of day and different days of the week to reflect traffic volumes. We can even vary these rates minute by minute according to a roadway's "popularity," as measured by the average speed of its traffic flow.
- We can charge different toll rates for different roadways (and even for different lanes on the same roadway) to reflect their relative popularity.
- We can charge different rates for vehicles of different sizes and types. Among other things, this opens the way to more effective and less costly enforcement of posted regulations that prohibit the use of certain local streets by trucks and other large commercial vehicles. We can arrange things so that a prohibited vehicle automatically gets charged a rate so high that the regulations become largely self-enforcing.
- We can use the same principle to enforce other traffic regulations more effectively and less expensively. For example, drivers exceeding the posted speed limit on a roadway can quickly find that they are paying a very high multiple of the normal rate for using the roadway.

The new technology that makes these and other benefits possible is simple, reliable, and surprisingly inexpensive.

- Simple transponders placed on vehicle windshields contain the vehicle owner's unique ID number, which can be read by electronic monitors along a roadway. By reading this number when the vehicle enters and leaves the roadway, we can compute the distance it travels. This lets us charge the vehicle owner's account for each use of the roadway on the basis of the distance traveled. At the appropriate per-mile rate for that type of vehicle. On that particular roadway. During that particular time of day.

When the roadway is experiencing that particular traffic volume.

- Wire loops beneath the pavement of roadway lanes can continuously measure average traffic speeds on each lane. We can use this flow of information to automatically adjust the per-mile rate we charge motorists to achieve any desired average speed. Raising rates when the speed falls too low will deter some motorists from using the roadway, thereby reducing traffic volume to a level that permits the higher average speed we desire.
- Pattern-recognition software in closed-circuit television monitoring systems can count the number of vehicles in roadway lanes. It can even give continuous counts broken down by each particular type of vehicle.
- Variable message signs along each highway can provide motorists with information about the current price rate for using the highway, its current average traffic speed, problems ahead, and even conditions on parallel roadways. But it will not be long before these signs can effectively be "moved inside the vehicle" to provide motorists with price and speed data for every roadway in the system, plus on-demand travel information about optimal routes and other useful services.

Intelligent use of this technology enables us to operate our roadway systems with much greater efficiency than in the past. In effect, we can narrow the often considerable gap between a roadway system's theoretical capacity and its functional capacity. We can do this by redistributing travel demand within a roadway system to achieve more efficient patterns—using different price levels to shift trips away from crowded roadways to less crowded roadways and away from high-demand periods to periods when demand is lower. We can accomplish this kind of redistribution by exploiting the classic economic principle of using price to control the demand for scarce resources. In the process, we are able to provide better service for our customers.

Yes, customers. Not motorists or travelers or taxpayers, but customers. Just like the people who buy movie tickets.

This distinction is very important. If we are going to be successful in running our roadway systems in a more businesslike way and charge fair prices for using them, we must develop a business manager's habit of regarding those who use roadways as customers first and foremost.

What exactly is a customer? Someone who is a willing buyer of what we have to sell at the particular price we are charging. What makes this someone a willing buyer? A personal judgment about whether the value to him or her of what we are selling is greater than the price we are charging.

Management guru Peter Drucker once pointed out that the most important goal for every business firm is to create customers—with profit simply being one of the costs we have to cover to stay in business. But Drucker also insisted that the goal of creating customers is just as important for public agencies as it is for business firms.

How do we create customers? By heightening the perception that what we are selling is worth more than the price we are charging. We do this by improving the quality of what we are selling, or by reducing its price, or by doing some of both.

Suppose a driver can use two different highways to reach his destination. One highway charges a relatively high toll rate per mile—but promises an average speed of 55 mph. The other highway charges nothing—but it is choked with slow, stop-and-go traffic moving at less than 20 mph. If the driver is on his way to an important business meeting and cannot afford to be late, he may decide that the value of the time saved by using the high-toll highway is greater than the price he must pay. But if he is simply making a trip to a shopping mall to buy gardening tools, he may opt to use the toll-free highway and put up with the additional travel time.

In other words, roadway pricing lets us create value for drivers by offering them shorter travel times for their high-priority trips. Who determines the priority of trips? The drivers themselves. Each one makes a personal judgment about the importance of the trip and how much he or she is willing to pay to reach the destination faster. For this, we offer the same kind of money-back guarantee that a movie house manager offers if the projector breaks down or the sound system goes dead.

Pricing access to roadways in the same way that we price access to movie seats enables us to operate roadway systems more efficiently. Just like a smart movie house manager, we can use the price mechanism to distribute travel demand at any given time in a rational manner—so that traffic volumes on each roadway reflect its capacity. If we do this intelligently, we will end up minimizing the aggregate trip times for all drivers. Shorter trip times mean better service for travel customers and allow our roadway systems to accommodate more trips per hour.

The Revenue Advantage

Roadway pricing also produces revenue—lots of revenue if we apply this concept to an entire metropolitan roadway system. So much revenue that we can abandon forever the crude, inefficient mechanisms we have had to rely on up to now to fund roadway operations and construction. We can abolish sales taxes on motor vehicle fuel and tires, eliminate high registration fees based on a vehicle's weight or purchase price, tear

down all those toll booths that slow traffic to a crawl during high-demand periods, and end the practice of using general tax revenues to support our roadways.

Instead, roadway systems become entirely self-supporting—just like movie houses. Paid for by the people who actually use them—according to how much they use them, when they use them, and the type of vehicle they are driving. Among other important benefits, making our roadway systems self-supporting can enable us to resume the long-deferred task of expanding their capacity to accommodate the new travel demands generated by rising economic activity.

The federal government has been heavily promoting the idea that "we can't build our way out of congestion." It does this to discourage state transportation departments from planning expensive new roadway projects and then coming to Washington for federal grants to help fund their construction. The federal government would rather pay off some of its debt than provide the nation with the new transportation and other infrastructure capacity it needs. This is like the homeowner who uses his latest raise to accelerate his mortgage payments rather than replacing his leaky roof or installing a more efficient heating system.

We can't build our way out of congestion? Of course we can. And we must if the nation is to prosper in the future. But there is no way to do this under today's inefficient and ineffective mechanisms for funding roadways.

But comprehensive roadway pricing gives us a sensible way to fund this badly needed new construction. The revenue streams generated by charging motorists fair prices for roadway use can support new transportation bond issues that spread capital costs over future years, to reflect the many years of benefits that new roadway projects can produce—benefits that are paid for by those who actually use the roadways.

Equally important, the realistic expectation of such revenue streams also enables us to bring together government and business in formal partnerships that exploit both public and private resources more effectively. We can do this by making greater use of a mechanism called "project financing."

Project financing is a low-key term for a high-key approach to financing the construction of capital facilities. The private sector has used it successfully to build electric power plants, oil pipelines, even Euro-Disneyland outside Paris. But we can also use it to build new highways, bridges, transit lines, and other public infrastructure facilities.

A more descriptive term for this approach is "asset-based financial engineering." In other words, the ability to raise construction funds depends entirely on the anticipated financial strength of the new capital asset that we are going to create. This is a marked departure from traditional capital financing, which depends on the real or perceived financial strength of the private firm or government unit that will own and operate the asset. That is why asset-based financing is widely used by commercial real-estate developers to finance the construction of office buildings, shopping malls, and large residential complexes. As we will see, focusing on the financial strength of the capital asset itself can make a world of difference when it comes to raising the funds we need to expand the capacity of our roadway systems.

How Project Financing Works

Figure 1 shows one example of how a partnership between government and private firms can use project financing to build a major new transportation facility. The details are important because they illustrate the pervasive nature of the benefits that new technology offers for operating and financing roadway systems more rationally.

We will call the transportation facility in question Metro West Turnpike. It is a new expressway that adds badly needed transportation capacity to a major travel corridor in a metropolitan region whose existing highways are heavily congested during much of the day. The expressway is designed to support itself with motor vehicle user charges, plus certain other income.

This particular travel corridor is defined by a classic 1950s urban expressway whose capacity has long since been overwhelmed by growing travel demand. Because the expressway runs through a number of densely developed areas, simply widening its right-of-way to add more lanes is not a feasible option. The only practical solution is to build what amounts to a second expressway on an elevated structure over the existing expressway.

The state's department of transportation previously handled all new highway construction in the traditional manner. This includes relying on grants from the federal government's Highway Trust Fund to cover most of the capital cost of building new highways. Such grants have become increasingly hard to come by now that Uncle Sam has put on his Uncle Scrooge hat. However, building the new expressway as a self-supporting toll road opens the way to funding its construction costs by issuing bonds against future toll revenues. This eliminates any need for federal grants, not to mention the lengthy grant application process.

Once the state department of transportation comes to terms with the idea of making the new expressway entirely self-supporting through user charges, it takes the next step and establishes a public-private partnership to build and operate it. This offers two additional advantages:

- The partnership can use the project financing approach to raise construction capital from a broader

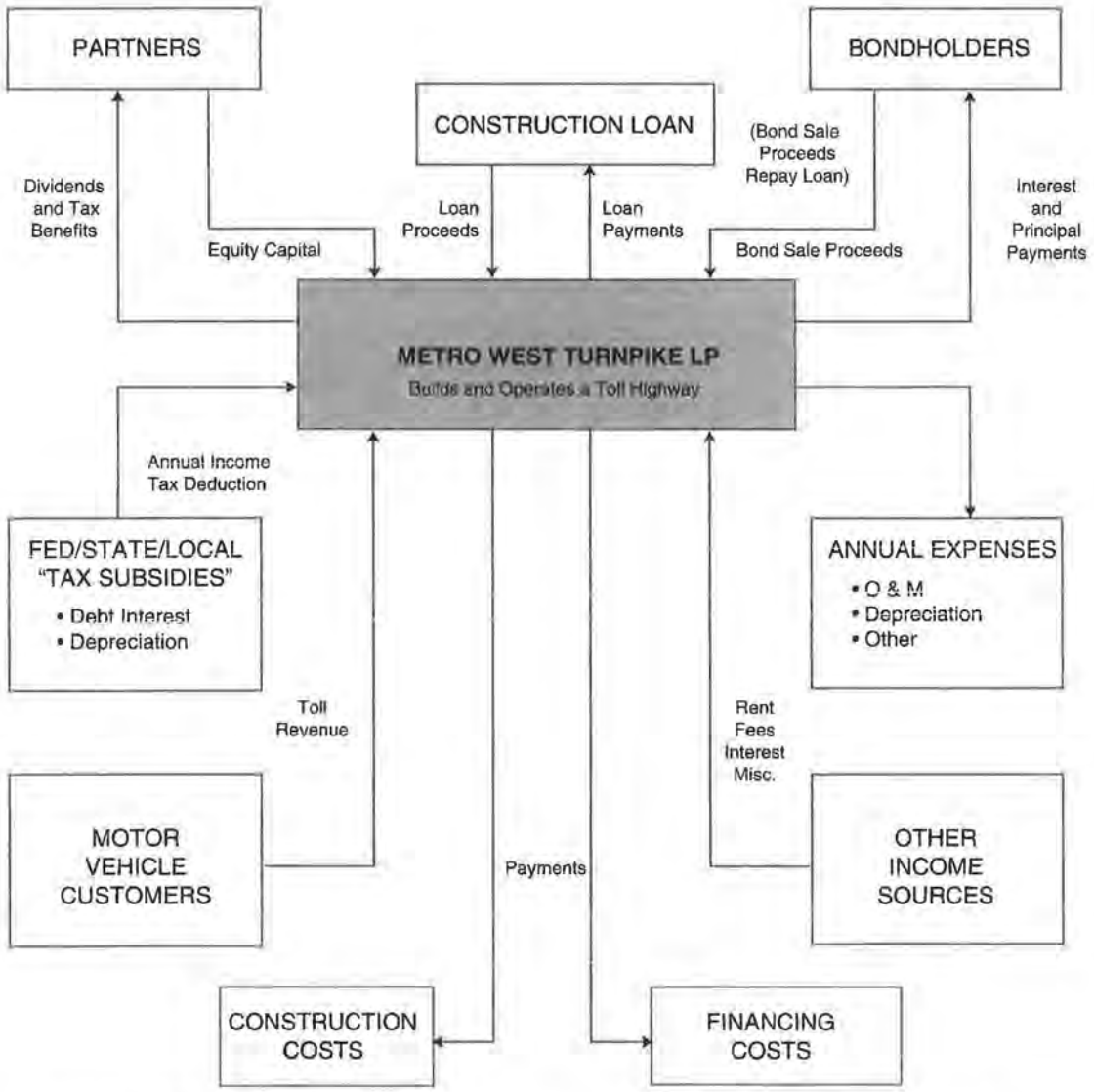

FIGURE 1 Toll highway limited partnership "project financing" funds flow diagram.

spectrum of sources than is available for traditional public financing.

• Some of this capital can take the form of equity contributions from the partners themselves. These partners may include certain business firms that have vested interests in seeing the highway built.

All this leads to the financial engineering structure shown in Figure 1. Its key element is Metro West Turnpike LP (MWT for short), which occupies the shaded box in the center. MWT is the legal entity that finances, builds, owns, and operates the expressway. The "LP" at the end of its name means that MWT is a limited partnership rather than an ordinary private corporation. Being a limited partnership has certain advantages that will become apparent as we explore its structure.

MWT follows a three-stage process to build the expressway and get it operating.

Stage 1: Construction

MWT uses the equity capital contributed by its partners, plus a construction loan from a consortium of commercial banks, to fund the expressway's construction and initial financing costs.

Stage 2: Refinancing

At the end of the construction period, MWT sells long-term mortgage bonds that are secured by a lien on its

assets (which means the expressway itself). The interest and principal payments on these bonds will be covered by the income that the expressway generates from tolls and other sources. MWT uses the proceeds of this bond sale to pay off its construction loan.

In other words, MWT converts its short-term bank debt into long-term mortgage debt once the expressway is ready to begin operating. This two-stage financing approach is commonly used by private real-estate developers to fund the construction of new office buildings and other projects.

Stage 3: Operations

Once the expressway opens for business, MWT uses the income it generates to fund its annual costs. As the diagram indicates, these costs include

- The expressway's normal operating and maintenance expenses;
- Interest and principal payments to MWT's bondholders;
- The maintenance of suitable levels of capital reserves, which MWT funds with the portion of its operating revenues that is allocated to annual depreciation of its capital plant and equipment; and
- Annual dividend payments to MWT's partners.

That is the whole story in a nutshell. But we need to look more closely at some of the details to understand the important subtleties of project financing. Let's proceed counterclockwise around Figure 1, starting with the Partners box in the upper left-hand corner.

Details of Project Financing

MWT's Partners

Some of MWT's partners are simply clients of securities brokers and other private investment firms that are always looking for new investment opportunities. The projected level of MWT's dividends makes it an attractive investment, especially since these dividends will be partially sheltered from income tax liability (more about this later).

MWT's partners also include various entities that have some kind of vested interest in seeing the turnpike built and are willing to contribute equity capital to help accomplish this. They include

- The state's department of transportation, which conceived and planned the expressway and established MWT;
- Three suburban governments whose jurisdictions are served by the expressway;
- Various construction firms that receive contracts to build the expressway (since MWT is a private-sector entity, it does not have to follow the standard arms-length, competitive bidding process required for government agencies);
- Firms that supply materials and equipment used in building the expressway;
- The engineering firm that receives the contract to design the expressway and manage its construction;
- An existing public toll bridge authority, to which MWT awards a contract to manage the expressway's daily operations and maintenance;
- Several telecommunications and electric power companies wishing to rent right-of-way space along the expressway to install new transmission cables;
- Large trucking firms hoping to benefit from the additional transportation capacity that the expressway provides in a high-demand travel corridor; and
- Distributors of petroleum products who believe that the expressway will help induce more daily motor vehicle miles of travel in the region, which will increase sales of gasoline and diesel fuel.

Tax Subsidies

Built into the federal, state, and local income tax codes are certain cost-saving deductions that are available to taxable private enterprises—but not to individuals or government agencies. These deductions are commonly known as tax subsidies. The two most important are as follows:

- Deductions for annual interest payments on outstanding debt. Unlike the interest payments that an individual makes on his personal credit card debt, all interest payments made by private business firms are fully deductible in determining their taxable income. In MWT's case, the effect is to reduce its out-of-pocket interest costs to levels that can be competitive with interest costs on tax-exempt bonds that the state government might otherwise have had to issue to fund the expressway's construction cost.
- Deductions for annual depreciation of capital plant and equipment. The tax codes allow MWT to depreciate these assets more rapidly for tax purposes than for regular accounting purposes. Since depreciation does not involve any actual cash outlays (as do such deductible costs as employee salaries and payments to outside suppliers), this amounts to a deduction for costs that MWT did not have to cover by writing checks during the tax year. Another way to look at tax depreciation is as a process for recovering invested capital more rapidly.

As a private, profit-seeking enterprise, MWT has income tax liability. But since it is also a limited partnership, this liability is passed along to its partners with the dividends they receive. However, the tax deductions for interest and depreciation are also passed along to the partners. So a significant portion of their dividend income is tax free.

Motor Vehicle Customers

These are the drivers who pay tolls to use the expressway. Electronic toll collection technology enables MWT to charge drivers on a per-mile basis rather than a traditional flat fee. The same technology also lets MWT vary the toll rate throughout the day to reflect actual demand.

The state's transportation planners did something very interesting when they conceived the expressway as a toll road. Instead of blindly seeking to maximize toll revenue by maximizing traffic volume, they decided to have the expressway cater to drivers who place a high value on their time. These drivers (most of whom are making business-related trips) are given the option of paying for faster trips on the expressway because its traffic volume is deliberately kept low enough to ensure a relative high average speed. The mechanism that regulates traffic volume is the toll rate per mile, which fluctuates with demand and effectively prices many drivers off the expressway during high-demand periods. These drivers have the option of using the old expressway, which remains toll free.

Special television cameras and loop detectors continually monitor average traffic speeds on the new expressway. When the new expressway's traffic volume rises to a point where this speed falls below 45 mph, the toll collection system's computer boosts the toll rate—and keeps boosting it to reduce traffic volume until the expressway's average speed moves above 45 mph. During periods of lower demand when the average speed rises above 55 mph, the system's computer reverses this process. It lowers the toll rate in incremental steps to encourage sufficient additional traffic volume for average speed to fall back below 55 mph. Drivers approaching each of the expressway's entrance ramps see the current average speed and toll rate clearly displayed on variable message signs.

In other words, from a purely business perspective, the expressway maximizes its toll revenue by charging the highest price for transportation access that travel demand warrants at different times throughout the day—just as a movie house manager prices his tickets according to demand.

Equally important, the expressway plays a rational transportation role by deliberately restricting itself to serving only "high-priority" trips during periods when travel demand in the corridor is heavy. Drivers themselves determine these trip priorities. They make their own individual judgments about whether the travel time saved by using the expressway at any particular time is worth the posted price. If they decide that the price is too high, they can use the toll-free lanes on the old expressway and put up with slower trips because of heavier traffic volume.

Construction Costs

As the name implies, construction costs are the costs of building the turnpike and equipping it to operate successfully.

Financing Costs

It costs money to raise capital funds. That is why investment banking is one of the most highly paid professions in the United States.

MWT's financing costs include the various underwriting fees paid to place its limited partnership shares through brokerage firms and to issue its long-term bonds, plus the origination fees paid to the consortium of banks that provide the construction loan. Also included are the capitalized debt interest during the construction period and the various reserves that MWT had to establish to underpin its bonds.

Other Income Sources

While toll revenues provide most of MWT's income, it aggressively exploits the expressway's potential to generate other kinds of income, including the following:

- Annual payments from electric power and telecommunications companies that lease right-of-way space along the expressway to install their transmission lines;
- Sales of commercial time to local advertisers on MWT's radio station, whose main purpose is to provide expressway customers with current information about traffic conditions;
- Sales of advertising billboard space on the expressway's variable message signs, which are located at each entrance ramp and at various points along its lanes (as a private roadway that was built without any federal funds, the expressway is not subject to federal regulations covering billboards);
- Fees paid by local towing and emergency automobile repair companies for the right to provide their ser-

vices to the drivers of vehicles that become disabled on the expressway; and

- Interest earnings on MWT's overnight cash balances.

Annual Expenses

Among the annual expenses are the following:

- Operating and maintenance costs. They include the salaries of MWT's employees, payments to outside suppliers, and fees paid to entities like the local toll bridge authority to which MWT contracts certain expressway management responsibilities.
- Depreciation. As noted earlier, MWT (which is a private-sector entity and therefore subject to the accounting standards governing all private firms) allocates a portion of each year's operating revenue to cover annual depreciation of the expressway's capital plant and equipment. This is regarded as a regular operating cost, just like employee salaries, and must therefore be covered by operating income. Funds allocated to depreciation are then transferred to MWT's capital reserve account.
- Other costs. These include the usual variety of miscellaneous costs incurred by all business enterprises.

MWT's Bondholders

Most of MWT's bondholders are life insurance companies, private pension funds, and other large institutional investors. Since a portion of MWT's bonds mature each year, these investors can buy bonds that promise the repayment of their invested funds on schedules that meet their estimated cash needs in the future. Meanwhile, they earn attractive interest income on their funds.

Why Project Financing Works

As MWT's cash flow suggests (Figure 2), the underlying premise of project financing involves a process of deliberately "commercializing" the services that a capital facility is built to provide. This means that these services must be perceived as necessary or desirable by enough customers who are willing to pay a sufficiently high price for them. In MWT's case, most of these customers

		STAGE 1 "CONSTRUCTION" $ MILLIONS	STAGE 1 "CONSTRUCTION" % OF SOURCES	STAGE 2 "REFINANCING" $ MILLIONS	STAGE 2 "REFINANCING" % OF SOURCES	STAGE 3 "OPERATION" (5 YRS.) $ MILLIONS	STAGE 3 "OPERATION" (5 YRS.) % OF SOURCES
1	**SOURCES OF FUNDS**	**$785**	**100%**	**$525**	**100%**	**$1,045**	**100%**
2	**Capital Sources**	**$785**	**100%**	**$525**	**100%**	**$120**	**11%**
3	Partners' Equity	160	20%	—	0%	—	0%
4	Construction Loan	400	51%	—	0%	—	0%
5	Bond Issue A	225	29%	—	0%	—	0%
6	Bond Issue B	—	0%	525	100%	—	0%
7	Depreciation Allowances	—	0%	—	0%	120	11%
8	**Operating Sources**	**—**	**0%**	**—**	**0%**	**$925**	**89%**
9	Toll Revenue	—	0%	—	0%	800	77%
10	Other Income	—	0%	—	0%	125	12%
11	**USES OF FUNDS**	**$785**	**100%**	**$525**	**100%**	**$1,045**	**100%**
12	**Capital Uses**	**$785**	**100%**	**$525**	**100%**	**$480**	**46%**
13	Construction Costs	600	76%	—	0%	—	0%
14	Financing Costs	185	24%	125	24%	—	0%
15	Construction Loan Payment	—	0%	400	76%	—	0%
16	Capital Reserve Increases	—	0%	—	0%	120	11%
17	Bond Principal Payments	—	0%	—	0%	40	4%
18	Partner Dividends	—	0%	—	0%	320	31%
19	**Operating Uses**	**—**	**0%**	**—**	**0%**	**$565**	**54%**
20	Operating Expenses	—	0%	—	0%	450	43%
21	Bond Interest Payments	—	0%	—	0%	90	9%
22	Other Expenses	—	0%	—	0%	25	2%

FIGURE 2 Toll highway limited partnership multistage cash flow illustration.

are drivers seeking to save travel time. Others include various business firms that believe they can profit by paying MWT for the right to use its right-of-way space, to advertise on its radio station and variable message signs, or to pay for the right to provide emergency road services to expressway travelers.

When this perception is achieved, the capital facility is able to generate a sufficiently large and reliable stream of business-type revenue. Lines 8 through 10 under the "Stage 3" heading of Figure 2 show that MWT generated $925 million in business-type revenue by selling its services to drivers and other customers during the first 5 years of the expressway's operation.

"Sufficiently large" means that the revenue stream can comfortably cover 100 percent of the facility's annual economic costs. Not the least of these costs is an adequate return on the equity and debt capital that the facility's owners and bondholders invested to fund its capital costs. Line 18 under Stage 3 shows that MWT paid $320 million in dividends to its partners during the first 5 years of the expressway's operation, while Line 21 shows that it made interest payments of $90 million to its bondholders during this period. These payments were in addition to MWT's $450 million in operating expenses (Line 20), $120 million in depreciation (Line 16), $40 million to retire maturing bonds (Line 17), and $25 million in other expenses (Line 22).

How large a return is adequate depends in part on the reliability of the revenue stream. Low levels of reliability mean greater risk for the investors who supply the capital to build the facility. Greater risk must be offset by a higher return—and vice versa. As the figure indicates, 86 percent of MWT's operating revenue during its first 5 years of operation comes from expressway tolls (Line 9) that rise steadily because increasing travel demand in the corridor results in both growing patronage and growing average daily toll rates.

These Stage 3 cash flows underpin a public-private partnership's ability to raise capital funds for construction by using the project financing approach (Stage 1 in MWT's cash flow figure). The basic principle is that reliable projections of a capital facility's future operating cash flows determine how much capital the partnership can raise and what sources it can tap.

- In MWT's case, it begins Stage 1 by raising $160 million in the form of equity contributions from its partners (Line 3).
- With this equity capital in hand, MWT obtains a $400 million construction loan (Line 4) from a consortium of commercial banks that have considerable experience in making similar loans to private real-estate developers. The basis for the loan is the assumption that MWT will pay it off at the end of the construction period by issuing long-term bonds (just as real-estate developers pay off their construction loans by taking out long-term mortgages on the commercial buildings they develop).
- This provides MWT with $560 million in capital funds. After deducting financing costs, this is enough to cover most of the expressway's construction costs.
- Toward the end of the construction period, MWT makes its first foray into the public debt market by issuing $225 million in bonds. After deducting financing costs, this is enough to complete the expressway and ready it for operations.

When the turnpike is finished, MWT proceeds to Stage 2. This involves refinancing its construction loan. MWT does this by issuing a second round of long-term bonds (Line 6) to raise an additional $525 million. After setting aside $125 million to establish the necessary debt service reserve and cover other financing costs, MWT uses the remaining $400 million to pay off its construction loan.

After completing Stage 2, MWT's capital totals $910 million. This consists of (*a*) $160 million in equity (17.6 percent of total capital) and (*b*) $750 million in long-term debt (82.4 percent), scheduled to mature in back-loaded annual installments over the 25 years of the expressway's expected useful operating life before it will require major capital reconstruction.

Nearly all of this capital is made up of private-sector funds that are supported entirely by MWT's operating income from commercializing its services to drivers and other customers. The only public-sector funds in this mix are the equity contributions made by the state and local governments. These are also supported by MWT's commercial income, not by tax revenues.

Contrasts with Traditional Public Financing

The typical "all-public" approach to building and operating highways and other infrastructure facilities normally avoids any attempt to commercialize the services they provide. Such facilities are supported entirely by the larger community of taxpayers, whose tax dollars provide the funds needed to cover operating and maintenance costs, payments of interest and principal on construction bonds issued by state and local governments, and federal grants.

The standard justification for the all-public approach is that infrastructure facilities provide a complex structure of direct and indirect benefits to the community as a whole, not just to the users of these facilities. These benefits lead to higher levels of economic activity in the community, which translate into higher incomes for individuals and higher profits for business firms. The

dollar value of the benefits to each taxpayer is assumed to be reflected by the size of an individual's income and a business firm's profits. By taxing these incomes and profits on a more or less proportional basis, government is therefore charging individuals and business firms what amounts to a fair annual fee for the benefits they receive.

Figure 3 illustrates the key differences between the all-public and the commercially oriented public-private partnership approaches to building and operating an infrastructure facility. Note that both approaches ultimately rely on a revenue base, which is composed of the individuals and business firms in the community.

- In the all-public approach, these individuals and business firms wear taxpayer hats. The taxes they pay to government are allocated as needed to fund the bonds and grants that provide the capital to build the facility, to cover its annual operating costs, and to support all other public services and facilities.
- In the public-private partnership approach, individuals and business firms wear customer hats. They are charged commercially viable prices for access to the facility. The business-type revenue this produces flows through the partnership and is dedicated exclusively to covering the facility's operating costs and supporting its capital structure.
- In the all-public approach, the operating and capital needs of all government undertakings are commingled and funded from a single revenue source called tax collections.
- In the public-private partnership approach, each infrastructure facility stands alone. It generates its own revenue by charging fees to its customers and is responsible for paying its own costs. There is no commingling of either revenues or costs with various other facilities.

The all-public approach embodies classical public finance theory. This can work quite effectively in certain kinds of societies. In Hong Kong, for example, the government imposes a high public savings rate on Hong Kong's residents and business firms through its tax policies, uses its resulting "operating budget surpluses" to fund the construction of infrastructure facilities on a largely pay-as-you-build basis, and makes expanded infrastructure capacity a key element of its strategy for guiding Hong Kong's metropolitan development in directions that promise greater economic prosperity in the future. This approach is widely accepted in Hong Kong, where it has contributed significantly to a level of per-capita gross domestic product that is one of the highest in the world.

But classical public finance theory appears to have broken down in the United States. Americans find it increasingly difficult to perceive a valid link between

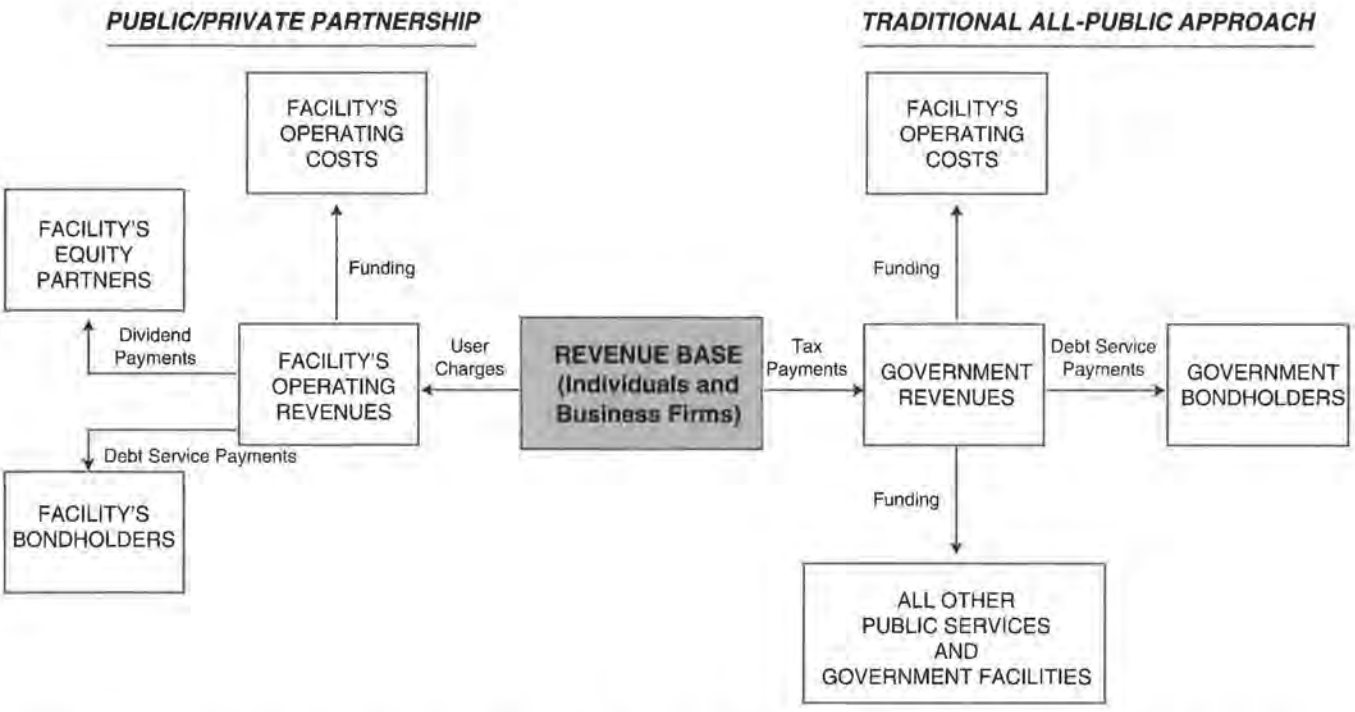

FIGURE 3 Differences between all-public and public-private partnership approaches to building and operating an infrastructure facility.

the value of the benefits they receive from government undertakings and the size of their tax bills. Too often, they suspect that the "other guy" is receiving too large a share of the benefits while they are being saddled with too large a share of the costs.

These suspicions have contributed to a growing national unwillingness to finance new infrastructure projects with taxes. But at the same time, they have increased the perceived attractiveness of user charges like tolls—which are regarded as fairer because only those who actually use a highway or other public facility are required to pay for it.

Conclusion

Now that we have the technology needed to apply what is essentially movie-ticket pricing to our roadway systems, we can significantly improve the way we operate and fund them.

- We can make these systems fully self-supporting by charging fair prices to those who actually use them.
- We can operate them more rationally by varying these prices to reflect demand—on each individual roadway link, at different times of day, and by each class of motor vehicle.
- We can expand their capacity to meet tomorrow's travel needs by creating formal partnerships between business and government to build and operate new roadway links.
- These partnerships can raise the necessary construction funds from a much wider spectrum of capital sources on the strength of the revenue streams generated by motorists and other customers.

We can call this a revolution if we wish—or simply another example of America's natural talent for developing new solutions to new needs. But whatever we call it, the time has come to take it seriously and start putting it to work.