RESOURCE PAPER

Strategies for Measuring Productive Highway Capital Stocks

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The Federal Highway Administration (FHWA) recently released a report describing an 18-month project to construct productive highway capital stocks (*1*). As few researchers will be able to undertake a project of such magnitude and many will not have time to read the full report, this paper summarizes the methodological concepts and techniques needed to measure productive highway capital stocks and outlines two shortcut measurement strategies.

This paper begins by briefly outlining the difference between productive and wealth capital stock. The sidebar on page 74 continues this conceptual discussion with particular reference to efficiency patterns. Next, the perpetual inventory method (PIM) is presented, as both measurement strategies call for its use. The strategies, whose description is the central core of this paper, are based on the findings and analysis in Fraumeni (*1*). The simplest strategy for measuring productive capital stock is described first, followed by a description of a more complicated and more time-consuming strategy. Reasons are given for why and in what circumstances the more complicated strategy should be followed. Either of these strategies can be applied to stock measurement at different administrative or geographic levels, for example, metropolitan, regional, local, state, and interstate. (In this paper, "state" refers to state-administered roads excluding interstates and "local" refers to all roads except for state-administered roads and interstates.) The more complicated strategy allows for the introduction of information specific to the particular project being undertaken. Tables 1–6 (pp. 82–88) list all data from Fraumeni (*1*) that might be needed to pursue the more complicated strategy. Table 7 (p. 89) shows how to calculate productive capital step by step using the information from Tables 2–6. The final topic covered is benchmarking, a necessary component of almost any effort to construct a capital stock. A list of definitions is given in the sidebar on page 72.

PRODUCTIVE VERSUS WEALTH CAPITAL STOCK

This theoretical section is included for two reasons: (*a*) wealth capital stock is the preferred measure in some cases, and (*b*) many researchers who should have used productive capital stock in fact employed wealth capital stock (*1*, pp. 12–19, 32–34).

Productive capital stock is the appropriate concept for estimating the productivity of capital stock or measuring the contribution of capital stock to economic growth. Wealth capital stock is the appropriate measure of the market value of capital and could be used in a balance sheet not using the book value convention. Wealth capital stock estimates give a sense of the future whereas productive capital stocks concentrate on the situation at a certain point in time. Both types of capital stock are adjusted for efficiency decline or the decline in the potential productive services of an asset still in use as it ages. Productive capital stock is adjusted for current and past declines in efficiency. Wealth capital stock in addition is adjusted for future declines in efficiency. Aside from a discount rate needed in the calculation of wealth capital stocks, the information needed to calculate the two different types of capital stock is identical. As a con-

DEFINITIONS

Capital is a durable asset. The convention is that any asset expected to last at least one year is called capital, and if an asset is expected to last less than one year it is termed a consumption good.

Capital outlay is a synonym for investment (see definition below).

Capital stock is a measure of how much capital you have at a particular point of time, for example, December 31, 1997.

Depreciation is the change in the value of an asset associated with aging.

Deterioration is the decline in the potential productive services of an asset as it ages. Deterioration includes the effects of efficiency decline or decay and retirements.

Economic life is the number of years that the benefits from an asset are at least as great as the cost of keeping the asset in service.

Efficiency decline is the decline in the potential productive services of an asset still in service as it ages.

Efficiency pattern, profile, or curve is the pattern, profile, or curve showing an asset's potential productive services as it ages. They reflect the efficiency decline of an asset still in service. Pattern, profile, and curve are synonyms.

Geometric deterioration. With this, the rate of deterioration is constant in every period. The rate of deterioration, δ, is as follows: $\delta = R/T$, where R is the estimated declining balance rate and T is the average service life of the asset. With geometric deterioration, the rate of deterioration is equal to the rate of depreciation.

Investment, a flow measure, is the addition to the capital stock over a particular time period, for example, from January 1, 1997, through December 31, 1997. Investment is a synonym for capital outlay.

Net capital stock is the sum of capital outlay minus deterioration (productive concept) or the sum of capital outlay minus depreciation (wealth concept).

One-hoss-shay. With this, there is zero deterioration until the asset is retired.

Perpetual inventory method. Under this method, capital stock is estimated by summing up capital outlay to produce gross capital stock or by summing up capital outlay and reducing the resulting total by an estimate of asset deterioration to produce net capital stock.

Productive capital stock is the capital stock that has been adjusted for the effects of deterioration, for example, efficiency decline and retirements. Productive capital stock is a net capital concept.

Retirements are assets withdrawn from service.

Service life is the number of years that an asset is kept in service or in use.

Wealth capital stock is the capital stock evaluated at its market value.

NOTE: Several of the definitions come from J. E. Triplett's Concepts of Capital for Production Accounts and for Wealth Accounts: The Implications for Statistical Programs, a paper presented at the International Conference on Capital Stock Statistics, Canberra, Australia, March 10-14, 1997. Others come from *System of National Accounts, 1993,* Commission of the European Communities, International Monetary Fund, Organization for Economic Co-operation and Development, United Nations, and World Bank, in Brussels, Luxembourg, Paris, New York, and Washington, D.C., 1993. The remainder are the sole responsibility of the author.

sequence, although this paper does not describe how to construct wealth capital stocks, all of the required input to such a calculation except for the discount rate is given in Tables 1–6.

Economists favor the lightbulb example to explain the difference between the two types of capital stocks. Assume a lightbulb is capable of shining for 12 months. At any point in time over that 12 months, until the bulb stops shining, it is 100 percent productive, as the intensity of light is constant. If one sold the lightbulb after 6 months of use, however, a rational buyer would only be willing to pay approximately half of the original purchase price. In stock measurement, at the 6-month point, a productive capital stock of the lightbulbs is approximately double the wealth capital stock.

The sidebar on page 74 continues this conceptual discussion with particular reference to efficiency patterns. Included is a discussion of the difference between an efficiency pattern for one asset versus a group of assets and the difference between productive capital stock and wealth capital stock under different deterioration assumptions.

Perpetual Inventory Method

Under the perpetual inventory method, capital stock is estimated by summing up investment and reducing the resulting total by an estimate of asset deterioration to produce net capital stock. [The terms "investment," "capital outlay," and "capital expenditures" are synonyms. "Capital outlay" is the term used in *Highway Statistics* (*2*), so it is used subsequently in this paper.] Under the simplifying assumption of a constant (geometric) rate of deterioration, δ, the general equation for the PIM is

$$\text{Capital stock}_{\text{year}} = \text{capital outlay}_{\text{year}} + (1 - \delta)\ \text{capital stock}_{\text{year}-1}$$

where "year" is the current year and "year – 1" is the previous year. Deterioration is the decline in the potential productive services of an asset as it ages. It includes the effects of efficiency decline and retirements. Retirements are assets withdrawn from service. The notion of retirements for highways is somewhat different from that for many other assets, as highways are not typically withdrawn from service or thrown away, rather components of them undergo major treatments. Pavement "retirement" occurs when a major treatment such as reconstruction, restoration, and rehabilitation or a major (not light) resurfacing is undertaken.

As information on capital outlays is typically available at best beginning in 1921 and frequently not until the post-World War II era, the use of PIM also requires a benchmark or starting point for the calculations. Benchmarks are discussed in a later section.

Capital stocks should be generated in real or constant dollars so that comparisons can be made across time. The easiest methodology is to deflate capital outlay before it enters into the PIM equation. Appropriate highway capital outlay deflators are available from the Bureau of Economic Analysis (BEA) on a computer disk (*3*) or in a printed volume (*4*). The BEA deflators used in Fraumeni (*1*) are listed in Table 6 (p. 88).

Simplest Approach to the Measurement of Productive Capital Stock

The simplest approach to the measurement of productive capital stock is to use the geometric rate of depreciation from the forthcoming BEA fixed capital benchmark study. The convention of using the term "deterioration" in conjunction with productive capital stocks and the term "depreciation" in conjunction with wealth capital stocks is followed in this paper. Depreciation is defined as the change in the value of an asset associated with aging.

Although BEA estimates wealth capital stocks, wealth stocks are identical to productive capital stocks when a geometric rate of depreciation is used. With a geometric rate, the rate of depreciation is equal to the rate of deterioration; therefore the stocks are equal to each other (*5,6*). If this simplest strategy is used, only total capital outlay on highways is needed, as well as a benchmark and a deflator.

The new BEA geometric rate of depreciation, which is equal to the rate of deterioration δ in the capital stock formula, is .0202. This rate is calculated from the formula $\delta = R/T$, where R (= .91) is the declining balance rate for structures and T is the service life (= 45) (*7*). The geometric rate of depreciation is being revised upward because two studies—the Fraumeni FHWA study (*1*) and a recent study by Beemiller of BEA (*8*)—concluded that the average service life for highways, including all components of a highway, is substantially lower than that previously used by BEA (*9*). If an asset's service life is lower than previously thought, then it also must be true that the asset "wears out" (declines in efficiency) at a faster rate than previously thought.

The result of the higher rate of depreciation/lower service life will be to bring the post-benchmark BEA highway capital stocks into closer alignment with the Fraumeni highway capital stocks. Figure 1 shows the current BEA highway capital stock versus the Fraumeni estimates of the same. Although differences will remain between the two series, following BEA's methodology is a defensible and simple strategy to approximate productive highway capital stocks at the national or subnational level. Although a rough estimate of the revised BEA stocks was calculated, an exact comparison of the

EFFICIENCY PATTERNS

A lightbulb is a special case of an asset as it follows what is called a "one-hoss-shay" pattern of decline in efficiency. Unlike a lightbulb, most assets decline at least somewhat in efficiency—for example, light intensity in the lightbulb case—before the end of their useful life.

It is important to think about the case of a group or sample of assets, because even a small town has more than one road. Looking at a sample of assets gives you a different picture than looking at one asset. The efficiency profile for a group of assets differs from the efficiency profile for one asset whenever assets "retired" (in this case, the lightbulb burns out) at different points of time.

With 20 lightbulbs, suppose that the lightbulbs burn out according to Table S-1.

One lightbulb declines in efficiency according to the one-hoss-shay pattern, as shown in Figure S-1, but the efficiency decline of the group of lightbulbs diverges from the one-hoss-shay pattern. This example could be complicated even further by looking at assets of different vintages, for example, capital outlays made in different years.

The difference between productive and wealth capital stocks depends upon the pattern of how assets decline in efficiency or are retired over time. The difference between measured productive and wealth capital stocks is greatest when assets decline in efficiency according to a one-hoss-shay pattern and all assets are retired at the same age. Introducing different retirement ages and different patterns of deterioration reduces the differences in the measures. With a geometric rate of deterioration, assets deteriorate at a constant rate. With a geometric rate, the difference between estimates of productive capital stocks and wealth capital stocks is the least; in fact, productive and wealth capital stocks are identical.

There are a variety of deterioration patterns in the Fraumeni (*1*) productive capital stocks. Grading is most closely approximated by a one-hoss-shay pattern. Pavement follows a pattern that is not one-hoss-shay, varying from reasonably close to a one-hoss-shay pattern to clearly substantially different from a one-hoss-shay pattern, for example, interstates versus local roads. Structure deterioration is approximated by a geometric pattern following the Bureau of Economic Analysis, as very little is known about structures.

TABLE S-1 Example of Lightbulbs Burning Out, in Total of 20

Age of Lightbulb in Months	*Number Burned Out by Month*	*Number Remaining by Month*
0	0	20
1	0	20
2	0	20
3	0	20
4	0	20
5	0	20
6	0	20
7	0	20
8	0	20
9	1	19
10	2	17
11	3	14
12	8	6
13	3	3
14	2	1
15	1	0

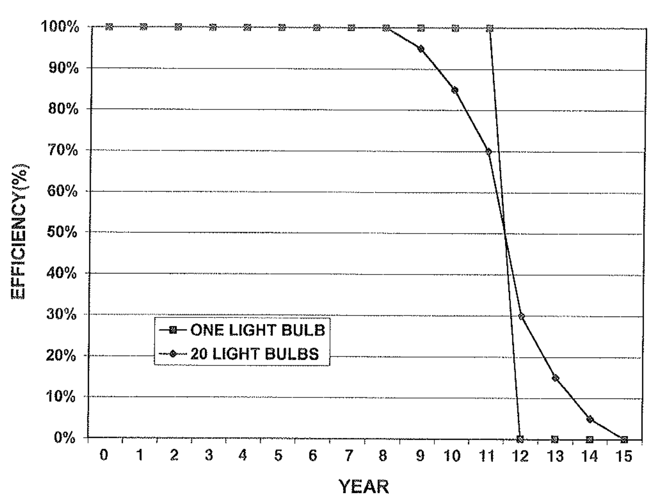

FIGURE S-1 Efficiency of one lightbulb versus 20 lightbulbs.

two series awaits the generation of the new benchmark BEA series.

A More Complicated Approach

A more complicated approach to the measurement of productive highway capital stocks is to use detailed results of Fraumeni (*1*). In order to do this, one needs to separate capital outlay by administrative level—interstate, state (i.e., noninterstate), and local (all other highways)—and by component—right-of-way, grading, pavement, and structures (*1*, pp. 69–71, 73–74). In addition, capital outlay should be separated into new construction and reconstruction versus all other ("other" refers to other than new construction and reconstruction capital outlay) (*1*, p. 72).

One tactic in the absence of information at this level of detail is to employ Table 4 information. For example, if the percentage split between new construction and reconstruction and other is unknown, the Table 4 splits can be used.

Given the substantial additional detail required to implement this strategy, it makes sense to ask, "Why bother?" The simplest approach previously described does not necessarily reflect the changing composition of capital outlay even at the national level. There are at least two sources of changes in the composition of capital outlay. One is the changing distribution of capital outlay among interstate, state, and local administrative levels; Figure 2 shows the changing percentage of interstate, state, and local capital stock for selected years. The second is the changing distribution of capital outlay between new construction and reconstruction versus other capital outlay; Figure 3 shows how the percentage of new construction and reconstruction capital outlay varies across time and by administrative level. Table 3 documents how the distribution of pavement, grading, and structures components of highways differs significantly between new construction and reconstruction versus other. The Table 3 numbers are generated from numbers underlying the 1997 Cost Allocation Study (found in unpublished worksheets by Arthur Jacoby). These 1997 numbers are given in Fraumeni (*1*, p. 73).

Figure 3 and Table 3 both demonstrate the importance of attempting to identify capital outlay for new construction and reconstruction versus other. If the composition of capital outlay changes, then the service life and the deterioration profile of the resulting aggregate capital stock will change. As noted previously, in the geometric case, the rate of deterioration δ, which is equal to the rate of depreciation, is equal to R/T, where R is the declining balance rate and T is the service life. Therefore, when the service life changes, the deterioration rate and the deterioration profile of the capital stock change.

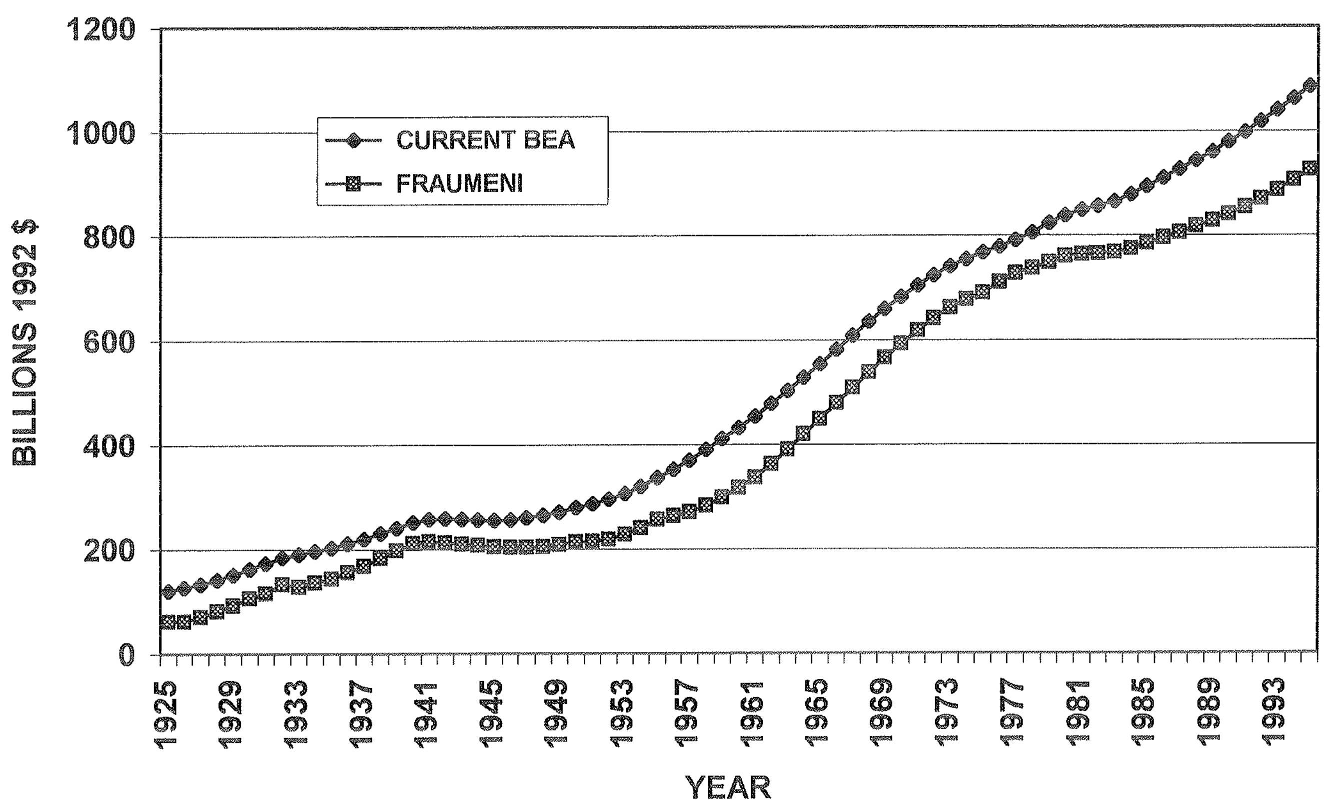

FIGURE 1 Fraumeni vs. current BEA capital stock, 1925–95.

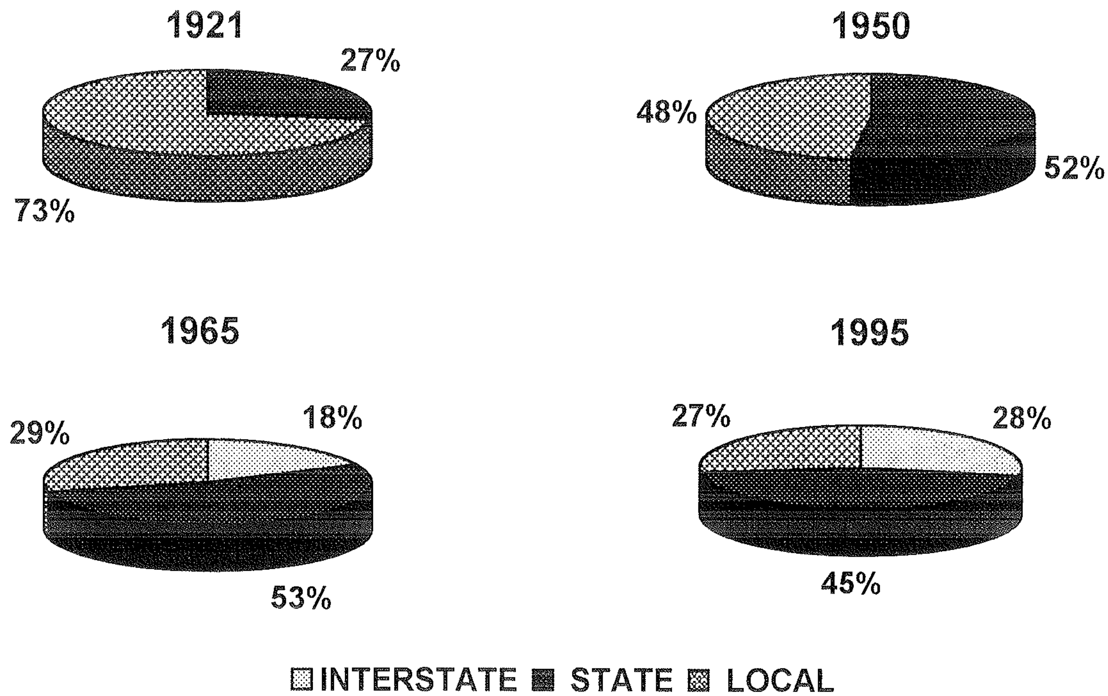

FIGURE 2 Type of capital split—interstate, state, and local.

In addition, the use of the BEA national geometric rate of deterioration in constructing capital stock for subnational units will not reflect significant differences among subnational regions and the nation in the composition of capital outlay and the resulting capital stock. Subnational regions can have different types of highways. For example, primarily rural states have relatively more miles of rural roads compared to primarily urban/suburban states.

Even within the more complicated approach, there are various levels of complexity. As noted earlier, a researcher can insert specific information about the particular highway stock being estimated or use all of the percentage splits and efficiency profiles from Fraumeni (*1*) given in Tables 1–6—or a strategy in between.

For example, if a researcher knows something about the composition of capital outlay by administrative level, this information can be used in combination with the percentage split between new construction and reconstruction versus other capital outlay from Fraumeni (*1*). This section, in conjunction with Table 7, is a guide to the use of the more complicated strategy. Table 7 uses the example of a $1,000 capital outlay in 1960 to demonstrate the use of the Fraumeni results (*1*) with the Tables 2–6 spreadsheet data as inputs. Clearly, the use of the more complicated approach depends upon the research effort that can be expended and whether anything is specifically known about the productive capital stock being measured.

The exposition of the more complicated strategy follows the order of the Tables 2–6 spreadsheet tables. Table 1 lists the contents of Tables 2–6.

Table 2: Percentage Right-of-Way Is of Capital Outlay

It is useful to split expenditures for right-of-way (ROW) from other types of capital outlay because ROW does not deteriorate—either you have it or you do not (*1*, pp. 70–71). ROW expenditures are added directly to the productive capital stock and remain at their full value forever. The spreadsheet data in Table 2 show that ROW expenditures as a percentage of capital outlays including ROW have varied over time and by administrative level. The capital outlay weighted average reflects the distribution of capital outlay by administrative level at the national level and may or may not be appropriate to use for particular subaggregates.

Table 3: Percentage Split of Capital Outlay Less ROW Among Pavement, Grading, and Structures

As the three major components of a highway have different deterioration patterns, it is important if possible to identify the different types of capital outlays (*1*, pp. 73–75). In Fraumeni (*1*), pavement, which represents the largest capital outlay category, is deteriorated according to efficiency profiles developed from American Asso-

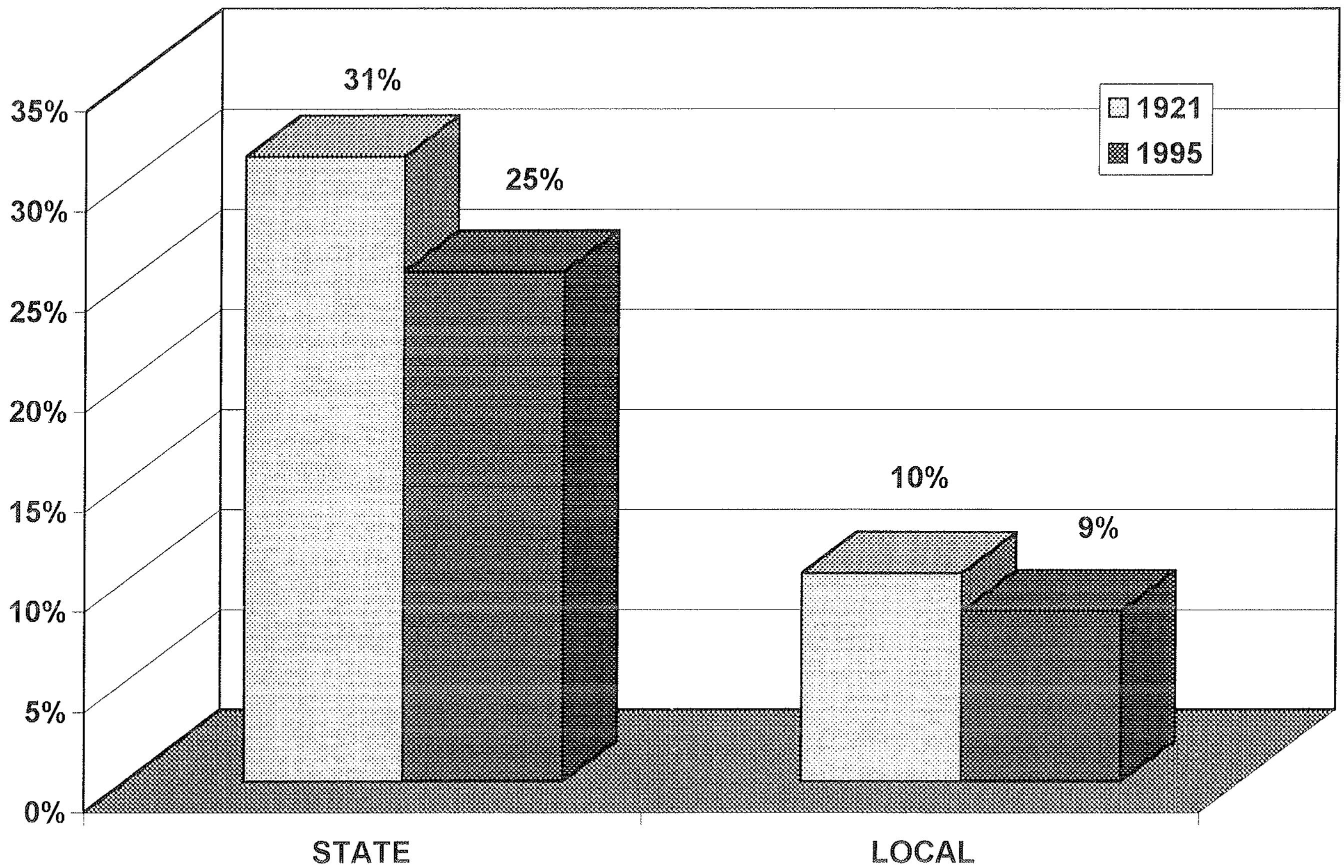

FIGURE 3 **Percentage new construction and reconstruction is of total capital outlays.**

ciation of State Highway and Transportation Officials pavement deterioration curves adjusted for time cost and operating cost (*1*, pp. 77–84). The service life of pavement is 20 years. Grading is deteriorated according to a one-hoss-shay pattern, with an assumed life of 80 years (*1*, pp. 25, 27, 46, 73–75, 82–83). This means that any capital outlay for grading made after 1915 enter the productive capital stock in the same way that ROW enters the productive capital stock, as the capital outlay is not retired until after 1995. These expenditures are added directly to the productive capital stock and remain at their full value for 80 years. Structures, which are mainly bridges, are assumed to deteriorate at a geometric rate of .0182 (*1*, pp. 46–47, 82–84). This rate is calculated from the formula $\delta = R/T$, where R (= .91) is the declining balance rate for structures and T is the service life (= 50), as the service life for most government buildings is 50 years (*7*). It was determined that highway structures are more comparable to government buildings than to any other type of asset covered by BEA.

As would be expected, the percentage of capital outlays, less ROW, for grading and structures is higher for new construction and reconstruction than for other. Accordingly, the percentage of capital outlays, less ROW, for pavement is lower for new construction and reconstruction than for other.

In spite of the fact that retirement patterns can significantly affect the efficiency pattern of a group of assets, as demonstrated in the sidebar on Page 77, it is assumed that all grading and pavement are retired at the same time as nothing is known about actual retirement patterns. A differential retirement pattern already is subsumed into a geometric rate of deterioration, so it is not assumed that all structures have the same service life.

A simple arithmetic average across the three administrative levels is included in the Table 3 spreadsheet for the percentage split of capital outlay less ROW among pavement, grading, and structures. Simple averages are used in the spreadsheets instead of capital outlay weighted averages when the information is reasonably similar across aggregated categories.

Table 4: Percentage of Capital Outlay Including ROW That Is New Construction or Reconstruction

As the percentage split of capital outlay among pavement, grading, and structures is different for new construction and reconstruction versus other, to fully capitalize on the information in the previous category, capital outlay must be split between new construction or reconstruction and other. As the new construction or reconstruction versus other percentages by administrative level are quite different, a capital outlay weighted average is given in the Table 4 spreadsheet (*1*, pp. 27, 42–45, 72).

Table 5: Pavement Efficiency Profiles

As capital outlay on pavements is the largest capital outlay component, a significant amount of time was spent in the development of the pavement efficiency profiles (*1*, pp. 77–82, 118–128). An efficiency profile is constructed for each of four initial capital outlay years—1921, 1941, 1961, and 1981—for state and local. There are only two initial years for interstates—1958 and 1978—as construction of the interstate system did not begin until 1956. For intermediate years, the prior initial year is used; for example, capital outlays made in 1921–1940 all use the 1921 initial-year deficiency profile. Figure 4 shows that there is a significant difference between the curves by administrative level. Figures 5 through 8 show the curves by administrative level by initial capital outlay year. A comparison of Figure 7 to Figure 8 demonstrates that axes' scale can significantly impact on the perception of similarity of curves. Figures 5 through 8 demonstrate that it is reasonable to use a simple arithmetic average to construct efficiencies by administrative level that could be used for any initial capital outlay year.

Table 6: BEA Capital Outlay Deflators

Current dollar or nominal capital outlay should be deflated by the BEA capital outlay/investment deflators as only constant dollar capital outlay and capital stocks can be compared across time. BEA deflators are available in Table 6 and in the downloadable website version. More recent versions of these deflators are available from the sources cited earlier.

BENCHMARKS

Even if capital outlay is available from 1921, as was true in the Fraumeni study (*1*), a benchmark is needed. Some parts of long-lived components of highways, such as grading, put in place during the 1920s are probably still

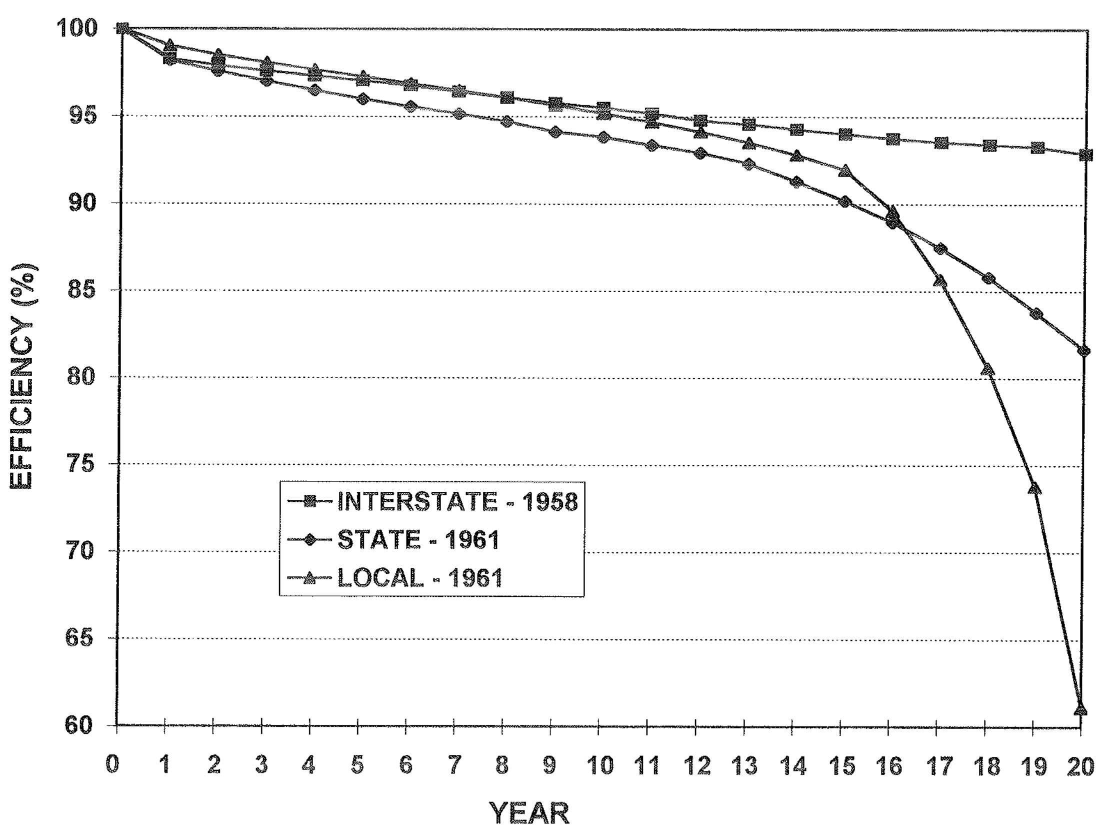

FIGURE 4 Efficiency curves.

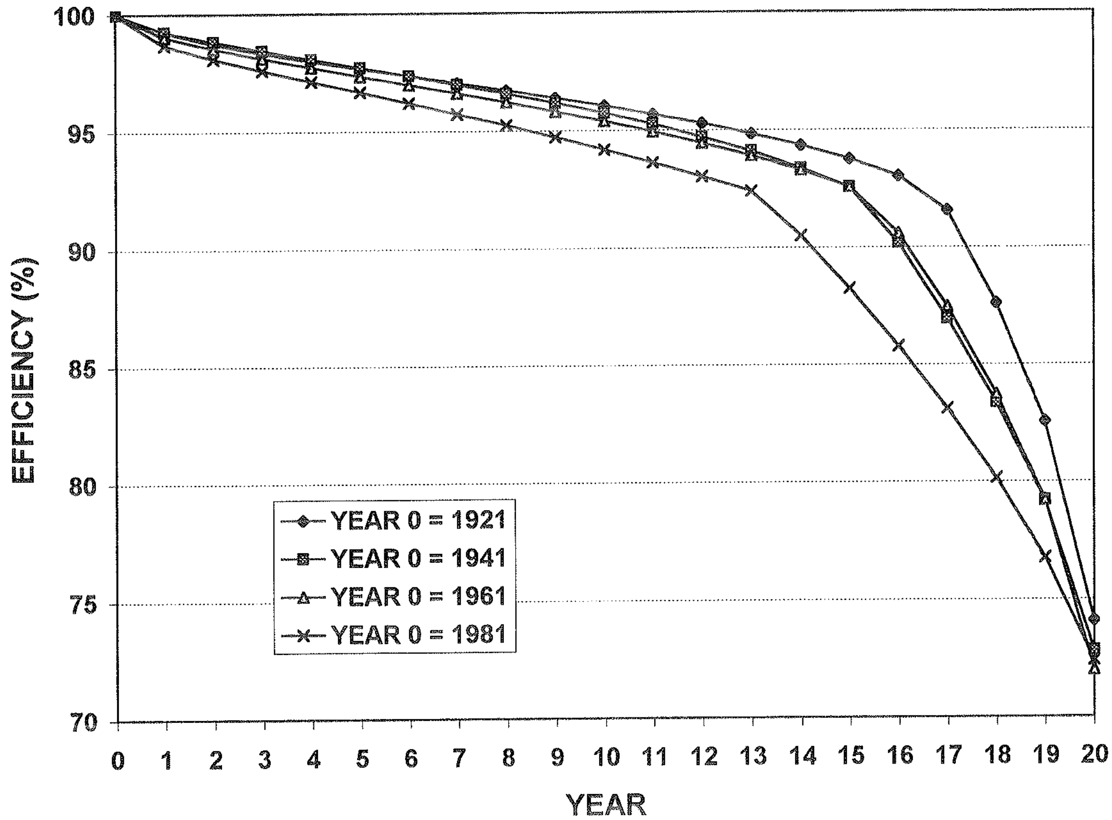

FIGURE 5 Local efficiency curves.

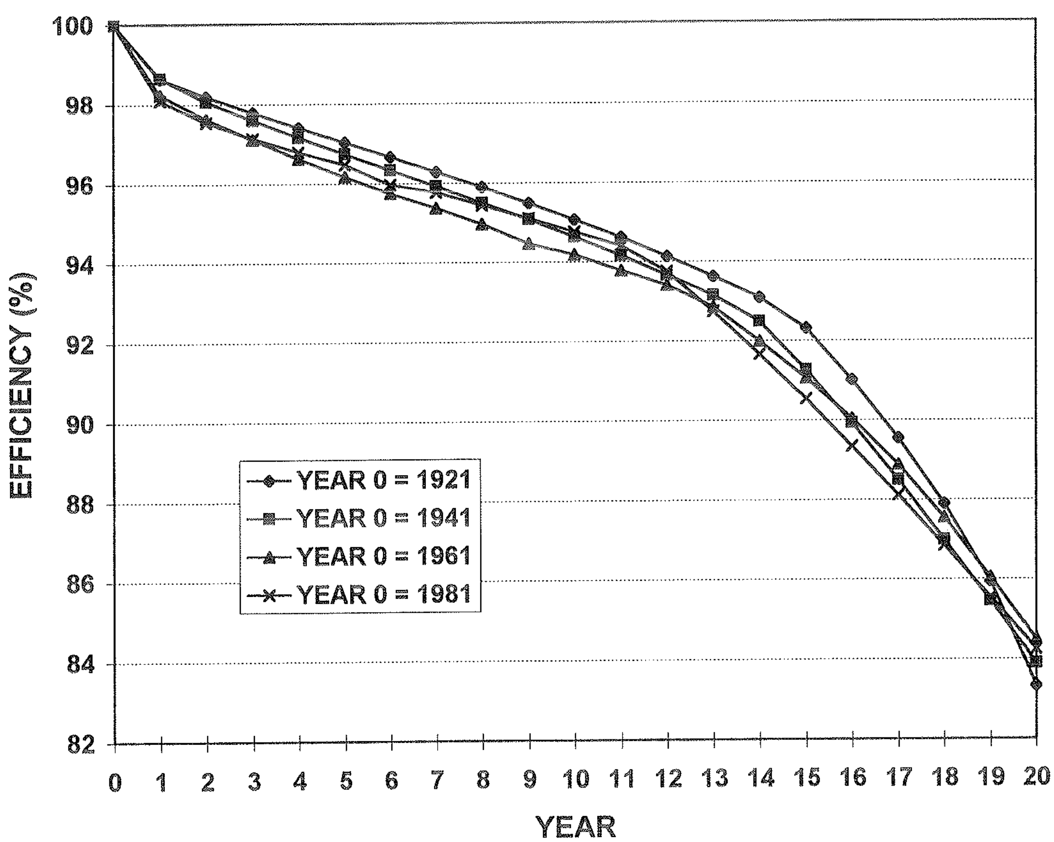

FIGURE 6 State efficiency curves.

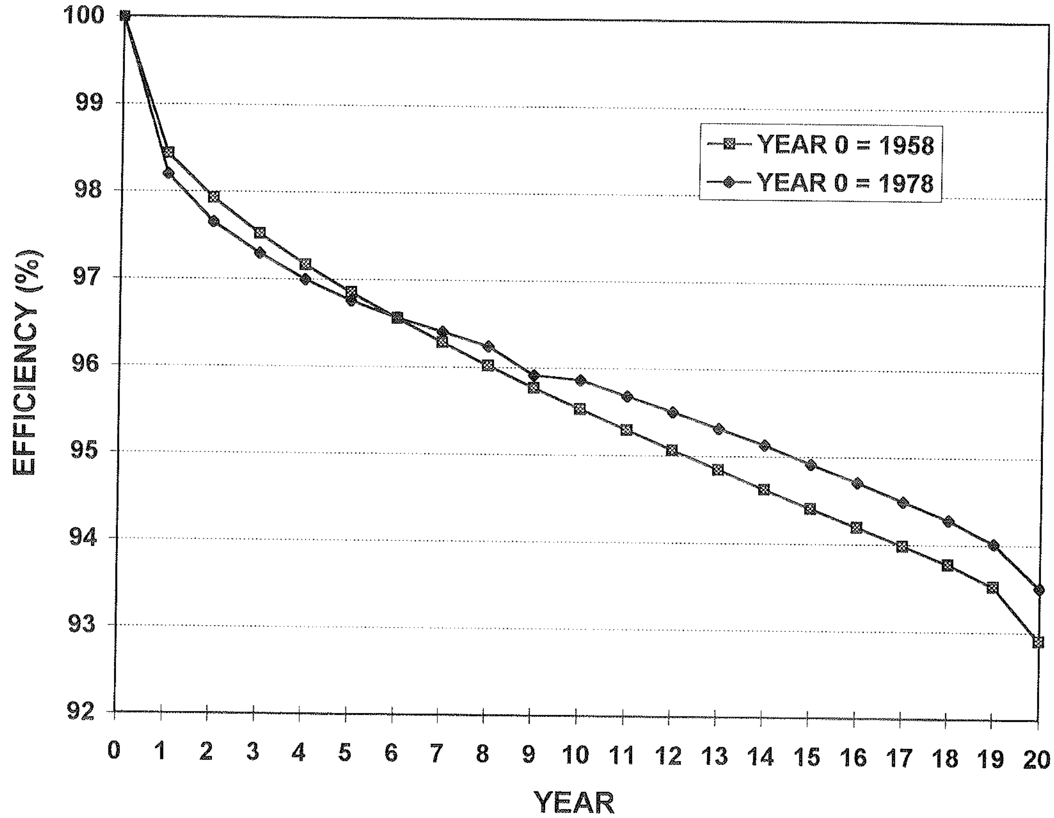

FIGURE 7 Interstate efficiency curves.

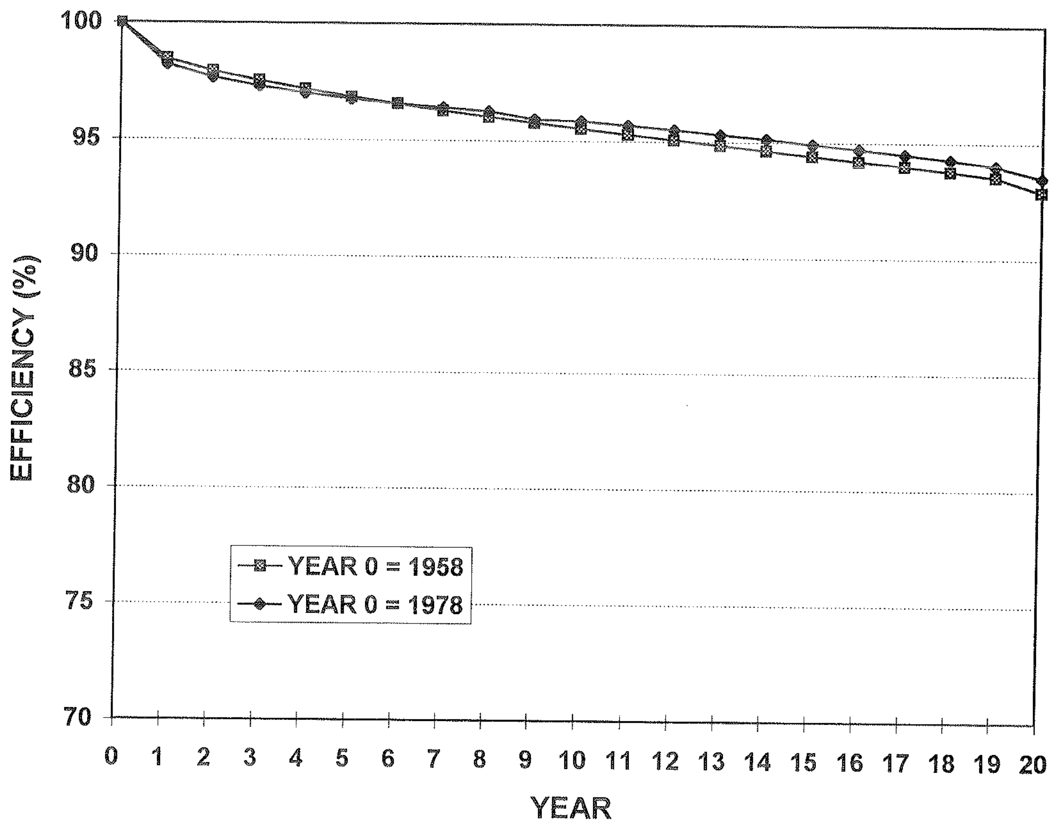

FIGURE 8 Interstate efficiency curves.

a productive part of highways during the post-World War II period. Figures in Fraumeni (*10*) show how the lack of a benchmark in 1931 significantly affects productive capital stock estimates even until the 1990s.

If national estimates are being calculated, then benchmarks can be directly lifted from the Fraumeni study (*1*). For an example, if capital outlay is available from 1958, the constant dollar U.S. capital stock benchmark is $270.799 billion (this number comes from the downloadable data set at www.fhwa.dot.gov/reports/phcsm/index.htm).

This and any benchmark stock deteriorate in years subsequent to 1958, its year of use, so a decision needs to be made about how to handle this. The easiest way to deal with benchmark deterioration is to employ a geometric rate for the benchmark stock. However, if the object is to construct national estimates, the Fraumeni (*1*) estimates could be used directly, so the relevant question is the benchmark strategy for subnational levels.

Several individuals have given considerable thought to benchmarking capital stocks (*1*, pp. 12–15, 23–26, 32–34, 75–76). Unfortunately, all strategies to estimate benchmarks have some problems.

An equivalent to Munnell's (*11*) public capital technique is to construct a pseudo highway capital stock starting with a zero benchmark for all states (or some mutually inclusive regional subdivision), then to scale all stocks to the Fraumeni (*1*) totals. Munnell and Holtz-Eakin (*12*) used BEA wealth stock as the relevant control total instead of a productive capital stock. The BEA wealth stock that they used differed from a productive capital stock as it was an earlier version of the BEA stock.

Holtz-Eakin (*12*) criticizes the Munnell approach for not being sensitive to differences in growth rates across states. Holtz-Eakin makes several points, including that states that grow faster than the national average will have final estimated capital stocks biased upward and vice versa for states that grow slower than the national average. In addition, he notes that the growth in capital stocks may differ between the period during which capital outlays are available and earlier periods, which would result in mis-estimation of the stocks.

An equivalent to Holtz-Eakin's public capital technique (*13*) is to construct a benchmark by divvying up the Fraumeni stock (*1*) according to expenditure shares. A pseudo stock would then be constructed and a geometric deterioration rate picked such that aggregate capital stock equaled the Fraumeni totals (*1*) in a given year, for example, 1985 following Holtz-Eakin. The resulting stock would not be systematically biased, but it still may not represent the actual level of capital stock.

Bell and McGuire (*14,15*) and Dalenberg and Eberts (*16*) explored a variety of benchmark techniques for both public and private capital. For public capital, the average of the ratio of state expenditure to U.S. expenditure was used to apportion national stocks to states to create the pseudo stocks beginning in 1977. Then, an imputed geometric deterioration rate was calculated from the implied initial year and final year benchmark. A benchmark was not used for their highway series beginning in 1931. The Bell and McGuire discussion (*15*, pp. 48–59) of benchmarking for private capital stock is of some interest because it comments on the appropriateness of a variety of techniques that might be used. For private capital stocks they constructed two variants of private capital stock, one using employment as allocators and the other using gross state product less indirect business taxes as allocators.

Garcia-Mila and McGuire (*17*) benchmarked their state estimates by allocating the total U.S. highway capital stock to states on the basis of a state's share of U.S. highway mileage. Although this appears to be an attractive assumption, it implies that all roads are equally productive, the share of different types of highways is the same across all states, and/or the efficiency pattern of all highway components is one-hoss-shay. Allocating the total U.S. highway capital stocks to states on the basis of a state's share of U.S. highway mileage by administrative level would be a significant improvement. The mileage data in *Highway Statistics* (*2*), Table HM-20, could be used to construct such a benchmark.

Whereas no method is optimal or even clearly the best, several summary comments are in order. First, a somewhat defensible benchmark is preferred to no, or a zero, benchmark. The benchmark procedures described above all seem defensible on at least one basis. Second, as the current BEA stocks can be used as productive or wealth stocks, they are an appropriate control total. Finally, adoption of the BEA geometric rate seems preferable to allowing the benchmark procedure to determine the geometric rate.

Numerical Example

Table 7 gives a numerical example of a $1,000 capital outlay in 1960. The information in the Tables 2–6 spreadsheets is the only input to the calculations. As the capital outlay is a one-time event, the constant dollar capital stock declines in size over time. This example is intended to serve as a blueprint for researchers attempting the more complicated approach.

In the numerical example, the column titles give the formula for the calculation of the numerical entry, a specific table location, the value of any data taken from the tables, and the location of any numerical entry in Table 7 used in the calculation. The split of the $1,000 current dollar capital outlay among administrative levels is calculated from the actual distribution of capital outlays in

1960. The numerical example has three sections: capital outlay, detailed capital stock in constant 1992 dollars, and total productive capital stock in constant 1992 dollars. The capital outlay section shows how to calculate capital outlay by administrative level (local, state, and interstate), by component type (ROW, pavement, grading, and structures), and by new construction and reconstruction, and other. In addition, it lists the deflators used to deflate current dollars to constant dollars and documents the methodology used in all subsequent current dollar to constant dollar transformations. Current dollar capital outlays also are deflated to constant 1992 dollar capital outlays. In the next section, the constant 1992 dollar capital outlays are used to calculate capital stocks by the same administrative levels and component types. Finally, in the last section, these capital stocks are summed to create total capital stock by administrative level and across all administrative levels.

Conclusion

Estimation of a productive highway capital stock is the first step toward assessing the contribution of highways to productivity and economic growth. However, research studies assume capital stock is an appropriate proxy for capital input or the actual benefits arising from highways. The problem of doing so is illustrated by the existence of highways leading to ghost towns as well as the potentially significant impact of highway networks. To understand a highway's contribution, the analyst needs to calculate capital input that reflects who uses the highway, where and how fast they are going, and what they are transporting. The measurement of highway capital input is the next step that needs to be taken in the attempts to accurately measure the contribution of highways.

The recent guidelines issued by the Government Accounting Standards Board (GASB) call for the construction of balance sheets for state and local government assets. As this could be a substantial undertaking, research in the area of public capital stock measurement probably will accelerate as a result of GASB's recent actions.

Hopefully this paper will demystify and simplify efforts to estimate highway capital stock, whether these stocks are needed for general economic research or to conform to GASB guidelines.

TABLE 1 Spreadsheet Data Available in Tables 2–6

Table 2: Percentage ROW is of capital outlay
- a. Local, 1921–1995
- b. State, 1921–1995
- c. Interstate, 1956–1995
- d. Capital outlay weighted average, 1921–1995

Table 3: Percentage split of capital outlay less ROW among pavement, grading, and structures
- a. Local
  - 1) Other than new construction or reconstruction
  - 2) New construction or reconstruction
- b. State
  - 1) Other than new construction or reconstruction
  - 2) New construction or reconstruction
- c. Interstate
  - 1) Other than new construction or reconstruction
  - 2) New construction or reconstruction
- d. Capital outlay weighted average
  - 1) Other than new construction or reconstruction
  - 2) New construction or reconstruction
- e. Simple average
  - 1) Other than new construction or reconstruction
  - 2) New construction or reconstruction

Table 4: Percentage of capital outlay including ROW that is new construction or reconstruction
- a. Local, 1921–1995
- b. State, 1921–1995
- c. Interstate, 1956–1995
- d. Capital outlay weighted average

Table 5: Pavement efficiency profiles
- a. Local
  - 1) Initial year = 1921
  - 2) Initial year = 1941
  - 3) Initial year = 1961
  - 4) Initial year = 1981
  - 5) Simple average
- b. State
  - 1) Initial year = 1921
  - 2) Initial year = 1941
  - 3) Initial year = 1961
  - 4) Initial year = 1981
  - 5) Simple average
- c. Interstate
  - 1) Initial year = 1958
  - 2) Initial year = 1978
  - 3) Simple average

Table 6: BEA capital outlay deflators
- a. Federal, 1956–1995
- b. State and local, 1921–1995

TABLE 2 ROW as Percentage of Capital Outlay Including ROW, 1921–95 (*1*)

				Capital Outlay: Current $			ROW as Percentage of Capital Outlay:
Year	*Local*	*State*	*Interstate*	*Local*	*State*	*Interstate*	*Weighted Average*
1921	0.049	0.133		530	301		0.079
1922	0.050	0.132		545	287		0.078
1923	0.049	0.132		470	280		0.080
1924	0.050	0.133		545	398		0.085
1925	0.050	0.131		626	404		0.082
1926	0.050	0.131		643	366		0.079
1927	0.050	0.131		746	419		0.079
1928	0.049	0.133		731	558		0.085
1929	0.049	0.132		692	575		0.087
1930	0.001	0.132		781	729		0.064
1931	0.000	0.133		605	798		0.076
1932	0.000	0.133		385	572		0.080
1933	0.001	0.132		304	532		0.084
1934	0.001	0.133		533	594		0.070
1935	0.007	0.131		419	449		0.071
1936	0.006	0.132		856	667		0.061
1937	0.015	0.133		725	601		0.069
1938	0.009	0.132		1062	582		0.053
1939	0.010	0.132		932	585		0.057
1940	0.019	0.132		796	636		0.069
1941	0.015	0.132		551	584		0.075
1942	0.018	0.133		333	429		0.083
1943	0.031	0.133		136	270		0.099
1944	0.038	0.133		131	211		0.097
1945	0.035	0.131		140	213		0.093
1946	0.035	0.132		270	508		0.098
1947	0.043	0.133		482	896		0.101
1948	0.050	0.132		592	1156		0.105
1949	0.053	0.132		708	1378		0.105
1950	0.066	0.132		686	1556		0.112
1951	0.052	0.132		710	1764		0.109
1952	0.044	0.132		857	1967		0.105
1953	0.049	0.132		955	2296		0.108
1954	0.065	0.132		1015	3020		0.115
1955	0.073	0.132		1092	3164		0.117
1956	0.072	0.138	0.130	1203	2443	1282	0.120
1957	0.070	0.126	0.164	1285	2485	1754	0.125
1958	0.073	0.101	0.198	1418	2773	2022	0.126
1959	0.063	0.121	0.197	1392	2736	2426	0.137
1960	0.061	0.135	0.191	1370	2555	2224	0.139
1961	0.060	0.133	0.198	1439	2761	2461	0.141
1962	0.059	0.128	0.198	1483	2987	2752	0.141
1963	0.063	0.117	0.166	1526	3111	3063	0.126
1964	0.059	0.128	0.172	1591	3040	3438	0.133
1965	0.065	0.129	0.182	1692	3038	3461	0.138
1966	0.063	0.147	0.176	1888	3384	3718	0.141
1967	0.071	0.141	0.161	2019	3555	3835	0.134
1968	0.073	0.148	0.144	2181	3924	4000	0.130
1969	0.062	0.145	0.143	2233	4182	3742	0.126

(continued)

TABLE 2 *Continued*

Year	*Local*	*State*	*Interstate*	*Capital Outlay: Current $* *Local*	*State*	*Interstate*	*ROW as Percentage of Capital Outlay: Weighted Average*
1970	0.055	0.125	0.139	2419	4864	4033	0.115
1971	0.049	0.121	0.110	2567	5264	4182	0.102
1972	0.049	0.135	0.104	2534	5132	4303	0.105
1973	0.050	0.128	0.105	2875	5103	3910	0.102
1974	0.047	0.110	0.085	3412	5689	3736	0.086
1975	0.030	0.086	0.069	3847	6451	3773	0.066
1976	0.027	0.081	0.063	3819	5999	3734	0.061
1977	0.027	0.098	0.079	3747	5707	3210	0.072
1978	0.025	0.080	0.068	4455	6624	3410	0.060
1979	0.024	0.074	0.034	5034	7761	4243	0.050
1980	0.027	0.085	0.067	5836	8723	5290	0.063
1981	0.026	0.094	0.062	6285	7783	4881	0.063
1982	0.022	0.106	0.074	6101	8547	3852	0.072
1983	0.016	0.120	0.087	6013	8736	4977	0.080
1984	0.019	0.087	0.089	6806	9723	6034	0.067
1985	0.021	0.092	0.060	7232	11371	7511	0.063
1986	0.022	0.095	0.060	8350	11909	8518	0.063
1987	0.029	0.149	0.079	9047	13658	7564	0.096
1988	0.031	0.157	0.068	9296	15813	7344	0.101
1989	0.037	0.154	0.082	9874	14887	8149	0.101
1990	0.043	0.158	0.083	10111	16106	8707	0.106
1991	0.042	0.145	0.075	10686	17385	8331	0.099
1992	0.047	0.145	0.085	10946	17780	9363	0.102
1993	0.046	0.126	0.066	10673	19586	8931	0.091
1994	0.043	0.085	0.025	11799	20143	10009	0.059
1995	0.044	0.099	0.025	13370	20308	10242	0.065

TABLE 3 Percentage Split of Capital Outlay Less ROW Among Pavement, Grading, and Structures (*1*)

	Pavement	*Grading*	*Structures*
Local			
Other than new construction or reconstruction	70.6%	13.2%	16.2%
New construction or reconstruction	53.1%	28.4%	18.5%
State			
Other than new construction or reconstruction	80.0%	12.6%	7.4%
New construction or reconstruction	63.6%	25.4%	11.0%
Interstate			
Other than new construction or reconstruction	73.6%	11.9%	14.5%
New construction or reconstruction	57.9%	23.1%	19.0%
Simple Average			
Other than new construction or reconstruction	74.7%	12.6%	12.7%
New construction or reconstruction	58.2%	25.6%	16.2%

TABLE 4 New Construction or Reconstruction as Percentage of Capital Outlay Including ROW, 1921–95 (*1*)

				Capital Outlay (Current $)			New Construction or Reconstruction as Percentage of Capital Outlay:
Year	*Local*	*State*	*Interstate*	*Local*	*State*	*Interstate*	*Weighted Average*
1921	0.104	0.312		530	301		0.179
1922	0.104	0.312		545	287		0.176
1923	0.104	0.312		470	280		0.182
1924	0.104	0.312		545	398		0.192
1925	0.104	0.312		626	404		0.186
1926	0.104	0.312		643	366		0.180
1927	0.104	0.312		746	419		0.179
1928	0.104	0.312		731	558		0.194
1929	0.104	0.312		692	575		0.199
1930	0.104	0.312		781	729		0.205
1931	0.104	0.312		605	798		0.222
1932	0.104	0.312		385	572		0.228
1933	0.104	0.312		304	532		0.237
1934	0.104	0.312		533	594		0.214
1935	0.104	0.312		419	449		0.212
1936	0.104	0.312		856	667		0.195
1937	0.104	0.312		725	601		0.198
1938	0.104	0.312		1062	582		0.178
1939	0.104	0.312		932	585		0.184
1940	0.104	0.312		796	636		0.196
1941	0.104	0.312		551	584		0.211
1942	0.104	0.312		333	429		0.221
1943	0.104	0.312		136	270		0.242
1944	0.104	0.312		131	211		0.232
1945	0.104	0.312		140	213		0.230
1946	0.104	0.312		270	508		0.240
1947	0.104	0.312		482	896		0.239
1948	0.104	0.312		592	1156		0.242
1949	0.104	0.312		708	1378		0.242
1950	0.104	0.312		686	1556		0.249
1951	0.104	0.312		710	1764		0.252
1952	0.104	0.312		857	1967		0.249
1953	0.104	0.312		955	2296		0.251
1954	0.104	0.312		1015	3020		0.260
1955	0.104	0.312		1092	3164		0.259
1956	0.104	0.312	1.000	1203	2443	1282	0.440
1957	0.104	0.312	1.000	1285	2485	1754	0.482
1958	0.104	0.312	1.000	1418	2773	2022	0.489
1959	0.104	0.312	1.000	1392	2736	2426	0.523
1960	0.104	0.312	1.000	1370	2555	2224	0.515
1961	0.104	0.312	1.000	1439	2761	2461	0.521
1962	0.104	0.312	1.000	1483	2987	2752	0.532
1963	0.104	0.312	1.000	1526	3111	3063	0.545
1964	0.104	0.312	1.000	1591	3040	3438	0.564
1965	0.104	0.312	1.000	1692	3038	3461	0.560
1966	0.104	0.312	1.000	1888	3384	3718	0.553
1967	0.104	0.312	1.000	2019	3555	3835	0.548
1968	0.104	0.312	1.000	2181	3924	4000	0.540
1969	0.104	0.312	1.000	2233	4182	3742	0.520
1970	0.104	0.312	1.000	2419	4864	4033	0.513
1971	0.104	0.312	1.000	2567	5264	4182	0.507
1972	0.104	0.312	1.000	2534	5132	4303	0.515
1973	0.104	0.312	1.000	2875	5103	3910	0.488

(continued)

TABLE 4 *Continued*

Year	Local	State	Interstate	Capital Outlay (Current $) Local	State	Interstate	New Construction or Reconstruction as Percentage of Capital Outlay: Weighted Average
1974	0.104	0.312	1.000	3412	5689	3736	0.457
1975	0.104	0.312	1.000	3847	6451	3773	0.440
1976	0.104	0.312	0.000	3819	5999	3734	0.168
1977	0.104	0.312	0.000	3747	5707	3210	0.171
1978	0.104	0.312	0.000	4455	6624	3410	0.175
1979	0.104	0.312	0.000	5034	7761	4243	0.173
1980	0.104	0.312	0.000	5836	8723	5290	0.168
1981	0.104	0.312	0.000	6285	7783	4881	0.163
1982	0.104	0.312	0.000	6101	8547	3852	0.179
1983	0.118	0.355	0.000	6013	8736	4977	0.193
1984	0.103	0.311	0.000	6806	9723	6034	0.165
1985	0.094	0.282	0.000	7232	11371	7511	0.149
1986	0.094	0.282	0.000	8350	11909	8518	0.144
1987	0.110	0.329	0.000	9047	13658	7564	0.181
1988	0.114	0.343	0.000	9296	15813	7344	0.200
1989	0.117	0.352	0.000	9874	14887	8149	0.194
1990	0.108	0.324	0.000	10111	16106	8707	0.181
1991	0.112	0.337	0.000	10686	17385	8331	0.194
1992	0.110	0.329	0.000	10946	17780	9363	0.185
1993	0.104	0.311	0.000	10673	19586	8931	0.184
1994	0.092	0.277	0.000	11799	20143	10009	0.159
1995	0.085	0.255	0.000	13370	20308	10242	0.144

NOTES: The $ derived figure should be subtracted from capital outlay excluding ROW to determine capital outlays for other than new construction or reconstruction.
All capital outlays for interstates in 1956–75 for new construction or "reconstruction by assumption" are assumed to occur with a 2-year lag—for example, capital outlays in 1956 enter the stock in 1958 and capital outlays for 1975 enter the stock in 1977; in 1976 and 1977, however, capital outlays for new construction or reconstruction from lagged capital are entering the stock at the same time as current outlays for projects other than new construction or reconstruction.

TABLE 5 **Pavement Efficiency Profiles, All Levels, All Initial Years (*1*)**

Year	Local Net Efficiency % Year 0 = 1921	Year 0 = 1941	Year 0 = 1961	Year 0 = 1981	Simple Average
0	100.00000	100.00000	100.00000	100.00000	100.00000
1	99.23962	99.23793	99.03745	98.68114	99.04903
2	98.73360	98.82215	98.53666	98.10727	98.54992
3	98.34465	98.44181	98.11236	97.60409	98.12573
4	97.99811	98.07673	97.72190	97.12949	97.73156
5	97.67207	97.71624	97.34563	96.66546	97.34985
6	97.35470	97.35357	96.97395	96.20069	96.97073
7	97.03868	96.98190	96.60008	95.72667	96.58683
8	96.71889	96.59440	96.21606	95.23709	96.19161
9	96.38964	96.18475	95.81731	94.72506	95.77919
10	96.04523	95.74263	95.39522	94.18651	95.34240
11	95.67934	95.25821	94.94288	93.61621	94.87416
12	95.28277	94.71533	94.44930	93.01406	94.36537
13	94.84342	94.09486	93.90118	92.38172	93.80529
14	94.34283	93.37408	93.28051	90.48767	92.87127
15	93.75040	92.54277	92.56807	88.24660	91.77696
16	93.01463	90.17051	90.56681	85.78869	89.88516
17	91.54489	86.93957	87.46792	83.10973	87.26553
18	87.58888	83.36330	83.73243	80.15705	83.71042
19	82.55961	79.18203	79.22052	76.77346	79.43391
20	74.08884	72.79983	71.99158	72.40745	72.82192

TABLE 5 *Continued*

	State Net Efficiency %				
Year	*Year 0 = 1921*	*Year 0 = 1941*	*Year 0 = 1961*	*Year 0 = 1981*	*Simple Average*
0	100.00000	100.00000	100.00000	100.00000	100.00000
1	98.64133	98.64635	98.22445	98.08670	98.39971
2	98.18404	98.06213	97.62414	97.53775	97.85201
3	97.77927	97.58498	97.09923	97.12548	97.39724
4	97.39756	97.15034	96.61708	96.78991	96.98872
5	97.02513	96.73500	96.15451	96.46259	96.59430
6	96.65317	96.32641	95.74080	95.96044	96.17020
7	96.27603	95.91766	95.36290	95.76427	95.83022
8	95.88868	95.50121	94.96359	95.42931	95.44570
9	95.48546	95.07203	94.45956	95.09848	95.02888
10	95.06131	94.62633	94.17724	94.75472	94.65490
11	94.61246	94.15846	93.78025	94.39998	94.23779
12	94.13450	93.66527	93.40263	93.75314	93.73889
13	93.62553	93.14614	92.85283	92.74143	93.09148
14	93.08495	92.47994	91.98625	91.65908	92.30256
15	92.30255	91.26403	91.05883	90.53083	91.28906
16	91.00526	89.92497	90.04133	89.34147	90.07826
17	89.54337	88.49002	88.88221	88.10922	88.75620
18	87.88925	86.99107	87.55252	86.84295	87.31895
19	85.94730	85.45167	86.03854	85.55079	85.74707
20	83.32548	83.89162	84.48275	84.24841	83.98707

	Interstate Net Efficiency %		
Year	*Year 0 = 1958*	*Year 0 = 1978*	*Simple Average*
0	100.00000	100.00000	100.00000
1	98.43541	98.19913	98.31727
2	97.92168	97.65195	97.78682
3	97.51520	97.29105	97.40312
4	97.16393	96.99447	97.07920
5	96.84709	96.75682	96.80195
6	96.55372	96.56371	96.55872
7	96.27890	96.40590	96.34240
8	96.01769	96.23986	96.12877
9	95.76736	95.91133	95.83935
10	95.52572	95.86203	95.69388
11	95.29168	95.67860	95.48514
12	95.06358	95.50153	95.28256
13	94.84033	95.31666	95.07849
14	94.62138	95.12713	94.87426
15	94.40563	94.91260	94.65912
16	94.19309	94.70722	94.45016
17	93.98265	94.49084	94.23674
18	93.77375	94.28335	94.02855
19	93.52247	94.01042	93.76644
20	92.89928	93.50925	93.20427

TABLE 6 **BEA Highway Capital Outlay Deflators, 1921–95 (*1*)**

Year	*Federal BEA Deflator*	*State & Local BEA Deflator*
1921		0.1238
1922		0.1178
1923		0.1319
1924		0.1391
1925		0.1419
1926		0.1343
1927		0.1335
1928		0.1241
1929		0.1200
1930		0.1116
1931		0.0992
1932		0.0758
1933		0.0940
1934		0.1089
1935		0.1053
1936		0.1155
1937		0.1075
1938		0.1038
1939		0.1010
1940		0.0983
1941		0.1123
1942		0.1456
1943		0.1641
1944		0.1508
1945		0.1449
1946		0.1554
1947		0.1777
1948		0.1988
1949		0.1923
1950		0.1741
1951		0.2123
1952		0.2184
1953		0.2104
1954		0.1991
1955		0.1939
1956	0.2173	0.2184
1957	0.2305	0.2276
1958	0.2247	0.2225
1959	0.2237	0.2213
1960	0.2154	0.2133
1961	0.2159	0.2142
1962	0.2228	0.2208
1963	0.2284	0.2263
1964	0.2310	0.2288
1965	0.2381	0.2365
1966	0.2518	0.2491
1967	0.2551	0.2580
1968	0.2697	0.2718
1969	0.2871	0.2877
1970	0.3182	0.3202
1971	0.3418	0.3447
1972	0.3536	0.3581
1973	0.3811	0.3900
1974	0.4909	0.5076
1975	0.5454	0.5527
1976	0.5290	0.5401
1977	0.5368	0.5349
1978	0.5406	0.5408
1979	0.5858	0.5851
1980	0.6778	0.6785
1981	0.8008	0.7939
1982	0.8716	0.8702
1983	0.8575	0.8558
1984	0.8265	0.8258
1985	0.8316	0.8322
1986	0.8731	0.8713
1987	0.9245	0.9238
1988	0.9407	0.9400
1989	0.9457	0.9475
1990	0.9834	0.9820
1991	0.9993	0.9991
1992	1.0000	1.0000
1993	1.0111	1.0111
1994	1.0372	1.0385
1995	1.0938	1.0950

NOTE: 1992 = 1.0000

TABLE 7 **Numerical Example**
(Summations of individual entries and totals may not be equal because of rounding.)

CAPITAL OUTLAY, 1960	*Current $*		*Constant $*
Capital Outlay	1000		
(Multiply by capital outlay split[a])			
Local: 1000 × 1370/(1370 + 2555 + 2224) =	223		
State: 1000 × 2555/(1370 + 2555 + 2224) =	416		
Interstate: 1000 × 2224/(1370 + 2555 + 2224) =	362		
ROW Capital Outlay			
(Multiply by ROW percentage[a])		(Divide by deflator[b])	
Local: 223 × 0.061 =	14	223/0.2133 =	64
State: 416 × 0.135 =	56	416/0.2133 =	263
Interstate: 362 × 0.191 =	69	362/0.2154 =	321
Outlay for New Construction or Reconstruction			
(Multiply by percentage of capital outlay including ROW[c])			
Local: 223 × 0.104 =	23		
State: 416 × 0.312 =	130		
Interstate: (Multiply by percentage of capital outlay less ROW[c]): 362 × 1.000 − 69 =	293		
Outlay for Other Than New Construction or Reconstruction			
(Capital outlay less ROW less outlay for new construction or reconstruction)			
Local: 223 − 14 − 23 =	186		
State: 416 − 56 − 130 =	230		
Interstate: 362 − 69 − 293 =	0		
Capital Outlay for Pavement, Grading, and Structures[d]			
Local			
Pavement: [(23 × 0.531) + 186] × 0.706 =	144		673
Grading: [(23 × 0.284) + 186] × 0.132 =	31		146
Structures: [(23 × 0.185) + 186] × 0.162 =	34		161
State			
Pavement: [(130 × 0.636) + 230] × 0.706 =	266		1248
Grading: [(130 × 0.254) + 230] × 0.126 =	62		290
Structures: [(130 × 0.110) + 230] × 0.074 =	31		147
Interstate			
Pavement: [(293 × 0.579) + 0] × 0.736 =	169		787
Grading: [(293 × 0.231) + 0] × 0.145 =	68		314
Structures: [(293 × 0.190) + 0] × 0.162 =	56		258

(*continued*)

[a] See Table 2.
[b] See Table 6.
[c] See Table 4.
[d] See Table 3

TABLE 7 *Continued*

DETAILED PRODUCTIVE CAPITAL STOCK IN CONSTANT 1992 DOLLARS

ROW Capital Stock

Year	*Local*	*State*	*Interstate*	*TOTAL*
1960–forever	64	260	321	645

Pavement Capital Stock
[(Capital outlay × Year 0 efficiency[e])/100 for 20 years]

Year	*Local*	*State*	*Interstate*	*TOTAL*
1960	673	1248	787	2708
1961	668	1231	774	2674
1962	666	1224	770	2660
1963	663	1218	767	2648
1964	660	1213	764	2638
1965	658	1208	762	2627
1966	656	1203	759	2618
1967	653	1197	757	2608
1968	651	1192	755	2598
1969	648	1187	753	2588
1970	645	1181	751	2577
1971	642	1175	749	2566
1972	638	1169	748	2555
1973	634	1163	746	2542
1974	629	1154	744	2528
1975	623	1139	743	2505
1976	607	1123	741	2471
1977	585	1105	739	2429
1978	561	1086	738	2385
1979	533	1067	736	2336
1980	0	0	0	0

Pavement Efficiencies[f]

Year	*Local*	*State*	*Interstate*
0	100.00000	100.00000	100.00000
1	99.23793	98.64635	98.43541
2	98.82215	98.06213	97.92168
3	98.44181	97.58498	97.51520
4	98.07673	97.15034	97.16393
5	97.71624	96.73500	96.84709
6	97.35357	96.32641	96.55372
7	96.98190	95.91766	96.27890
8	96.59440	95.50121	96.01769
9	96.18475	95.07203	95.76736
10	95.74263	94.62633	95.52572
11	95.25821	94.15846	95.29168
12	94.71533	93.66527	95.06358
13	94.09486	93.14614	94.84033
14	93.37408	92.47994	94.62138
15	92.54277	91.26403	94.40563
16	90.17051	89.92497	94.19309
17	86.93957	88.49002	93.98265
18	83.36330	86.99107	93.77375
19	79.18203	85.45167	93.52247
20	72.79983	83.89162	92.89928

Grading Capital Stock
(For 80 years)

Year	*Local*	*State*	*Interstate*	*TOTAL*
1960–2039	146	290	314	750
2040	0	0	0	0

Structures Capital Stock
[Previous year's capital stock × (1 – 0.01820), the geometric rate, forever]

Year	*Local*	*State*	*Interstate*	*TOTAL*
1960	161	147	258	566
1961	158	144	253	556
1962	156	141	249	546
1963	153	139	244	536
1964	150	136	240	526
1965	147	134	235	516
1966	145	131	231	507
1967	142	129	227	498
1968	139	127	223	489
1969	137	124	219	480
1970	134	122	215	471
1971	132	120	211	463
1972	129	118	207	454
1973	127	115	203	446
1974	125	113	200	438
1975	123	111	196	430
1976	120	109	192	422
1977	118	107	189	414
1978	116	105	185	407
1979	114	103	182	399
1980	112	102	179	392
1981	110	100	175	385
1982	108	98	172	378
1983	106	96	169	371
1984	104	94	166	364
1985	102	93	163	358
1986	100	91	160	351
1987	98	89	157	345
1988	96	88	154	338
1989	95	86	152	332
1990	93	84	149	326
1991	91	83	146	320
1992	90	81	143	314
1993	88	80	141	309
1994	86	78	138	303
1995	85	77	136	298
1996	83	76	133	292
1997	82	74	131	287
1998	80	73	128	282
1999	79	72	126	277
2000	77	70	124	272
2001	76	69	122	267
2002	75	68	119	262

(*continued*)

[e] See Table 5.
[f] See Table 5; in the calculations shown, the efficiency for year 20 is set equal to 0 as the asset is retired.

TABLE 7 *Continued*

Structures Capital Stock (*continued*)

Year	*Local*	*State*	*Interstate*	*TOTAL*
2003	73	67	117	257
2004	72	65	115	252
2005	71	64	113	248
2006	69	63	111	243
2007	68	62	109	239
2008	67	61	107	234
2009	66	60	105	230
2010	64	59	103	226
2011	63	57	101	222
2012	62	56	99	218
2013	61	55	98	214
2014	60	54	96	210
2015	59	53	94	206
2016	58	52	92	202
2017	57	51	91	199
2018	56	51	89	195
2019	55	50	87	192
2020	54	49	86	188
2021	53	48	84	185
2022	52	47	83	181
2023	51	46	81	178
2024	50	45	80	175
2025	49	44	78	172
2026	48	44	77	168
2027	47	43	75	165
2028	46	42	74	162
2029	45	41	73	159
2030	45	41	71	156
2031	44	40	70	154
2032	43	39	69	151
2033	42	38	68	148
2034	41	38	66	145
2035	41	37	65	143
2036	40	36	64	140
2037	39	36	63	138
2038	39	35	62	135
2039	38	34	60	133
2040	etc.	etc.	etc.	etc.

TOTAL PRODUCTIVE CAPITAL STOCK
IN CONSTANT 1992 DOLLARS
(Summation of ROW, pavement, grading, and structures)

Year	*Local*	*State*	*Interstate*	*TOTAL*
1960	1045	1945	1679	4669
1961	1036	1926	1662	4624
1962	1031	1916	1653	4600
1963	1025	1907	1646	4579
1964	1020	1900	1639	4558
1965	1015	1892	1632	4539
1966	1010	1884	1625	4519
1967	1005	1877	1619	4500
1968	1000	1869	1613	4481
1969	994	1862	1607	4462

TOTAL PRODUCTIVE CAPITAL STOCK
IN CONSTANT 1992 DOLLARS (*continued*)

Year	*Local*	*State*	*Interstate*	*TOTAL*
1970	989	1854	1601	4443
1971	983	1846	1595	4424
1972	977	1837	1589	4404
1973	970	1829	1584	4383
1974	963	1818	1578	4360
1975	955	1801	1573	4330
1976	937	1782	1568	4287
1977	913	1762	1563	4238
1978	887	1742	1557	4186
1979	857	1721	1552	4130
1980	321	652	813	1787
1981	319	650	810	1780
1982	317	648	807	1773
1983	315	647	804	1766
1984	314	645	801	1759
1985	312	643	798	1752
1986	310	641	795	1746
1987	308	640	792	1739
1988	306	638	789	1733
1989	304	637	786	1727
1990	303	635	783	1721
1991	301	633	781	1715
1992	299	632	778	1709
1993	298	630	775	1704
1994	296	629	773	1698
1995	295	628	770	1692
1996	293	626	768	1687
1997	291	625	765	1682
1998	290	623	763	1676
1999	289	622	761	1671
2000	287	621	758	1666
2001	286	620	756	1661
2002	284	618	754	1656
2003	283	617	752	1652
2004	282	616	750	1647
2005	280	615	747	1642
2006	279	613	745	1638
2007	278	612	743	1633
2008	277	611	741	1629
2009	275	610	739	1625
2010	274	609	738	1621
2011	273	608	736	1617
2012	272	607	734	1613
2013	271	606	732	1609
2014	270	605	730	1605
2015	268	604	728	1601
2016	267	603	727	1597
2017	266	602	725	1593
2018	265	601	723	1590
2019	264	600	722	1586
2020	263	599	720	1583
2021	262	598	719	1579

(*continued*)

TABLE 7 *Continued*

TOTAL PRODUCTIVE CAPITAL STOCK IN CONSTANT 1992 DOLLARS (*continued*)

Year	*Local*	*State*	*Interstate*	*TOTAL*
2022	261	597	717	1576
2023	260	597	716	1573
2024	260	596	714	1569
2025	259	595	713	1566
2026	258	594	711	1563
2027	257	593	710	1560
2028	256	593	709	1557
2029	255	592	707	1554
2030	254	591	706	1551
2031	254	590	705	1548
2032	253	590	703	1546
2033	252	589	702	1543
2034	251	588	701	1540
2035	250	587	700	1537
2036	250	587	698	1535
2037	249	586	697	1532
2038	248	586	696	1530
2039	248	585	695	1527
2040	etc.	etc.	etc.	etc.

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