Volume Title: Factors in Business Investment

Volume Author/Editor: Robert Eisner

Volume Publisher: NBER

Volume ISBN: 0-88410-484-2

Volume URL: http://www.nber.org/books/eisn78-1

Publication Date: 1978

Chapter Title: Components of Capital Expenditures -- Replacement and Modernization versus Expansion

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Chapter URL: http://www.nber.org/chapters/c3845

Chapter pages in book: (p. 175 - 188)

Chapter Eight

Components of Capital Expenditures— Replacement and Modernization versus Expansion

INTRODUCTION AND DESCRIPTION OF DATA

Probably more than half of capital expenditures involve, in one sense or another, the replacement of existing stock. The timing and determinants of replacement expenditures have given rise to a host of competing hypotheses, some of which are listed below.

1. Replacement expenditures are a fairly constant proportion of capital.
2. Replacement expenditures substitute for expansion expenditures, thus stabilizing the annual rate of investment, falling when expansion increases and rising when expansion decreases.
3. They are closely tied or essentially equal to depreciation charges.
4. They vary with the current rate of profit or flow of funds.
5. They are positively related to the age of capital stock.

The McGraw-Hill capital expenditure survey data and collateral statistics offer a unique opportunity to test these and related hypotheses. Feldstein and Foot (1971) utilized McGraw-Hill aggregative reports, along with a series from the Department of Commerce on planned capital expenditures and from the Federal Trade Commission and Securities Exchange Commission on flow of funds, in an

Note: An earlier version of this paper was presented at the Second World Congress of the Econometric Society in Cambridge, England, in September 1970.

analysis of replacement expenditures. This chapter offers a partly parallel analysis of expansion as well as replacement expenditures on the basis of individual firm data.

Key to the analysis is a question that has been included in the McGraw-Hill spring surveys in the years 1952 through 1955 and from 1957 to date: "Of the total amount you now plan to invest in new plants and equipment in [the current year] how much is for: expansion ______%; replacement and modernization ______%?" Applying the indicated proportions to anticipated and actual capital expenditures has resulted in estimates of expenditures for replacement and modernization as well as expenditures for expansion. In the case of actual expenditures, these estimates related to from 112 to 254 firms in each of the fourteen years from 1954 to 1968, excluding 1956.[1] Estimates of anticipated expenditures were available for approximately the same firms.

The basic data are as follows:[2]

Variable	*Intervals for Utilized Observations*
$i_t^* = I_t/K_{t-1}$	[0.6, 0)
$i_{t+1}^{t*} = I_{t+1}^t/K_{t-1}$	[0.6, 0)
$e_t^{t-1} = (I^e/I)_t^{t-1}$	[1, 0]
$d_t^* = D_t/K_{t-1}$	[0.4, 0)
$p_t^* = P_t/K_{t-1}$	[0.7, −0.4]
$r_t^d = R_t/K_{t-1}$	[1, 0]
$u_t^c = u_t^a/u_t^p$	[1.3, 0.3]
$s_{t+1}^t, \Delta s_{t-j}^*$	[0.7, −0.6]

[1] Small numbers of observations, forty-nine for 1952 and sixty-seven for 1953, were eliminated from the final analysis when 1967 and 1968 data became available because the capacity of our regression program was limited to a total of fourteen years.

[2] Brackets again indicate closed intervals, parentheses, semiopen intervals, excluding lower bounds. Some 6 percent of observations were rejected because one or more of the variables contained "extreme values," outside the indicated intervals. Elimination of extreme values or "outliers" in these individual firm data has seemed prudent in order to minimize the possibility of substantial impact due to reporting or processing errors and/or extremely low denominators for variables in ratio form.

where

I_t	= capital expenditures of the year t
I_{t+1}^t	= capital expenditure anticipations for the year $t+1$(presumably held at the end of the year t and reported in the spring survey of the year $t+1$)
K	= gross fixed assets
D	= depreciation charges
P	= profits after taxes
R	= depreciation reserves
u^a	= actual utilization of capacity
u^p	= preferred utilization of capacity
s_{t+1}^t and Δs_{t-j}^*	= expected and ex post relative sales changes, respectively.[3]

Superscripts e and r denote expansion or replacement and modernization, respectively. Time superscripts indicate that variables are anticipated and reveal the year of anticipations, and time subscripts indicate years (or ends of years) to which variables apply.

$$i_t^e = e_t^{t-1} i_t^*, \quad i_t^r = (1 - e_t^{t-1}) i_t^*, \quad i_{t+1}^{et} = e_{t+1}^t i_{t+1}^{t^*},$$

$$\text{and } i_{t+1}^{rt} = (1 - e_{t+1}^t) i_{t+1}^{t^*}$$

are "actual" and anticipated expansion and replacement expenditures.[4]

[3] s_{t+1}^t was denoted Δs_{t+1}^t in Eisner (1967).

[4] The McGraw-Hill surveys have included questions as to anticipated proportions of expenditures for expansion and for replacement and modernization in all years except 1956, but questions as to the actual proportions, viewed ex post, were included only irregularly. Feldstein and Foot (1971) matched these anticipations with the Department of Commerce series for anticipated capital expenditures.

Tables 8-1, 8-2, and 8-3 relate to i_t^r and i_t^e, the products of reported actual total expenditures divided by gross fixed assets and the proportions anticipated for expansion and for replacement and modernization. These are taken as estimates of "actual" expenditures for expansion and for replacement (and modernization). To the extent that discrepancies between actual and anticipated expenditures do not fall evenly on the two anticipated components our measure is inexact. We have, however, also conducted the analysis with the data for anticipated expenditures

$$i_{t+1}^{et} = e_{t+1}^t \cdot i_{t+1}^{t^*} \text{ and } i_{t+1}^{rt} = (1 - e_{t+1}^t)\, i_{t+1}^{t^*}$$

Capital expenditures and capital expenditure anticipations, the capacity variables, expected sales changes, and the expansion-replacement ratios are taken from the McGraw-Hill surveys. The other variables are from financial reports, generally as recorded in Moody's. All flow variables (I, I^{t*}_{t+1}, sales, and P) except depreciation charges are price-deflated, with indexes set at 1.00 in 1954. The stock variables, gross fixed assets and depreciation reserves are not price-deflated.[5]

The body of data available proved sufficient to generate up to 2,692 individual firm observations in six broad industry groups, as indicated in Table 8-1B. The bulk of the observations, however, was in manufacturing.

RELATIVE STABILITY OF REPLACEMENT VERSUS EXPANSION INVESTMENT

Table 8-1 offers a variety of evidence on the relatively greater stability of replacement expenditures as a proportion of gross fixed assets. From a quick visual inspection of the table's section A, it is clear that reported expenditures for replacement and modernization were not only higher than those for expansion in every year except one (1957), averaging some 60 percent of total expenditures, but also markedly more stable. The standard deviation of the annual mean ratios of replacement expenditures to previous gross fixed assets was 0.0056, as against 0.0116 for the corresponding figures for expansion investment, and the coefficients of variation (standard deviation divided by mean) shown in section B were 0.1241 for the former, compared with 0.3762 for the latter. This comparison holds up at both the industry and individual firm levels. Replacement

and results were not substantially different from those for the "actual" expenditures. In Table 8.4, where we seek to isolate and compare determinants of expansion and replacement expenditures, we report results for the anticipated expenditures, which should facilitate comparison with the Feldstein and Foot analysis of determinants of replacement expenditures.

[5] The use of undeflated gross fixed assets raises some problems. In principle, a measure of net capital stock in constant prices, corresponding to current real capacity, would be better. Measures of price-deflated gross fixed assets obtained by utilizing ratios of accumulated previous deflated and undeflated capital expenditures were employed in other work (Eisner, 1967, pp. 371, 384-86), but did not appear to affect the results sufficiently to warrant the substantial consequent loss in observations (due to lack of full information on previous capital expenditures). In a crude way, the failure to depreciate for decreasing capacity or efficiency with age and the failure to appreciate for rising prices may be taken as compensating errors, so that the gross fixed assets measure may come as close to representing real capital stock as any other imperfect measure that we might readily employ. We may further note the finding by Feldstein and Foot (1971, pp. 53, 55, and footnote 22) that estimates of the relations with which we are concerned prove insensitive to the measure of capital stock, including the substitution of a net capital series for the gross capital figures that they used.

Table 8-1. Cap
Expansion, 195

Year (t)	Replacement (i^r_t)
1968	.0401
1967	.0449
1966	.0493
1965	.0486
1964	.0482
1963	.0421
1962	.0418

M
S
A

B

(1)

Observations

Time Series
Aggregate
Industries[b]
Firms
Primary metals
Metalworking
Chemical processi
All other manufac
Mining
Petroleum
All industries[c]
Cross Sections
Aggregate
Industries
Firms, within indus

[a] See Chapter 1 for sta
[b] No observations we
one or more years in t
were no observations
[c] Firm time series st
number of total obser
Note: Table M7-10 a

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available.

Table 8-1. Capital Expenditures for Replacement and Modernization and for Expansion, 1954-1955, 1957-1968, as Ratios of Previous Gross Fixed Assets

A. Mean Ratios and Number of Firms, by Year

Year (t)	*Replacement* (i_t^r)	*Expansion* (i_t^e)	*Number of Firms*	*Year* (t)	*Replacement* (i_t^r)	*Expansion* (i_t^e)	*Number of Firms*
1968	.0401	.0337	112	1961	.0385	.0183	244
1967	.0449	.0363	152	1960	.0434	.0280	254
1966	.0493	.0433	199	1959	.0411	.0215	226
1965	.0486	.0341	169	1958	.0397	.0249	244
1964	.0482	.0237	203	1957	.0493	.0584	175
1963	.0421	.0189	193	1955	.0566	.0437	153
1962	.0418	.0220	201	1954	.0558	.0405	167
		Means, All Years			.0452	.0307	2692
		Standard Deviations of Annual Mean Ratios			.0056	.0116	

B. Standard Deviations, Means, and Coefficients of Variation (σ/Mean)[a]

(1) Observations	(2) n	(3) i^r σ	(4) i^r Mean	(5) i^r σ/Mean	(6) i^e σ	(7) i^e Mean	(8) i^e σ/Mean
Time Series							
Aggregate	14	.0056	.0452	.1241	.0116	.0307	.3762
Industries[b]	83	.0081	.0452	.1788	.0153	.0307	.4984
Firms							
Primary metals	231	.0226	.0352	.6428	.0625	.0323	1.9353
Metalworking	1084	.0334	.0528	.6321	.0379	.0304	1.2458
Chemical processing	568	.0175	.0332	.5280	.0341	.0383	.8908
All other manufacturing	628	.0267	.0464	.5743	.0359	.0252	1.4237
Mining	34	.0325	.0395	.8240	.0633	.0304	2.0867
Petroleum	80	.0264	.0546	.4838	.0327	.0186	1.7543
All industries[c]	2625	.0279	.0454	.6140	.0398	.0307	1.2979
Cross Sections							
Aggregate	6	.0088	.0452	.1956	.0052	.0307	.1702
Industries	83	.0108	.0452	.2385	.0118	.0307	.3827
Firms, within industries	2692	.0322	.0452	.7125	.0416	.0307	1.3544

[a]See Chapter 1 for statement of the various deviations underlying the calculation of σ.

[b]No observations were available in several regressions and in these summary statistics for one or more years in the mining and petroleum industries. For Tables 8-1, 8-2, and 8-3 there were no observations in petroleum for 1968.

[c]Firm time series statistics exclude firms with only one observation—hence the lesser number of total observations.

Note: Table M7-10 appears only in microfiche.

expenditures vary less over time than expansion expenditures in the aggregates, in annual means for each industry, and within individual firms in each of the six industry groups for which data were available.

Evidence showing expenditures for replacement and modernization to be more than half of total capital expenditures and to be relatively stable should not be construed as a guarantee against cyclical fluctuations. For one thing, the highly variable expansion expenditures still constitute 40 percent of total expenditures. Second, variation in replacement expenditures is only relatively small. The 0.1241 coefficient of variation in the aggregative data implies that, in about one-third of the years, the ratio of replacement to capital will vary by as much as one-eighth from its mean. As observed by Feldstein and Foot (1971) and argued earlier by Eisner and Nadiri (1968), this contradicts the hypothesis of a constant ratio of replacement to capital stock maintained by Jorgenson and his associates in their work on investment (Jorgenson [1963] and Jorgenson and Stephenson [1967a and b], for example)—at least insofar as McGraw-Hill respondents can be believed. It is true that conditions for a strict test of the Jorgenson hypothesis are not met: the gross fixed assets data cannot be taken as a measure of capital stock necessarily consistent over time with the path of gross capital expenditures and replacement. However, year-to-year variation in replacement, both in our data here and in the aggregates reported by Feldstein and Foot, is clearly greater than could be accounted for by any corrections of the relatively slow-moving capital stock series.[6]

A critical question is whether, in years of slackening demand for expansion, firms fill in at least part of the slack by drawing on a backlog of needs for replacement and modernization. If this were true, it would suggest a substantial source of stability for capital expenditures as a whole. However, the evidence points the other way. As indicated in Table 8-2, in the pooled individual firm time series, there is no correlation between the ratios of replacement and expansion investment to gross fixed assets, but the industry time series shows a distinct positive relation. Within each industry, replacement investment moved in the same direction as expansion investment, with about one-fourth of its amplitude. Pooling all the observations in the weighted aggregate time series, we find replacement investment varying in the same direction as expansion investment, with about one-third of its amplitude and with a corrected coefficient of determination of 0.48.

The failure of replacement and modernization expenditures to compensate for the volatility of expansion expenditures is confirmed in Table 8-3. We note there that total investment is positively related to the proportion of investment designated for expansion. This

[6] This vitiates the objection by Jorgenson (1971, p. 1140) to the work of Feldstein and Foot.

Table 8-2. Replacement Expenditures as a Function of Expansion Expenditures

$$i^r_t = b_0 + b_1 i^e_t + u_t$$

(1)	(2)	(3)	(4)
	Coefficients and Standard Errors		
		Time Series	
Variable or Statistic	*Firm*	*Industries*	*Aggregate*
Constant	.0450	.0379	.0344
	(.007)	(.0018)	(.0032)
i^e_t	.0126	.2375	.3496
	(.0148)	(.0542)	(.0972)
$\bar{r}^2$	–.0001	.1909	.4790
$n(-6)$	2625	83	14
r.d.f.	2247	76	12

positive relation is highly significant at the firm, industry, and aggregate levels. At the aggregate level, indeed, the proportion of expenditures for expansion explains almost 80 percent of the variance in annual capital expenditures. Since the proportion of expenditures for replacement and modernization is the complement of that for expansion, the regression coefficients of total expenditures on the proportion for replacement and modernization would be simply the negatives of those for the expansion proportion shown in Table 8-3.

DETERMINANTS OF ANTICIPATED REPLACEMENT AND EXPANSION EXPENDITURES

Evidence enabling us to discriminate among determinants of expenditures for replacement and modernization versus those for expansion is harder to come by. Two basic parallel relations were estimated for anticipated replacement and expansion expenditures.[7] These were

$$i^{xt}_{t+1} = b^x_0 + b^x_1(d^*_t + p^*_t) + b^x_2(d^*_{t-1} + p^*_{t-1}) + b^x_3 r^d_t + b^x_4 u^c_t + b^x_5 u^c_{t-1} + \sum_{j=0}^{5} b^x_{j+6} \Delta s^*_{t-j} + v^x_t \qquad (8.1)$$

[7] As indicated above (footnote 4), a similar analysis has been conducted with the actual expenditures which are the subject of Tables 8-1, 8-2, and 8-3. Results, not substantially different from those reported below, are described in the paper presented at the World Econometric Congress. Use of anticipated expenditures here will facilitate comparison with the findings subsequently reported by Feldstein and Foot.

Table 8-3. Total Investment as a Function of the Proportion of Investment Planned for Expansion, Firm, Industry, and Aggregate Time Series

$$i_t = b_0 + b_1 e_t^{t-1} + v_t$$

(1)	*(2)*	*(3)*	*(4)*
	Regression Coefficients and Standard Errors		
Variable or Statistic	*Firm*	*Industry*	*Aggregate*
Constant	.0483 (.0016)	.0156 (.0070)	.0012 (.0115)
e_t^{t-1}	.0845 (.0042)	.1833 (.0206)	.2268 (.0344)
$\bar{r}^2$	.1542	.5034	.7658
$n(-6)$	2625	83	14
r.d.f.	2247	76	12
Mean e_t^{t-1}	.3283	.3292	.3292
Mean i_t	.0761	.0759	.0759
Elasticity at Means	.3645	.7950	.9837
Elasticity from Logarithmic relation with $e_t^{t-1} > .01$	.2767	.6658	1.2022

where $x = r$ for "replacement and modernization" in one case and $x = e$ for "expansion" in the other.

There is some evidence in the firm time series shown in Table 8-4 that anticipated expenditures for expansion are positively related to sales changes and utilization of capacity, while replacement expenditures are related to previous profits. The sum of the sales change coefficients for expansion expenditures is distinctly higher than the corresponding sum for replacement expenditures: the sum of estimated coefficients of depreciation charges and profits, $d + p$, however, is smaller for anticipated expansion expenditures than for anticipated replacement expenditures.[8] The depreciation reserve variable, rd, introduced as a proxy for age of capital, yields only a very low positive coefficient for replacement and modernization expenditures and shows a slightly higher value for expansion expenditures. This may relate to its imperfect character as a proxy, reflecting, for example, the varying mix of plant and equipment or, more generally, longer- and shorter-lived capital in the investment of

[8] When depreciation charges and profits were introduced separately in the regressions, coefficients of the depreciation variable seemed erratic, with high standard errors. This may have related to the very low time series variance of $d (\sigma < 0.01$, as against almost 0.05 for profits variables).

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COMPARISON

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previous years. In a period of high expansion expenditures, if much recent investment has been for short-lived equipment with relatively rapid post-1962 depreciation rates, depreciation reserves may prove high even if age of capital is low.

In the industry time series, the decisive role of sales change variables in expansion investment is all the more apparent, possibly because of a larger permanent component in the variance of sales changes; the sum of sales change coefficients is 0.3275. In the replacement regression, sales change coefficients sum to approximately zero. The capacity utilization coefficients, however, are positive and of about the same (small) magnitude in both regressions. The sum of the coefficients of profits plus depreciation is again positive, and more substantial, in the replacement regression and this time negative in the expansion relation.

As indicated earlier (particularly in Chapter 4), cross sections and overall regressions of grouped data, containing smaller proportions of transitory components and transitory variations, may yield better estimates of permanent, structural relations. This is confirmed by the "industry overall" regressions (based upon appropriately weighted sums of squares and cross products of deviations, around the overall mean, of observations that are themselves means of the individual firm observations of an industry for a year, shown in Table 8-4). First, the sum of sales change coefficients is a fairly significant 0.32 in the expansion regression but virtually zero in the regression for replacement and modernization expenditures. The sum of utilization of capacity coefficients is also significantly positive in the expansion regression but not significant (and slightly negative) for replacement. Conversely, the sum of coefficients for depreciation charges and profits is a significant 0.15 in the replacement relation while virtually zero in the expansion relation. And now, the depreciation reserve ratio is also significantly positive in the replacement relation and close to zero in the regression for expansion expenditures.

COMPARISON WITH FELDSTEIN-FOOT RESULTS

It is useful to compare our analysis more explicitly with that of Feldstein and Foot. They join us in rejecting "the proportional replacement theory as a description of short-run behavior," but emphasize a "negative short-run interdependence of expansion and replacement expenditures" along with "the importance of internal availability of funds."[9]

Their negative relation between replacement and expansion ex-

[9] Feldstein and Foot (1971, p. 57).

Table 8-4. Anticipated Expansion Investment versus Replacement and Modernization Investment Functions

$$i^{xt}_{t+1} = b^x_0 + b^x_1 (d^*_t + p^*_t) + b^x_2 (d^*_{t-1} + p^*_{t-1}) + b^*_3 r^d_t + b^x_4 u^c_t + b^x_5 u^c_{t-1} + \sum_{j=0}^{5} b^x_{j+6} \Delta s^*_{t-j} + v^x_t$$

Variable or Statistic	Regression Coefficients and Standard Errors					
	Firm and industry time series[a]				Industry overall regressions	
	Firms		Industries			
	Expansion (i^{et}_{t+1})	Replacement (i^{rt}_{t+1})	Expansion (i^{et}_{t+1})	Replacement (i^{rt}_{t+1})	Expansion (i^{et}_{t+1})	Replacement (i^{rt}_{t+1})
Constant	−.0476 (.0133)	.0053 (.0101)	−.0645 (.0387)	−.0670 (.0259)	−.0745 (.0341)	−.0204 (.0334)
$d^*_t + p^*_t$	.0458 (.0223)	.0576 (.0169)	−.1854 (.1152)	.0630 (.0771)	−.1056 (.1145)	.0094 (.1121)
$d^*_{t-1} + p^*_{t-1}$	−.0198 (.0215)	.0299 (.0163)	.0883 (.1109)	.0875 (.0743)	.1005 (.1073)	.1417 (.1051)
r^d_t	.0459 (.0145)	.0134 (.0109)	.0340 (.0480)	.0335 (.0322)	.0110 (.0439)	.1173 (.0430)
u^c_t	.0255 (.0107)	.0178 (.0081)	.0474 (.0363)	.0470 (.0243)	.0575 (.0336)	−.0113 (.0329)
u^c_{t-1}	.0195 (.0106)	.0043 (.0083)	.0288 (.0294)	.0348 (.0197)	.0288 (.0262)	−.0140 (.0256)
s^t_{t+1}	.0368 (.0142)	.0133 (.0107)	.1428 (.0488)	.0865 (.0327)	.1424 (.0436)	.0511 (.0427)
$\sum_{j=0}^{5} \Delta s^*_{t-j}$ coefficients	.0687 (.0325)	−.0276 (.0246)	.1848 (.0781)	−.1487 (.0523)	.1767 (.0613)	−.0185 (.0600)
Sum of s^t_{t+1} and Δs^*_{t-j} coefficients	.1055 (.0372)	−.0143 (.0282)	.3275 (.0897)	−.0622 (.0601)	.3191 (.0726)	.0326 (.0711)
Sum of u^c coefficients	.0450 (.0138)	.0221 (.0104)	.0762 (.0441)	.0818 (.0296)	.0863 (.0317)	−.0252 (.0311)
Sum of $d^* + p^*$ coefficients	.0260 (.0255)	.0875 (.0193)	−.0971 (.0833)	.1505 (.0558)	−.0051 (.0366)	.1511 (.0358)
n(−58)	1054	1054	58	58	58	58

	(.0107)	(.0081)	(.0363)	(.0243)	(.0336)	(.0329)
u^c_{t-1}	.0195 (.0106)	.0043 (.0083)	.0288 (.0294)	.0348 (.0197)	.0288 (.0262)	-.0140 (.0256)
s^t_{t+1}	.0368 (.0142)	.0133 (.0107)	.1428 (.0488)	.0865 (.0327)	.1424 (.0436)	.0511 (.0427)
$\sum_{j=0}^{5} \Delta s^*_{t-j}$ coefficients	.0687 (.0325)	-.0276 (.0246)	.1848 (.0781)	-.1487 (.0523)	.1767 (.0613)	-.0185 (.0600)
Sum of s^t_{t+1} and Δs^*_{t-j} coefficients	.1055 (.0372)	-.0143 (.0282)	.3275 (.0897)	-.0622 (.0601)	.3191 (.0726)	.0326 (.0711)
Sum of u^c coefficients	.0450 (.0138)	.0221 (.0104)	.0762 (.0441)	.0818 (.0296)	.0863 (.0317)	-.0252 (.0311)
Sum of $d^* + p^*$ coefficients	.0260 (.0255)	.0875 (.0193)	-.0971 (.0833)	.1505 (.0558)	-.0051 (.0366)	.1511 (.0358)
$n(-58)$	1054	1054	58	58	58	58
r.d.f.	840	840	40	40	45	45
$\bar{R}^2$	.0577	.0511	.3547	.3183	.3285	.3464
F	5.35	4.82	3.38	3.02	3.32	3.52
$F_{.01}$	2.21	2.21	2.66	2.66	2.61	2.61

[a]For t = 1958 to 1968 only; depreciation data were not available for observations of years prior to 1958. Only fifty-eight industry-year observations were available because there were no observations in mining for t = 1958, 1959, 1960, 1966, 1967 and 1968 and, similarly, none for petroleum for t = 1967 and 1968.

penditures turns up in regressions where the flow of funds and utilization of capacity enter as other independent variables with positive coefficients. Reestimates of the Feldstein-Foot relation with our data yield results somewhat different from theirs, as shown in Table 8-5. Taking the aggregate relations, we find that the positive coefficient of planned expansion expenditures is brought close to zero when utilization of capacity and flow of funds variables are included, but that it does not turn sharply negative as in the Feldstein-Foot estimates. And in this case, our industry and firm regressions are roughly consistent with our aggregate regression.

The Feldstein-Foot relation indicates that higher utilization of capacity, as well as a greater flow of funds, brings on greater replacement expenditures, except to the extent that they, or other forces, also bring on higher expansion expenditures. That expansion expenditures might relate negatively to replacement expenditures is plausible, for expanding firms would be more likely to retain all existing capacity. Also, Feldstein and Foot point out that while the

Table 8-5. Comparison with Feldstein-Foot Time Series Estimates, Planned Replacement Expenditures:

$i^{rt}_{t+1} = (1 - e^{t}_{t+1})\, i^{t*}_{t+1}$

(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
	Regression Coefficients and Standard Errors						
Variable or Statistic	*Eisner*						*Feldstein-Foot*
	Firms		*Industries*		*Aggregate*		*Aggregate*
Constant	.044	.013	.041	.012	.040	.018	−.051
	(.001)	(.005)	(.002)	(.014)	(.003)	(.021)	(.022)
u_t^c	–	.019	–	.017	–	.015	.104[a]
	–	(.006)	–	(.016)	–	(.024)	(.032)
$f_t (= p_t^* + d_t^*)$	–	.097	–	.105	–	.083	.216
	–	(.011)	–	(.034)	–	(.061)	(.070)
i^{et}_{t+1}	.077	.034	.166	.057	.214	.055	−.337
	(.016)	(.016)	(.056)	(.061)	(.075)	(.131)	(.106)
$n(-38)$	1990	1990	81[b]	81[b]	14	14	13
r.d.f.	1682	1680	74	72	12	10	9
$\hat{R}^2$	.013	.069	.094	.212	.355	.367	.85

[a] u_t^a, actual utilization of capacity, in the Feldstein-Foot relation.

[b] The fourteen years of data for six industries generated only eighty-one industry observations because there were no individual firm observations in mining for t = 1966 and 1967 and in petroleum for t = 1967.

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same factors may contribute in part to both replacement and expansion expenditures (causing them to be correlated with one another, as confirmed by their positive sample correlations and ours), the increasing cost of higher gross investment may tend to make expansion and replacement partial substitutes. The lack of confirmation of a negative coefficient of expansion investment in our data may be related to our considerably higher positive simple correlation of replacement and expansion investment: 0.60 as compared with from 0.27 to 0.47 reported by Feldstein and Foot (1971, p. 54, footnote 25).

This, in turn, may stem from the fact that our capital expenditure anticipations data and anticipated proportions for replacement and expansion involve the same coverage and, indeed, identical respondents. To the extent that part of the Feldstein Commerce Department capital expenditure anticipations are unrelated to the expenditures underlying the McGraw-Hill anticipated proportions, there would be a negative relation between measured anticipated expansion and anticipated replacement: with a given (unrelated) total, a higher fraction in one category must mean a lower fraction in the other. Thus, the simple positive correlation due to common determinants would be reduced, permitting more sharply negative partial correlation and regression coefficients. On the other hand, the likely error in our gross fixed assets measure of capital stock may produce a spurious positive correlation between expansion and replacement expenditures variables; that this error in the common divisor is at least not sufficient to create a common trend, however, can be seen in Table 8-1A, where mean values are found to be approximately the same in the later years (1962-1968) as in the early years (1954-1961).

The higher flow of funds coefficient for the Feldstein-Foot data may reflect a feedback of capital expenditures to income, which should be more conspicuous in the more comprehensive Department of Commerce and FTC-SEC aggregates than in our more modest McGraw-Hill sample. The differences in the capacity utilization coefficient may relate to differences in the variable. Feldstein and Foot use the Federal Reserve Board index of capacity utilization, while we utilize McGraw-Hill responses to calculate the ratio for each firm's actual to "preferred" rate of capacity utilization; our aggregate observations are annual means of these individual firm ratios.[10]

In any event, however, there is danger of misconception in the

[10] It should also be noted that there are certain cross-sectional elements in both our industry and aggregate time series because the samples of firms responding, while largely overlapping, are not identical from year to year.

Feldstein-Foot statement, "Expansion investment causes an offsetting fall in replacement investment, supporting the view that firms postpone replacement during periods of expansion investment and accelerate replacement when there is less expansion investment."[11] From the Feldstein-Foot data it would appear that, ceteris paribus, more expansion investment means less replacement investment. But other things are not the same, and when there is more expansion investment there also tends to be more replacement investment. This is shown in the positive simple correlation between i^e and i^r reported by Feldstein and Foot, and is more sharply delineated in the simple regression of i^r on i^e that we have presented in Table 8-5.

SUMMARY AND CONCLUSIONS

This brief report of extensive statistical results enables us to offer the following tentative conclusions.

1. Expenditures planned for replacement and modernization varied over time and, as observed by Feldstein and Foot, were not a constant proportion of capital (in our case, gross fixed assets), although they were a much more constant proportion than were expenditures planned for expansion.
2. While varying less, replacement and modernization expenditures were not a stabilizing substitute for expansion expenditures, but rather moved up and down with expansion expenditures.
3. Expenditures for expansion are clearly related to past and expected sales changes (and to some extent utilization of capacity), particularly in cross sections and industry regressions in which random or transitory components of individual firm variance over time may cancel out.
4. Replacement and modernization expenditures, conversely, are usually more positively related to previous depreciation charges and profits and, less certainly, to the depreciation reserve as a possible proxy for the age of capital.

[11] Feldstein and Foot (1971, p. 54).

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