PRIVATE CORPORATE INVESTMENT AND EFFECTIVE TAX RATES: A RE-EXAMINATION OF A FELDSTEIN-CHIRINKO CONTROVERSY

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NO. 6/88 OCTOBER 1988

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ABSTRACT

We examine the relationship between private corporate investment and effective tax rates. We first attempt an analysis of causality between effective tax rates and business investment in India. We then proceed to comment on the controversy between Feldstein (1982, 1987) and Chirinko (1987). Our results support Feldstein's net rate of return model and we are unable to support the refinements to this model proposed by Chirinko.

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1. Introduction

In his celebrated Fisher-Schultz lecture, Feldstein (1982) proposed a clear and direct relation between business investment and taxes. He hypothesised that taxes and investment expenditure are strongly related; an increase in the former tends to discourage the latter. To support his hypothesis he specified three alternative models and presented econometric evidence pertaining to the US economy. Of the three specifications, he placed most emphasis on the net rate of return model which is based on a set of assumptions that are tractable[1] and affords a simple and direct test of the relationship between investment and taxes. In the neoclassical tradition, Feldstein's model is an innovation.

Unfortunately, before this approach could become popular it has become controversial. Chirinko (1987) has extensively criticised this approach. He feels that Feldstein has "misspecified" the net rate of return model. According to Chirinko, "net revaluations to capital" should be added to the net rate of return. When he does so he does not find much support for Feldstein's hypothesis.

Feldstein (1987) has defended his work on two main grounds. First, that his model works well with newer set of data, and second, that the variable "net revaluations to capital" is not relevant in his model.

In our opinion an important issue in this debate is an empirical one. Hence we thought that conducting an exercise parallel to the Feldstein-Chirinko approach with a different data set (in our case, Indian) might shed additional light on this controversy. There is another reason why the present paper could be important. In India the share of private corporate investment in the gross domestic product of the economy has tended to stagnate. Many observers[2] have linked the structure of direct tax pertaining to income from investment to this poor performance of private corporate investment. This motivation for our paper is the same as that behind Feldstein's. He too was concerned about the poor performance of investment.

The plan of this paper is as follows. We briefly review the Feldstein-Chirinko controversy in the following section. In section 3 we present a purely suggestive[3] analysis of the causal relationship between investment and taxes in India. Section 4 presents the empirical estimates of the investment function for India and our appraisal of the Feldstein-Chirinko controversy in the light of these results. Section 5 offers some concluding comments.

2. The Feldstein-Chirinko Controversy

Feldstein writes the basic net rate of return model as:

$$\frac{I_t}{Y_t} = a_o + a_1 \, RN_{t-1} + a_2 \, UCap_{t-1} + u_t \qquad (1)$$

Where (i) RN_{t-1} is the one-year lag value of the real net of tax return on capital income,

(ii) $UCap_{t-1}$ is the one-year lag value of capacity utilisation,

(iii) I_t is the real net fixed non-residential investment,

(iv) Y_t is the real gross national product.

The variable RN_t is defined as the product of the real pre-tax return on capital (R_t) and one minus the effective tax rate (ETR_t) on that return, i.e.,

$$RN_t = (1-ETR_t) \times R_t$$

Feldstein found good support for this equation and concluded that price (RN_t) and quantity ($UCap_t$) variables are important in determining investment behaviour. He also gets "expected" signs.

Chirinko (1987) feels that Feldstein has misspecified his model. He believes that net revaluation of capital (NR_t) should be added to RN_t in order to fully capture the price variable. Operationally he defines NR_t as:

$$NR_t = 0.65 \{(\dot{q}/q)_{PE,t} - (\dot{p}/p)_t\} \qquad (2)$$

Where 0.65 is the share of plant and equipment in the firm´s tangible capital stock (in the US), $(\dot{q}/q)_{PE,t}$ is the percentage change in the value of plant and equipment, and $(\dot{p}/p)$ is the overall rate of inflation.

Chirinko defines the net of tax real return with net revaluation of capital as:

$RNNR_t = RN_t + NR_t$ so that his estimated investment function is

$$\frac{I_t}{Y_t} = a_0' + a_1' \, RNNR_{t-1} + a_2' \, UCap_{t-1} + u_t \qquad (3)$$

Chirinko does not get a very good fit, but, more importantly, finds that the roles of the price and output variables have been reversed.

Feldstein (1987) has replied to Chirinko´s criticism. Among other things, he objects to Chirinko´s treatment of net revaluation of capital.

3. Investment and Taxes in India - A Suggestive Causal Analysis

In this section we report results of a suggestive test of causality between investment and taxes along the lines suggested by Geweke and Dent (1983). They present a simple Granger test for causality whose logic runs along the following lines. If the system or universe is entirely linear and if all the variables are identified within that system, then (partial) correlation between two variables implies that they are causally related. However, since the universe may not be linear the presence/indication of high correlation among variables does not in any necessary sense establish that they are causally related. Variables may be functionally related and yet be uncorrelated and they may be correlated but not causally related.

In this context the Dent-Geweke-Granger strategy[4] is to adopt a pragmatic approach. If X and Y are two stationary stochastic variables then four patterns of causality can be identified: (i) simple causality, (ii) instantaneous causality, (iii) lag causality, and (iv) feedback causality.

Given the relevant data set, these patterns of causality can be identified by estimating regressions of Y and X and _vice versa_ on all the relevant variables including the current and past values of X and Y respectively, and by testing approximate hypotheses. Thus the general causal model can be written as:

$$y_t = b_o + a_o X_t + \sum_{j=1}^{m} a_j X_{t-j} + \sum_{i=1}^{n} b_i Y_{t-i} + u_t \qquad (4)$$

and

$$X_t = c_o + d_o Y_t + \sum_{i=1}^{n} C_i X_{t-i} + \sum_{j=1}^{m} d_j y_{t-j} + V_t \qquad (5)$$

where u_t and V_t are mutually uncorrelated white noise series. The test for causality runs the regressions (4) and (5) and tests the null hypotheses that $a_j = d_j = o$ against the alternative hypotheses that $a_j \neq 0$ and $d_j \neq 0$ for at least some j. The testable patterns of causality are reported in Table 1 of Singh-Sahni (1984).

To test for causality between investment (Y) and corporation tax (X) in the Indian case private capital formation, we collected data from Central Statistical Organisation (CSO) and Reserve Bank of India (RBI) bulletins for the period 1960-1980. The results are noted in Table 1 appended.

From Table 1 we conclude that corporate taxes cause private corporate investment with a lag. Hence there is further confirmation of the basis of the type of investment equation estimated by Feldstein.

4. Feldstein-Chirinko Controversy in the Light of Indian Experience

To estimate Feldstein's model for the Indian private corporate sector we need the following data: (i) net fixed investment, profits (net of depreciation) before taxes, interest expenses, value of capital stock, and taxes paid; (ii) a measure of capacity utilisation for the private corporate sector; and (iii) real GNP.

For the first set of variables Reserve Bank of India (RBI) bulletins are the only source of data. However, the bulletins give figures for a selected sample of companies. These figures were blown up to get the population figures, i.e., for the Indian private corporate sector as a whole, using the procedure outlined in RBI (1967).

For capacity utilisation measure there is no continuous series for the period 1960-80. There are three different series on capacity utilisation:

a. For the period 1960-1973 we have data from the RBI bulletins. In this series capacity utilisation is defined as the ratio of average production index to the potential production of the industry during one year. This series covers 80 per cent of the industries mentioned in the General Index of Industrial Production (GIIP).

b. The second series is published by the Industrial Development Bank of India (IDBI) in its various reports and covers the period 1970-1984. This series covers 50.8 per cent of industries in GIIP and defines capacity utilisation as the ratio of realised production to installed capacity.

c. Finally, we have the RBI's figures in its Report on Currency and Finance (RCF) (various issues) for the period 1970-1980. This series defines capacity utilisation as the ratio of the realised production to installed capacity and its coverage has varied somewhat.

We constructed five different measures of capacity utilisation as:

i. The RR series: We have merged the RBI series and RCF series without any adjustment. For the overlapping years RBI figures were used.

ii. RRA series: We have adjusted the IDBI series and clubbed it with the RBI series. For the overlapping years the proportionate average common difference between the two series was calculated and the IDBI series was scaled up by that proportion[5].

iii. (RIA) and (iv) RBII: We constructed an index of capacity utilisation with the RBI series for 1960-1973 with 1960 as base. Then we used the IDBI series for 1970-1980 and constructed an index of capacity utilisation with 1970 as base. The IDBI index and the RBI index were spliced together to get two series with base 1960 (RIA) and base 1970 (RBII).

v. IDBII series: We adjusted the RCF series using the method detailed in (ii) and used it with the RBI series.

GNP figures are obtainable from the Central Statistical Organisation, Government of India.

To estimate the Chirinko model we calculated the average share of plant and equipment in tangible capital stock to be 0.576 for the Indian private corporate sector. To estimate NR_t we use

$$NR_t = 0.576 \{(\dot{q}/q)_{PE,t} - (\dot{p}/p)_t\}$$

Data on value of plant and equipment, value of total capital stock and the wholesale price index was collected from various bulletins of RBI.

The results of regressions are reported in Table 2 whereas the restricted F tests are reported in Table 3.

5. Conclusions

On the basis of the empirical analysis reported above, we draw the following conclusions:

a. There is no reversal of the importance of the price and output variables for the Indian private corporate sector in Feldstein's model after incorporating net revaluations to capital.

b. Using standard criteria like R^2 and t and F tests, we found that Feldstein's model applied well to the Indian private corporate sector for the period 1960-1980. Indeed the estimated Feldstein equations perform marginally better than the Chirinko equations. Also this result does not seem to be sensitive to the definition of capacity utilisation used.

c. Taxes are, undoubtedly, an important determinant of private corporate investment in India. The present study underscores the urgent necessity of a detailed and thorough investigation of this relation.

TABLE 1

Causality between Investment and Taxes

(Y refers to Investment and X to Corporation Tax)

(1)	(2)	(3)	(4)	(5)
Equation (4)	R^2	DWS	F_c	F_r
$Y = f(X_o, X_{-1}, X_{-2}, Y_{-1}, Y_{-2})$	.83	1.78	17.74	4.83
$Y = f(X_o, X_{-1}, Y_{-1}, Y_{-2})$	.78	1.81	17.48	7.43
$Y = f(X_o, Y_{-1}, Y_{-2})$	.70	1.87	15.73	0.525
Equation (5)				
$X = f(Y_o, Y_{-1}, Y_{-2}, X_{-1}, X_{-2})$	.35	1.66	2.45	.356
$X = f(Y_o, Y_{-1}, X_{-1}, X_{-2})$	.34	1.71	2.47	4.11
$X = f(Y_o, X_{-1}, X_{-2})$	.20	1.67	1.92	3.715

Inference: Unidirectional Lag Causality, etc., X causes Y with a lag.

Note: F statistic in oolumn 4 F_c) tests the null hypothosis that all regressors had zero coefficients and F statistio in column 5 (F_r) tests the hypothesis that the regressor dropped coefficient had zero.

Table 2

Results on the Feldstein and Chirinko Models

Definition of Capacity Utilization	Feldstein's Model			Chirinko's Model		
1. RR	$\frac{I_t}{Y_t}$ = $-1.05(10^{-3})$	+ $2.95(10^{-4})RN_{t-1}$	+ $1.31(10^{-5})UCAP_{t-1}$	$\frac{I_t}{Y_t}$ = $-1.09(10^{-3})$	+ $2.9\ (10^{-4})RNNR_{t-1}$	+ $1.35(10^{-5})UCAP_{t-1}$
	$(5.4)(10^{-4})$	$(7.17(10^{-5}))$	$(6.7(10^{-6}))$	$(6.06)(10^{-4})$	$(7.7(10^{-5}))$	$(7.5(10^{-6}))$
	(1.99)*	(4.11)**	(1.95)*	(-1.8)*	(3.7)**	(1.8)*
	R^2 = .525	DWS = 2.3	SSR = $4.8(10^{-7})$	R^2 = .50	DWS = 2.39	SSR = $5.04(10^{-7})$
2. RRA	$\frac{I_t}{Y_t}$ = $-9.17(10^{-4})$	+ $2.72(10^{-4})$	+ $1.11(10^{-5})UCAP_{t-1}$	$\frac{I_t}{Y_t}$ = $-9.2\ (10^{-4})$	+ $2.72(10^{-4})RNNR_{t-1}$*	+ $1.12(10^{-5})UCAP_{t-1}$
	$(8.7)(10^{-4})$	$(7.57(10^{-5}))$	$(1.05(10^{-5}))$	$(9.7)(10^{-4})$	$(7.8)(10^{-5})$	$(1.18)(10^{-5})$
	(1.04)	(3.59)**	$(1.05(10^{-5}))$	(-.94)	(3.5)**	(0.94)
	R^2 = .45	DWS = 2.26	SSR = $5.56(10^{-7})$	R^2 = .45	DWS = 2.26	SSR = $5.56(10^{-7})$
3. RIA	$\frac{I_t}{Y_t}$ = $-1.2\ (10^{-3})$	+ $3.13(10^{-4})RN_{t-1}$	+ $1.4\ (10^{-5})UCAP_{t-1}$	$\frac{I_t}{Y_t}$ = $-1.24(10^{-3})$	+ $3.09(10^{-4})RNNR_{t-1}$	+ $1.5\ (10^{-5})UCAP_{t-1}$
	$(6.5)(10^{-4})$	$(7.6x10^{-5})$	$(8.6x10^{-6})$	$(7.4)(10^{-4})$	$(8.1x10^{-5})$	$(9.1x10^{-6})$
	(-1.8)*	(4.12)**	(1.85)*	(-1.67)	(3.77)**	(1.66)
	R^2 = .52	DWS = 2.29	SSR = $(4.9)(10^{-7})$	R^2 = .48	DWS = 2.36	SSR = $(5.8)(10^{-7})$
4. RBII	$\frac{I_t}{Y_t}$ = $-1.19(10^{-3})$	+ $3.12(10^{-4})RN_{t-1}$	+ $1.28(10^{-5})UCAP_{t-1}$	$\frac{I_t}{Y_t}$ = $-1.25(10^{-3})$	+ $3.13(10^{-4})RNNR_{t-1}$	+ $1.35(10^{-5})UCAP_{t-1}$
	$(6.5)(10^{-4})$	$(7.6)(10^{-5})$	$(7.06)(10^{-6})$	$(7.2)(10^{-4})$	$(7.8)(10^{-5})$	$(7.81)(10^{-6})$
	(1.8)*	(4.09)**	(1.8)*	(-1.7)	(3.98)**	(1.73)
	R^2 = .513	DWS = 2.27	SSR = $4.9(10^{-7})$	R^2 = .514	DWS = 2.29	SSR = $4.9(10^{-7})$
5. IDBII	$\frac{I_t}{Y}$ = $-1.19(10^{-3})$	+ $3.12(10^{-4})RN_{t-1}$	+ $1.17(10^{-5})UCAP_{t-1}$	$\frac{I_t}{Y_t}$ = $-1.25(10^{-3})$	+ $3.12(10^{-4})RNNR_{t-1}$	+ $1.24(10^{-5})UCAP_{t-1}$
	$(6.6)(10^{-4})$	$(7.6)(10^{-5})$	$(6.4)(10^{-6})$	$(7.2)(10^{-4})$	$(7.87)(10^{-5})$	$(7.16)(10^{-6})$
	(-1.8)*	(4.08)**	(1.8)*	(-1.72)	(3.97)**	(1.72)
	R^2 = .512	DWS = 2.27	SSR = $4.9(10^{-7})$	R^2 = .513	DWS = 2.28	SSR = $4.9(10^{-7})$

N.B. (i) The first number below a coefficient indicates standard error, the second t value. An asterisk (*) above a t value indicates significance at 5%. A double asterisk (**) denotes significance at 1%.

(ii) All data are annual.

Table 3 : Restricted F-Test

Definition of Capacity Utilization	Feldstein's Model		Chirinko's Model	
	H_0: Coefficient of $RN_{t-1}=0$	H_0: Coefficient of $UCAP_{t-1}=0$	H_0: Coefficient $RNNR_{t-1}=0$	H_0: Coefficient of $UCAP_{t-1}=0$
RR	16.92	3.88		
RRA	12.91	1.107	12.08	0.89
RIA	16.98	3.44	14.23	2.76
RBII	16.76	3.3	16.76	3.3
IDBII	16.7	3.27	16.7	3.27

NOTES

1. The older approach due primarily to the classic works of Jorgenson does make a number of stringent assumptions and has been criticised, among others, by Coen (1969).

2. See, for instance, Government of India (1985).

3. We wish to emphasise that the following is a purely suggestive analysis of causality designed to better understand the relation between investment and taxes. We do not claim this to be a full-scale analysis of causality.

4. See Geweke and Dent (1983) or Granger (1969).

5. Given the definitions used, it is clear that the IDBI series would consistently under-estimate capacity utilisation in comparison to the RBI series.

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