SAVING AND SOCIAL CHOICE: AN ANALYSIS OF THE RELATIONSHIP BETWEEN CORPORATE AND PERSONAL SAVING

MATTHEW J. LAMBRINIDES

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I. Introduction

The development of the advanced, western economies over the last two centuries has been one of economic expansion and change. That a marked acceleration in the rate of economic growth, in both absolute and per capita terms, and an incessant change in the structure of consumption and production are two features of capitalist development which differentiate it from the pre-industrial forms of social organization is one of the few propositions in economics that will not evoke any controversy.

The importance of these two dimensions of capitalist development has been reflected in the history of economic thought. The interpretation of the causes and consequences of growth, or lack thereof, has been a central pre-occupation of economic enquiry since Adam Smith. Within this broad field of investigation, few themes have concerned economic theorists more than the location of control over the rate and pattern of economic change in a market economy where production takes place within privately owned, autonomous firms. The neoclassical system of analysis has been the dominant theory of capitalist economies for over a century. It is one of the fundamental neoclassical principles that the development of a competitive capitalist economy follows the preferences of its individual members in a certain well defined sense. Under a series of strong assumptions, it is shown that all individuals are in agreement concerning the rate and pattern of economic expansion. Neoclassical economists, in other words, deny that the corporate managers and other who occupy the higher positions in the hierarchy of capitalist organizations are effective in imposing their interests on the remaining and less favorably placed members of society.

The following essay is an analysis of some important aspects of the neo-classical principle of individual sovereignty. After presenting a testable version of the neo-classical theory and some of its competitor hypotheses, we proceed to confront the theories with the relevant data

from the U.S. economy.

II. Economic Development and Individual Choice

1. The Importance of the Location of Control Over the Saving Decision

Economic growth requires capital accumulation and capital accumulation requires saving. The proposition that, if a society is to accumulate capital and expand its output, it must abstain from consuming its entire product, has an important corollary. That is, if an individual or group in the society is to exert any influence on the rate and pattern of economic growth, then this individual or group must share in the control over the decision determining the rate of saving and the pattern of accumulation.(1)

2. The Neo-Classical Theory of Intertemporal Choice

According to the neo-classical theory of Irving Fisher and its extensions, the social rate of saving and the pattern of accumulation are the result of the independent decisions of all the individuals concerning the allocation of their wealth between present and future consumption.

Provided that they expect no diminution in income, individuals are willing to save part of their income only if their abstinence is rewarded by an adequate return over and above the amount of their saving. Utility-maximizing individuals will, therefore, abstain from immediately consuming their income up to the point where the sacrifice entailed by one extra dollar of postponed consumption just equals the interest reward offered in the market for investible funds.

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(1) Thinking about growth within the framework of neo-classical, steady-state models, would necessitate a qualification of the last statement. In steady-state, the saving rate does not affect the equilibrium rate of growth. Even in such models, however, the saving rate affects several features of the growth path which have welfare significance. The level of income per capita, the level of consumption per capita, and the wage rate along any given growth path depend on the saving rate.

Firms, in turn, choose to borrow the savings of individuals at a positive interest cost because they can invest the resources so acquired in capital-using methods of production which, after the passage of some time, yield a return over and above their cost. Following a marginal calculus of costs and benefits analogous to the one used by consumers, profit maximizing firms will keep borrowing so long as the rate of return over cost per dollar invested in the expansion of their capital stock exceeds the market rate of interest.

Since any utility-maximizing individual will lend his savings to those firms which promise the highest interest reward, equilibrium in the market for investible funds implies that the rate of interest is equal, first, to the (common) rate of return on investment in all lines of production, and second, to the (common) marginal rate of time preference of every individual in the society.(2) In other words, the sacrifice of one extra dollar of foregone consumption on the part of any individual just equals the net benefit to be derived from investing one extra dollar in any line of industrial activity. It follows that , within the 'rules of the game' that define an atomistic, competitive, capitalist economy, there is no reason for any utility-maximizing individual to want a change in the

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(2) This conclusion is, of course, contingent on the absence of externalities and non-convexities.

amount of saving or the pattern of investment.[3] Given the distribution of property and human capital, all individuals are in agreement concerning the share of the social product which should be witheld from present consumption as well as about the lines of productive activity into which the social saving fund should be channelled. This is the content of the principle of individual sovereignty when formulated explicitly in an intertemporal context.

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(3) The qualification concerning the 'rules of the game' is intended to emphasize the restrictive content of the consensus achieved through the operation of the market system.

Any specific social group, for example the poor, would have an interest in forcing some other social group, for example the rich, to save more than the latter would choose to under 'neo-classical'conditions. This would be the case so long as, first, an increase in the capital-labor ratio would raise the social productivity of labor, and, second, the poor would receive some portion of the extra output. For, under the stated conditions, the poor would gain something (whatever portion of the extra social product accrues to them) for nothing (since it is the rich and not the poor who suffer the additional abstinence). But, in an atomistic economy, individuals are free to dispose of their income as they like. The poor have no way of prevailing upon the rich to dispose of their income in a way other than the one which maximizes the intertemporal utility function of the rich.

3. Criticisms of the Neo-Classical Hypothesis

The validity of the principle of individual sovereignty, as applied to saving, hinges critically on two premises.

First, that the saving done by each individual (or, head of household) is the result of a deliberate allocation of his anticipated life-time wealth between present and future consumption. If personal saving is not determined by such a utility-maximizing, life-time plan, then it cannot be maintainedthat, in equilibrium, the rate of interest reflects the rate of time preference of all the members of the community; in this case the rate of time preference is a meaningless concept.

Second, the neo-classical theorem of individual sovereignty depends critically on whether there is any saving done in the economy which is not subject to the control of individuals.

In this paper, we will be concerned with the second line of criticism of Fisher's theory as it applies to corporate saving.

III. Corporate Saving and Individual Sovereignty

1. The Managerial Argument

The argument that corporate saving does not reflect the preferences of individuals is based on the thesis of Managerial Capitalism. The economic system of developed capitalist economies is, according to this thesis, dominated by large corporations whose owenership is widely dispersed. The dilution of ownership makes it practically impossible for stockholders to supervise actively the operations of their corporation. The managers of modern joint-stock companies are thus left with wide discretionary power to run their enterprises according to their own preferences, rather than according to the preferences of stockholders.

One of the dimensions of corporate policy where managerial sovereignty makes a difference is the determination of the rate of saving of corporations. Managerial teams attach utility to the growth of their enterprise and have a strong preference for financing its expansion from internally generated funds. Now, it may very well be that, up to a point corporate saving reflects the wishes of individual stockholders. This is the case when the successful investment of retained earnings results in increases in the stream of dividends and capital gains which more than compensate the individual stockholder for his abstinence.(4) But the benefits which stockholders derive from extra retentions always require a sacrifice on their part; namely, abstinence from consuming the dividend equivalent of the extra retained earnings. In contrast, the benefits which managers derive from corporate saving do not require any abstinence. When they make decisions concerning retentions, managers are not sacrificing their own present income. It follows that managers will always want to push the saving rate of their corporations beyond the level which is most preferred by stockholders.

2. The Neo-Classical Reply

The neo-classical reply to the managerial thesis is that the separation of ownership from control is more apparent than real. Market forces constrain management-controlled firms to behave in a way that their stockholders want them to. As Solow has put it:

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(4) The preferential taxation of capital gains is of importance here.

> Theories that emphasize the separation of ownership from control tend to ignore the fact that, if a common stockholder cannot control the policy of the corporation he owns, he can arrange to own a different corporation by merely telephoning his broker. (5)

The management which does not follow the preferences of the corporation's stockholders with regard to the saving, or any other, policy decision

> will find that the stockmarket puts a relatively low valuation on its assets. This may offer an aggressive management elsewhere a tempting opportunity to acquire assets cheap, and the result may be a merger offer or a takeover bid, a definite threat to the autonomy of the management taken over. (6)

For the purposes of the present analysis, the important implication of Solow's hypothesis of the functioning of the stockmarket is that corporate saving is, like personal saving, under the control of individuals who determine the total amount of their saving in the manner described by Fisher. It follows that the distribution of after-tax private income between households and corporations is of no consequence for the total amount of private saving. S^{pers}/Y^{pers} always varies inversely with S^{corp}/Y^{priv} so as to neutralize the effect of S^{corp}/Y^{priv} on S^{priv}/Y^{priv}.(8)

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(5) Robert M. Solow, "The New Industrial State or Son of Affluence," in The Public Interest, (Fall 1967), p.107.

(6) Ibid.

(7) See Franco Modigliani, "The Life Cycle Hypothesis of Saving and Intercountry Differences in the Saving Ratio," in W.A. Eltis, et.al., (ed.), Induction, Growth and Trade: Essays in Honor of Sir Roy Harrod. Oxford:Clarendon Press, 1970, especially pp. 219-21.

(8) Notation: S^{pers} stands for personal saving, Y^{pers} for disposable personal income, S^{corp} for corporate saving, S^{priv} for private saving (= $S^{pers} + S^{corp}$), and Y^{priv} for private income (=$Y^{pers} + S^{corp}$).

This is so because the division of total private saving between personal and corporate saving is, in effect, a subsidiary decision which follows the determination of the level of private saving and is determined by the relative costs and benefits of the personal and corporate forms of saving.

IV. Testable Formulation of the Neo-Classical Theory: Modigliani's Life Cycle Hypothesis of Saving

So far our task has been one of exposition of first principles. We have stated the central theorems of the neo-classical theory and given particular emphasis to their application to corporate saving. We have also outlined the competitor hypothesis that corporate saving is subject to the discretion of corporate managements. We are now in the position to turn to the examination of testable formulations of the competing hypotheses

Testing the neo-classical theory is not an easy undertaking. The central proposition of Fisher's hypothesis is that the allocation of an individual's current income (both his personal and his share of corporate income) between consumption and saving depends on his expected life-time resources, the rate of interest, and his preferences between present and future consumption. Now, the concept of expected life-time resources is an extremely difficult one to measure. This is so because an individual's conception of his "expected life-time resources" is highly subjective and frequently modified. The two best known attempts to give operational content to the concept of "expected life-time resources" are Friedman's Permanent Income and Modigliani's Life-Cycle Hypotheses. We will concentrate exclusively on the model of Modigliani and his associates Brumberg and Ando because it is the only one of the two models which has definite implications for corporate saving and its relationship to personal saving.

> The Modigliani ... model starts from the utility function of the individual consumer: his utility is assumed to be a function of his own aggregate consumption in current and future periods. The individual is then assumed to maximize his utility subject to the resources available to him, his resources being the sum of current and discounted future earnings over his lifetime and his current net worth. As a result of this maximization the current consumption of the individual can be expressed as a function of his resources and the rate of return on capital with parameters depending on age. The individual consumption functions thus obtained are then aggregated to arrive at the aggregate consumption function for the community. (9)

This is, of course, simply the Fisherian theory of intertemporal choice. To give operational content to the time-series version of their model Modigliani and Ando make the following restrictive assumptions.

Assumption 1 : The utility function of each and every individual is homogeneous of degree one with respect to consumption in different periods.

Assumption 2 : Individual consumers do not receive or leave any inheritance.

Assumptions (1) and (2) imply that, at time t, and individual of age T will consume an amount c_t^T given by:

$$C_t^T = k_t^T \left[a_{t-1}^T + y_t^T + (N - T)\, y_t^{eT} \right] \qquad (1)$$

where k_t^T is a proportionality factor, a_{t-1}^T is net worth at the beginning of period t, y_t^T is current non-property income, and y_t^{eT} is expected average annual non-property income over the individual's earning span which is given by N.

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(9) Ando, Albert and Modigliani, Franco, "The 'Life-Cycle' Hypothesis of Saving: Aggregate Implications and Tests," American Economic Review, March, 1963, p.56.

y_t^{eT} is given by: $$y_t^{eT} = \sum_{p=T+1}^{N} \frac{y_t^{eTp}}{(1+r)^{P-T}} \qquad (2)$$

where y_t^{eTp} is expected non-property income in year p and r is the rate of return on assets.

Assumption 3: k_t^T is identical for all individuals in the age group T. This assumption enables Modigliani and Ando to aggregate (1) for each age group.

Assumption 4: The parameters of equation (1) are constant over time for each age group.

Assumption 5: The age structure of the population remains constant over time.

Assumption 6: The distribution of income, expected income and net worth among age groups remains constant over time.

The last three assumptions make it possible to aggregate (1) over all age groups to obtain the aggregate consumption function:

$$C_t = d_1' Y_t + d_2' Y_t^e + d_3' A_{t-1} \qquad (3)$$

where capital letters stand for national aggregates of the previously defined variables. This still leaves us with Y_t^e undefined.

Assumption 7: $Y_t^e = f\, Y_t$ where f is a proportionality constant, yields $C_t = (d_1' + f d_2')Y_t + d_3' A_{t-1}$,

or

$$C_t = d_1 Y_t + d_3 A_{t-1}, \quad \text{where}$$

$$d_1 = d_1' + f\, d_2'$$

$$d_3 = d_3' \qquad (4)$$

The aggregate private savings function is obtained by starting from the identity, $$S_t^{pri} = Y_t^{pri} - C_t \qquad (5)$$

where $$S_t^{pri} = S_t^{corp} + S_t^{pers} \qquad (6)$$

with S_t^{corp} being corporate and S_t^{pers} being personal saving.

Similarly, total private income is given by

$$Y_t^{pri} = Y_t + P_t \qquad (7)$$

with Y_t being non-property and P_t property income.

Assumption 8: The rate of return on assets is constant and is expected to remain constant, that is $P_t = rA_{t-1}$ (8)

for all t.

Equations (5) through (8) yield:

$$S_t^{pri} = (1-d_1)\, Y_t^{pri} + (d_1 r - d_3)A_{t-1} \qquad (9)$$

But $Y_t^{pri} = Y_t^{pers} + S_t^{corp}$ (10), where Y_t^{pers} is disposable personal income. By subsititutíng for Y_t^{pri} from (10) into (9), we obtain:

$$S_t^{pri} = (1-d_1)\, Y_t^{pers} + (1-d_1)\, S_t^{corp} + (d_1 r - d_3)A_{t-1} \qquad (11)$$

(11) implies that $\dfrac{\partial S_t^{pri}}{\partial Y_t^{pers}} = \dfrac{\partial S_t^{pri}}{\partial S_t^{corp}}$. In other words, the division of private income between disposable personal income and corporate saving is, according to Modigliani, of no consequence for the determination of the total amount of private saving.(10)

V. Econometric Tests of the Neo-Classical and Managerial Hypotheses of Corporate Saving.

1. Design

We are now in the position to design econometric tests which will, hopefully, discriminate between the neo-classical and the managerial hypotheses of corporate saving. Suppose that we fit the equation:

$$S_t^{pri} = h_1 + h_2\, Y_t^{pers} + h_3\, S_t^{corp} + h_4\, A_{t-1} \qquad (12)$$

We distinguish three cases:

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(10) See Part III-2 of this paper.

(i) The Neo-Classical Case As we saw in the previous section, the Modigliani-Ando version of the neo-classical hypothesis implies that we should obtain

$$h_2 = h_3, \quad h_1 = 0, \text{ and } h_4 < 0.$$

(ii) The Managerial Case The central managerial thesis is that, while personal saving is under the discretion of individuals irrespective of their position in the process of production, corporate saving is under the control of corporate managements and will, in general, not follow the preferences of the nominal owners of corporate capital. Under this case, we distinguish two possibilities.

(ii-a) The Independence Case. Suppose that, first, managements are in control of their corporations' saving, and, second, stockholders do not regard corporate saving as one form of their personal saving. In other words, individual stockholders do not adjust their personal saving depending upon whether the amount of corporate saving is high or low given the level of private income. In this case, personal saving is independent of corporate saving. Fitting (12) should yield $h_3 = 1$ since there is no compensating movement in S_t^{pers} given S_t^{corp}, and $h_2 < h_3$ since consumption is always at a positive level. Case ii-a has no definite implication for h_1 and h_4.

(ii-b) The Harrod Case. In his Economic Dynamics Harrod made the following argument:

> Corporate saving .... is mainly actuated by the desire of entrepreneurs to provide resources for the expansion of business without forfeiting a controlling interest or unduly enlarging fixed charges. But while the motive for this kind of saving is different (from the motive for personal saving), the result is that individuals ... are provided with additional capital resources, which may serve to meet their private needs ... For this reason corporate saving may not be additional to personal saving, but part of it. To the extent that the value of a man's business saving grows, he is exempted from the necessity of saving out of his personal income in order to provide for his personal contingencies.

> It does not follow that corporate saving can be neglected as a separate constituent of total saving. For instance, it is conceivable that corporate saving might exceed the total that all individuals would be disposed to save .... What is more probable is that owing to vis inertiae or business ambition individuals may be led on by their corporate holdings ... to save more than they would choose to, merely in order to provide for their private needs. I shall call an excess of this sort surplus corporate saving; we must add to it personal savings as determined by the fundamental private motives ... in order to reach the total saving by the community. (11)
> (italics added)

Harrod's argument implies that $\frac{S_t^{pers}}{Y_t^{pers}}$ varies inversely with $\frac{S_t^{corp}}{Y_t^{pri}}$.

So far Harrod is in agreement with the neo-classical view. But the second component of Harrod's argument, namely that such variations in $\frac{S_t^{pers}}{Y_t^{pers}}$ do not neutralize completely movements in $\frac{S_t^{corp}}{Y_t^{pri}}$, is at variance with the Modigliani argument. In terms of the parameters of (12) according to Harrod's hypothesis, we should obtain $h_2 < h_3 < 1$.

2. Treatment of Depreciation

Before we proceed to the presentation of the empirical evidence, we must address ourselves to the question of the measurement of the variables of equation (12). The main issue here is whether corporate saving should be measured gross or net of depreciation. The usual argument for using a netmeasure of corporate saving in equations describing the process of choice among alternative consumption streams is straightforward. Capital equipment is used up during the process of production and depreciation allowances are specifically earmarked for the replacement of worn-out equipment. As such, capital consumption

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(11) R.F. Harrod, Towards a Dynamic Economics, New York: St. Martin's Press, 1966 edition, pp. 47-48.

allowances are irrelevant from the viewpoint of the choice of a life-time consumption stream on the part of the owners of corporations. The above argument would be valid only if there were indeed no choice to be made regarding the use of depreciation allowances. For this to be true the following two conditions should be met. First, all capital consumption allowances should be quickly used for the replacement of worn-out equipment. Second, depreciation allowances should just be equal in value to the wear and tear of plant and machines during the relevant period. Neither of these two conditions is fulfilled in the real world. Depreciation allowances are kept in reserves until an opportunity arises for their profitable investment. Furthermore, a firm has considerable freedom to use that method for writing off assets which best suits is financial operations. Finally, depreciation laws change so as to stimulate or discourage investment by supplying corporations with more or fewer funds which are not subject to the corporation income tax. On the last two counts, it is clear that depreciation reserves are not intended to and in fact do not equal the physical wear and tear of business capital. On the first count, the use of depreciation allowances is speeded up or delayed according to the prospective profitability of their investment. To sum up, it is not true that there is no intertemporal choice to be made concerning the use of depreciation allowances. Business saving in the form of capital consumption allowances is, to a considerable extent, subject to the discretion of corporations. Furthermore, such saving is often used for the same purpose as net saving in the form of retained earnings; namely, for the acquisition of net additions to plant and equipment.

To the extent that the last two propositions are correct, saving in the form of depreciation allowances is a substitute for

saving in the form of net retained earnings, and it is the measure of gross saving that is relevant for the analysis of intertemporal choice. Motivated by the belief that depreciation allowances are a partial substitute for retained earnings, we will fit (12) using measures of both gross and net corporate saving. The two results should, thus, bracket the true behavioral relationship.

3. The Data and the Period of Observation

We have fitted equation (12) using annual data for the period 1919-58. We ended the observation period in 1958 because of the lack of data on net worth following that year. The series are essentially the same as those used by Modigliani and Ando. A detailed statement of the sources and transformations of the data can be found in the Statistical Appendix.

4. Results

Table A contains the results for the equations in which a gross measure of corporate saving was used. Table B reports the results based on the use of retained earnings net of depreciation allowances.

Equation(12) was fitted on the levels and first differences of its variables, as well as in ratio form. The ratio-model (equations a-4 and b-4) was derived from (12) as follows.

Dividing through (12) by Y_t^{pri}, we have:

$$\frac{S_t^{pri}}{Y_t^{pri}} = \frac{h_1}{Y_t^{pri}} + h_2 \frac{Y_t^{pers}}{Y_t^{pri}} + h_3 \frac{S_t^{corp}}{Y_t^{pri}} + h_4 \frac{A_{t-1}}{Y_t^{pri}} \qquad (13)$$

$$\text{But} \quad \frac{Y_t^{pers}}{Y_t^{pri}} = 1 - \frac{S_t^{corp}}{Y_t^{pri}} \qquad (14)$$

TABLE A

Equation 12. Results Based on Use of Gross Corporate Saving
Dependent Variable: Gross Private Saving

#	Type of Equation	Constant h_1	Personal Income h_2	Corporate Saving h_3	Net Worth h_4	R^2	F	Degrees of Freedom	Durbin-Watson Statistic	Standard Error of Estimate
a-1	Levels	-1.256 (-1.706)	0.27169 (7.013)	0.54745 (3.727)	-0.0334 (-5.465)	0.9941	1696.9	30	1.66	1.469
a-2	Levels		0.25288 (6.607)	0.70934 (6.136)	-0.03438 (-5.485)	0.9941	1696.9	31	1.66	1.513
a-3	First Differences		0.2788 (4.252)	0.62627 (3.279)	-0.041 (-3.510)	0.8718	66.2	30	2.63	1.839
		k_1		k_2	k_3					
a-4	Ratios	0.2818 (8.61)		0.33402 (2.179)	-0.03924 (-7.983)	0.9297	205.0	31	1.09	0.014
		Implied Estimates	h_2	h_3	h_4					
a-4	Ratios		0.2818	0.61582	-0.03924					

Note: t-statistics, appropriate for testing the hypothesis that the corresponding parameter is equal to zero, are given in parentheses.

TABLE B

Equation 12. Results Based on Use of Net Corporate Saving
Dependent Variable: Net Private Saving

#	Type of Equation	Constant h_1	Personal Income h_2	Corporate Saving h_3	Net Worth h_4	R^2	F	Degrees of Freedom	Durbin-Watson Statistic	Standard Error of Estimate
b-1	Levels	-0.0894 (-0.164)	0.28119 (7.709)	0.57644 (4.934)	-0.04259 (-5.921)	0.9896	947.36	30	1.69	1.405
b-2	Levels		0.28227 (8.012)	0.57951 (5.098)	-0.04296 (-6.417)	0.9896	947.36	31	1.69	1.913
b-3	First Differences		0.28190 (4.439)	0.60581 (3.237)	-0.4415 (-3.597)	0.8587	58.74	30	2.65	1.823
		k_1		k_2	k_3					
b-4	Ratios	0.3040 (7.625)		0.2188 (1.134)	-0.47201 (-6.498)	0.9499	294.1	31	1.06	0.014
		Implied Estimates	h_2	h_3	h_4					
b-4	Ratios		0.304	0.5228	-0.47201					

Note: t-statistics, appropriate for testing the hypothesis that the corresponding parameter is equal to zero, are given in parentheses.

Substituting from (14) into (13) we obtain:

$$\frac{S_t^{pri}}{Y_t^{pri}} = \frac{h_1}{Y_t^{pri}} + h_2 \left(1 - \frac{S_t^{corp}}{Y_t^{pri}}\right) + h_3 \frac{S_t^{corp}}{Y_t^{pri}} + h_4 \frac{A_{t-1}}{Y_t^{pri}}$$

$$\text{or, } \frac{S_t^{pri}}{Y_t^{pri}} = \frac{h_1}{Y_t^{pri}} + h_2 + (h_3 - h_2) \frac{S_t^{corp}}{Y_t^{pri}} + h_4 \frac{A_{t-1}}{Y_t^{pri}} \qquad (15)$$

From equations (a-1) and (b-1), we have $d_1 = 0$.

(15) thus, becomes:

$$\frac{S_t^{pri}}{Y_t^{pri}} = k_1 + k_2 \frac{S_t^{corp}}{Y_t^{pri}} + k_3 \frac{A_{t-1}}{Y_t^{pri}} \qquad (16)$$

where $k_1 = h_2$, $k_3 = h_4$ and $k_2 = h_3 - h_2$. (17)

(17) implies $h_2 = k_1$, $h_3 = k_1 + k_2$ and $h_4 = k_3$ (18)

(18) is the ratio form of (12) which was fitted on the data.

TABLE C

Test of the Hypothesis that $h_3 = h_2$

Equation #	Value of t-statistic[a/]	Degrees of Freedom
a-2	3.04338	31
a-3	1.4037	30
b-2	2.04848	31
b-3	1.34467	30

$$\text{a/}\quad t = \frac{\hat{h}_3 - \hat{h}_2}{\sqrt{\frac{e'e}{d.f.}}\sqrt{(-1\ 1\ 0)\,(X'X)^{-1}\begin{bmatrix}-1\\1\\0\end{bmatrix}}}$$

where X is as defined in the text.

TABLE D

Test of the Hypothesis that $h_3 = 1$

Equation #	Value of t-statistic[a/]	Degrees of Freedom
a-2	-2.51016	31
a-3	-3.69581	30
b-2	-1.95419	31
b-3	-2.10747	30

$$\text{a/}\quad t = \frac{\hat{h}_3 - 1}{\sqrt{\frac{e'e}{d.f.}}\sqrt{X_{33}}}$$, where X_{33} is defined in text.

TABLE E

Critical Values for Student's t-distribution
Prob(t ≤ tabled value) = P

Degrees of freedom	p		
	0.75	0.90	0.95
30	0.6828	1.3104	1.6973
31	0.6825	1.3095	1.6955

Source: D.B. Owen, Handbook of Statistical Tables (Reading, Massachusetts: Addison-Wesley, 1962), pp.27-30.

The neo-classical hypothesis that $h_3 = h_2$ was first tested on the equations using levels and first differences of the annual data. The test was based on the statistic

$$\frac{\hat{h}_3 - \hat{h}_2}{\sqrt{\frac{(e'e)}{d.f.}} \sqrt{(-1 \quad 1 \quad 0)\,(X'X)^{-1} \begin{bmatrix} -1 \\ 1 \\ 0 \end{bmatrix}}}$$

which is distributed as Student's t with (d.f.) degrees of freedom.[12] e'e is the sum of estimated squared residuals. X is the matrix of observations on the relevant measures of personal income, corporate saving and net worth. Comparing the values of the t-statistic given on Table C with its critical values of Table IV-e, we see that the null hypothesis that the coefficient of corporate saving (h_3) is insignificantly different from the coefficient of personal income (h_2) is always rejected at the

(12) See J. Johnston, Econometric Methods (New York: McGraw-Hill, 1963), pp.131-135.

90% confidence level and two out of four times rejected at the 95% level.

The same hypothesis can be tested for the ratio-form of equation (12). According to (17) $\hat{k}_2$ thus provides an estimate of h_3-h_2 and the t-statistics given on tables A (line a-4) and B (line b-4) are appropriate for testing the null hypothesis that h_3-h_2 is insignificantly different from zero. In the case of (a-4) $t_{31}= 2.179$; that is, the null hypothesis is rejected at the 95% confidence level. In (b-4), $t_{31}= 1.134$. The null hypothesis is here rejected at the 75% confidence level (see Table E), but not at the 90% or higher levels.

We see then that the results are somewhat mixed with the balance against the neo-classical hypothesis. The null hypothesis that $h_2=h_3$ is always rejected at the 75% confidence level, five out of six times rejected at the 90% level, and three out of six rejected at the 95% level.

Let us now turn to the independence hypothesis. Table D presents the relevant statistics for testing the null hypothesis that $h_3=1$ in equations (a-2), (a-3), (b-2) and (b-4). The test is based on the statistic

$$\frac{\hat{h}_3-1}{(e'e/d.f.)^{\frac{1}{2}}X_{33}^{\frac{1}{2}}} \qquad (19)$$

where X_{33} is the element on the principal diagonal of $(X'X)^{-1}$ corresponding to corporate saving. (19) is distributed as Student's t with (d.f.) degrees of freedom.(13) Comparing the values given on Table D with the critical values given on Table E, we are led to

(13) See Johnston, op.cit., p.118

rejecting the Independence Hypothesis at the 95% confidence level in all four cases. Being on balance unfavorable both to the neo-classical and the independence hypothesis, our tests support Harrod's argument concerning the relationship between personal and corporate saving. The remaining part of this section will expand on the economic meaning of our findings on the basis of the maximum-likelihood estimates of the parameters of (12); that is, on the basis, of the point estimates given on Tables IV-a and IV-b.

Let us begin with the equations using gross corporate saving, given on Table A.

Consider equations (a-1) and (a-2). The intercept in (a-1) is of a lower order of significance than the remaining variables and its estimated value is of a small order of magnitude; less than 4% of the mean value of the dependent variable. We can, therefore, concentrate our discussion on equation (a-2). A $1 increase in corporate saving is, on the average, expected to add $0.71 to total private saving. (a-2) indicates that a $0.29 compensating movement in personal saving follows a $1 addition to corporate saving, when personal income and net worth remain constant. (a-2) thus supports Harrod's hypothesis that corporate saving does add to total private saving but not by its full amount. In terms of R^2, the fit of (a-2) is very good; the R^2 is 0.9941 and the F-statistic for three independent variables and 30 degrees of freedom is 1606.909. The Durbin-Watson statistic, in this case equal to 1.66, indicates that there is no problem of significant

positive serial correlation of the estimated residuals.[14]

The results of fitting (12) on the first differences of the variables is reported on line (a-3). The economic implications of (a-3) are similar to those of (a-2). Corporate saving has a coefficient of 0.62627 and personal income a coefficient of 0.2788. The absence of marked changes in the coefficients in moving from (a-2) to (a-3) is evidence of the robustness of our test to alternative specifications of the basic equation (12). The reduction of the R^2 from 0.9941 to 0.8718 is accounted for by the reduced influence of the common trend on the first differences of the variables.

Equation (a-4) reports on another attempt to test the robustness of our results. In (a-4) we used the ratios of corporate saving and net worth to private income. The maximum-likelihood estimates of the coefficents of (a-4) imply that $h_2 = 0.2818$ and $h_3 = 0.6158$. Again, the estimates of the structural parameters are not changed appreciably by the ratio transformation. The Durbin-Watson statistic of 1.09 indicates, however, that insofar as serial correlation is concerned, the efficiency of our estimates is reduced by the ratio transformation.

The results from fitting the equations using a measure of corporate saving net of depreciation are given in Table B. It is readily observed that the difference between h_3 and h_2 is, according to this second series of tests, smaller than the difference implied by the equations using gross saving. But, in terms of maximum likelihood estimates, the Harrod hypothesis is sustained in this case also.

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(14) The values of d_u and $4-d_u$ relevant for rejecting the hypothesis of serial correlation at the 99% confidence level are 1.42 and 2.58 respectively.

5. Simultaneous-Equations Bias

Our results were derived using the single-equation, ordinary least squares method. This method leads to estimates which are biased, both for finite sample size and in the limit, when one or more of the explanatory variables are related to the dependent variable by other simultaneous relations.

In our model, S^{corp} is related to S^{pri} through the identity

$$S_t^{pri} = S_t^{pers} + S_t^{corp}. \tag{20}$$

It is, furthermore, probable that Y^{pers}, S^{pers}, and S^{corp} are related in ways other than the one described in (12) or (20). This is so because, according to any meaningful view of the economic process, (12) must be considered as one of a system of equations which describe the operation of the economy in any given observation period.

The only adequate way of dealing with the bias due to simultaneities would be to construct an econometric model of the entire economy of which (12) would be only one part. Due to financial and other resource limitations, such a task could not be undertaken. The possible effects of simultaneous-equations bias on our conclusions must, therefore, be brushed aside at present.

6. Conclusion

Using the framework of one of the models which are put forward in support of the neo-classical theory, we saw that the relevant data for the U.S. economy over the period 1919-58, on balance, contradict the proposition that the level of corporate saving does not have an effect on the level of total private saving. The data also contradict the extreme alternative hypothesis that corporate and personal saving are independent.

The hypothesis which fits the data best is Harrod's argument that movements in personal saving compensate for only part of the movements of corporate saving. A one dollar re-allocation of private income from individuals to corporations results in approximately twenty to forty extra cents of private saving.

Our findings then imply that the corporate structure of the U.S. economy has had an effect on the rate of saving of its non-government sector. The private sector's rate of saving was greater the greater was the portion of after-tax private income retained by corporations. The neo-classical argument that those occupying the higher positions in the hierarchy of corporate enterprises are not able to impose a higher rate of saving than the one which would have been chosen under Fisherian conditions is refuted by our tests.[15]

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15 Our results might be susceptible to some of the usual shortcomings of time-series tests. Most aggregate time-series have a cyclical component. When the (positive or negative) cyclical co-variation of two or more explanatory variables results in near-extreme collinearity of the time-series of these variables, the moments-matrix of the regressors is near-singular and the statistical estimation of the individual regressors breaks down. The standard errors of the regressors are, in this case, so large that no coefficient is significantly different from zero. This is the case even if the overall relationship fits well in terms of R^2 (See A.S. Goldberger, Econometric Theory. New York: John Wiley and Sons, Inc., 1964; pp. 192-193). The high t-statistics obtained in our regressions show that multicollinearity was not a problem in our tests.

The presence of a cyclical component in time-series data can, however, result in a second estimation problem which is much more difficult to detect than multicollinearity. When one of the regressors acts as a proxy for the cyclical component of the dependent variable, the estimated coefficient reflects not only the partial effect of the regressor in question on the dependent variable but also the cyclical behavior of the dependent variable. Detecting whether a regressor is acting as a proxy for the stage of the business cycle is a difficult task. The best procedure for safeguarding one's results against such a possibility is to never rely exclusively on time-series data. Prudence dictates that the competing hypotheses which were studied in this paper should be subjected to cross-section as well as to time-series tests. One step in this direction is undertaken in my forthcoming paper Saving, Organizations and Households: A Cross-Country Test of an Institutional Theory of Saving.

STATISTICAL APPENDIX: SOURCES AND PROCESSING OF DATA

TABLE 1

Data Series Used for Tests
(billions of current dollars)

	Net Corporate Saving (1)	Depreciation Allowances (2)	Personal Saving (3)	Disposable Personal Income (4)	Net Worth (5)
1919	3.6	2.0	7.8	68.6	323.3
1920	1.7	2.2	5.1	74.1	324.0
1921	-1.9	2.3	1.3	56.3	244.6
1922	1.9	2.7	4.5	60.2	303.8
1923	2.3	2.7	6.4	68.7	324.3
1924	1.7	2.8	5.7	68.8	338.1
1925	2.7	2.9	6.8	74.3	356.1
1926	2.3	3.3	6.2	76.8	374.4
1927	1.4	3.4	7.0	76.1	400.5
1928	2.5	3.6	3.6	76.4	436.1
1929	2.8	4.2	4.2	83.3	455.3
1930	-2.6	4.3	3.4	74.5	449.1
1931	-4.9	4.3	2.6	64.0	383.1
1932	-5.2	4.0	-0.6	48.7	310.7
1933	-1.6	3.8	-0.9	45.5	313.0
1934	-1.0	3.6	0.4	52.4	321.3
1935	-0.2	3.6	2.1	58.5	338.0
1936	0.4	3.6	3.6	66.3	366.9
1937	0.6	3.6	3.8	71.2	383.7
1938	-0.2	3.7	0.7	65.5	360.1
1939	1.8	3.7	2.6	70.3	379.7
1940	3.2	3.8	3.8	75.7	388.1
1947	13.9	5.8	7.3	169.8	831.7
1948	15.6	7.0	13.4	189.1	876.6
1949	11.3	7.9	9.4	188.6	888.9
1950	16.0	8.8	13.1	206.9	992.9
1951	13.0	10.3	17.3	226.6	1072.9
1952	11.0	11.5	18.1	238.3	1107.1
1953	11.5	13.2	18.3	252.6	1143.6
1954	11.3	15.0	16.4	257.4	1236.8
1955	16.5	17.4	15.8	275.3	1341.9
1956	15.9	18.9	20.6	293.2	1423.8
1957	14.2	20.8	20.7	308.5	1459.7
1958	10.8	22.0	22.3	318.8	1612.4

Sources: Col. (1) and (2): Net Corporate Saving and Depreciation Allowances 1919-28. The basic source is John A. Brittain, Corporate Dividend Policy (Washington: Brookings Institution, 1966), Appendix A. Brittain has extended the O.B.E. series for net profits, cash flow and dividends back to 1919 by using estimates supplied by Kuznets.[15/]

15/ See J.A. Brittain, ibid., p. 215.

Sources for Table 1 (continued)

Net corporate saving (= retained earnings) was obtained as the difference between net profits (after taxes and depreciation charges) and dividends. Depreciation allowances were obtained by subtracting net profits from cash flow. Brittain's data are given in Table 2, together with the author's estimates of retained earnings and depreciation allowances.

1929-58. O.B.E. Series as reported in the Economic Report of the President (Washington, 1970), Table C-71.

Col. (3): Personal Saving

1919-28: I extended the O.B.E. series back to 1919 by linking it with Goldsmith's series of personal saving net of consumer durables.(16) The two series were linked by regressing the O.B.E. series on the Goldsmith series for the years 1929-49. The resulting equation was

$$(A\text{-}1) \qquad \begin{bmatrix} \text{Personal} \\ \text{Saving -} \\ \text{O.B.E.} \end{bmatrix} = 0.834175 \cdot \begin{bmatrix} \text{Personal} \\ \text{Saving -} \\ \text{Goldsmith} \end{bmatrix}$$

with $R^2 = 0.9768$ and $t_{20} = 39.0$. A regression was also run with a constant term. The intercept proved to be insignificantly different from zero at conventional levels of significance. The data used in the calculations are given in Tables 3 and 4.

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(16) Raymond W. Goldsmith, A Study of Saving in the United States (Princeton University Press, 1955).

TABLE 2

Estimates of Corporate Saving: 1919-28
(in billions of current dollars)

	Net Profits (1)	Cash Flow (2)	Dividends (3)	Net Corporate Saving (4)	Depreciation Allowances (5)
1919	6.29	8.28	2.69	3.60	1.99
1920	4.65	6.84	2.98	1.67	2.19
1921	0.85	3.19	2.72	-1.87	2.34
1922	4.67	7.33	2.79	1.88	2.66
1923	5.86	8.57	3.53	2.33	2.71
1924	5.11	7.93	3.46	1.65	2.82
1925	6.67	9.57	4.02	2.65	2.90
1926	6.66	9.93	4.36	2.31	3.27
1927	5.99	9.34	4.63	1.36	3.35
1928	8.48	11.08	5.03	2.45	3.60

Source: (1), (2), and (3): J.H. Brittain, ibid., Appendix A.

Note: Col (4) = Col (1) - Col (3)
Col (5) = Col (2) - Col (1).

TABLE 3

Data Used for Equation (A-1)

	Goldsmith's Total Personal Saving (1)	Goldsmith's Consumer Durables (2)	Goldsmith's Personal Saving Net of Durables (3)	O.B.E. series of Personal Saving (4)
	(millions of current dollars)			(billions of current dollars
1929	11485	1951	9534	4.2
1930	5617	-66	5683	3.4
1931	2466	-1096	3562	2.6
1932	-3273	-2099	-1174	-0.6
1933	-3805	-1500	-2305	-0.9
1934	-954	-662	-292	0.4
1935	2349	560	1789	2.1
1936	5275	1768	3507	3.6
1937	7322	1964	5358	3.8
1938	3715	139	3576	0.7
1939	6852	1353	5499	2.6
1940	8543	2234	6309	3.8
1941	13971	3081	1089	11.0
1942	33237	-1314	34551	27.6
1943	36167	-1505	37672	33.4
1944	39299	-1660	40959	37.3
1945	36409	-748	37157	29.6
1946	22527	6401	16126	15.2
1947	20186	9079	11107	7.3
1948	26723	8529	18194	13.4
1949	22457	8786	13671	9.4

Sources: Col. (1) and (2): Goldsmith, ibid., Vol. I, Table T-1.

Col. (4): Economic Report of the President, 1970.

Note: Col. (3) = Col. (1) - Col. (2).

TABLE 4

Personal Saving: 1919-28
(millions of current dollars)

	Goldsmith's Total Personal Saving (1)	Goldsmith's Consumer Durables (2)	Goldsmith's Personal Saving Net of Durables (3)	O.B.E.-linked series for Personal Saving (4)
1919	9764	461	9303	7761
1920	6568	514	6054	5050
1921	1286	-301	1587	1324
1922	6300	896	5404	4508
1923	9880	2184	7696	6420
1924	8616	1841	6775	5652
1925	10744	2634	8110	6765
1926	10103	2697	7406	6178
1927	10074	1680	8394	7002
1928	6014	1661	4353	3631

Sources and Notes:

Col. (1) and (2) were obtained from Goldsmith, ibid., Table T-1.

Col. (3) = Col. (1) - Col. (2).

Col. (4) = Col. (3) · 0.8342 (See text)

TABLE 5

Estimation of Disposable Personal Income Series
1919-28
(billions of current dollars)

	$DPI_{Goldsmith}$ (1)	$GNP_{Goldsmith}$ (2)	$\frac{DPI_{Goldsmith}}{GNP_{Goldsmith}}$ (3)	$GNP_{O.B.E.}$ (4)	$DPI_{O.B.E.}$ (5)
1919	69.7	85.3	0.8171	84.0	68.6
1920	73.9	91.3	0.8094	91.5	74.1
1921	58.7	72.5	0.8096	69.6	56.3
1922	59.1	72.8	0.8118	74.1	60.2
1923	69.0	85.5	0.8070	85.1	68.7
1924	69.8	85.9	0.8125	84.7	68.8
1925	72.1	90.3	0.7984	93.1	74.3
1926	76.7	96.9	0.7915	97.0	76.8
1927	76.5	95.4	0.8018	94.9	76.1
1928	76.6	97.2	0.7880	97.0	76.4

Sources and Notes: Col. (1) and (2) were obtained from Goldsmith, ibid., Table N-1.

Col. (4) was obtained from U.S. Department of Commerce, O.B.E., The National Income and Product Accounts of the United States, 1929-65, (Washington).

Col. (5) = Col. (3)·Col. (4).

1929-58 : O.B.E. series obtained from the Economic Report of the President (Washington, 1970) Table C-15.

Col. (4) : Disposable Personal Income

1919-1928 : The O.B.E. series was extended backwards to 1919 by using the formula

$$DPI_{O.B.E.} = \left[\frac{DPI\ Goldsmith}{GNP\ Goldsmith}\right] \cdot GNP_{O.B.E.},$$

where DPI is disposable personal income, GNP is gross national product, and the subscript indicates the source of the series. The data and calculations are presented in Table A-5.

1929-58 : O.B.E. series from the Economic Report of the President, ibid., Table C-15.

Col. (5) : Private Net Worth

Obtained from Franco Modigliani, "The Life Cycle Hypothesis of Saving, the Demand for Wealth, and the Supply of Capital," Social Research, Vol. 33, No. 2, Summer 1966, Appendix A.