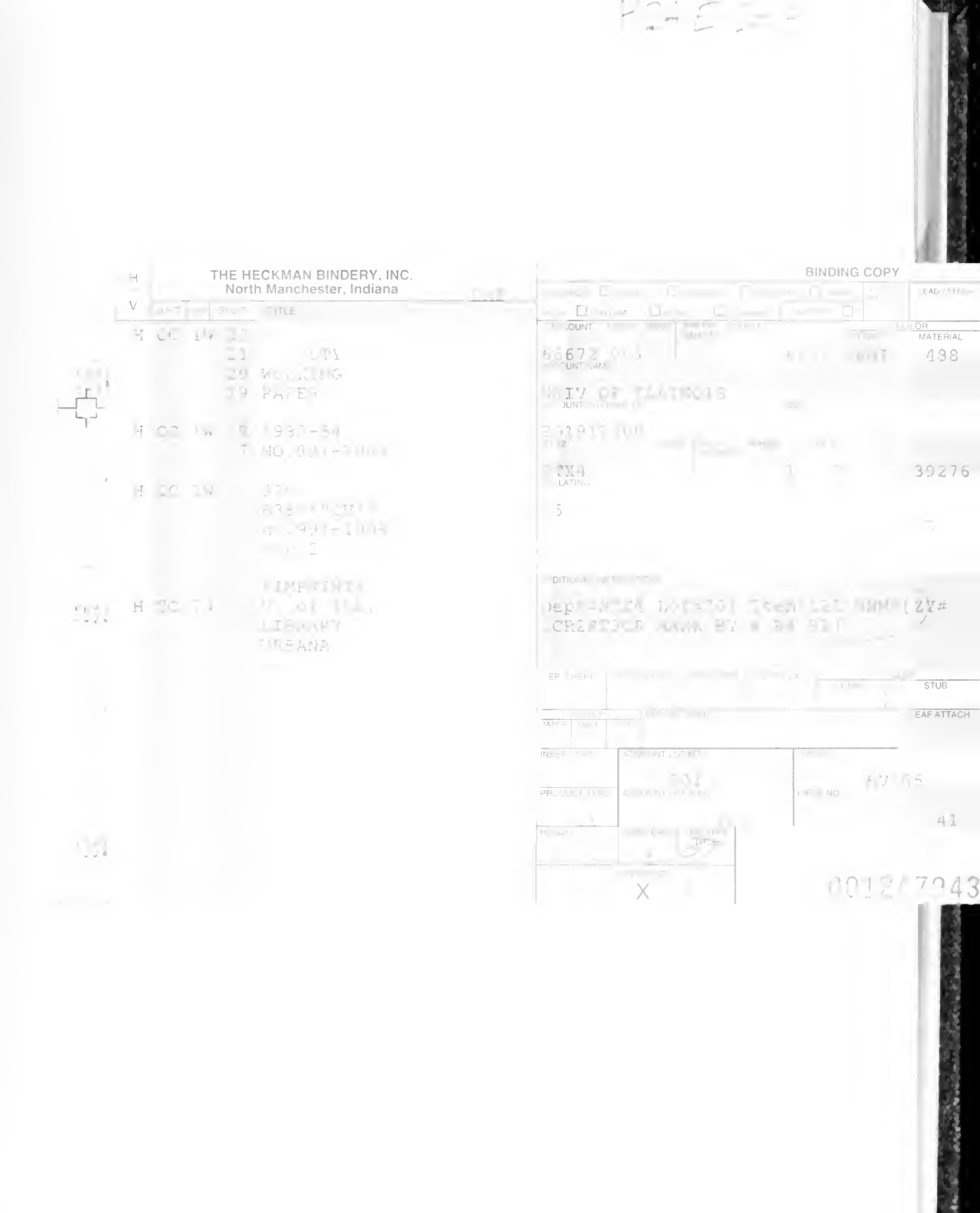
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The Nonlinear Consumption Function: Could Reagan Be Right?

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The Nonlinear Consumption Function: Could Reagen Be Right?

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Abstract

Evidence presented twelve years ago indicated that the consumption function was nonlinear with marginal propensities to consume declining with income. In this paper, new evidence from the 1972-73 Consumer Expenditure Survey is presented which tends to confirm that the consumption function is indeed nonlinear. As a result, redistributions of income from higher income families to lower income families will cause aggregate spending to increase. Conversely, redistributions of income from lower to higher income families will cause aggregate saving to increase.

The Nonlinear Consumption Function: Could Reagan Be Right?

Introduction

Some years ago, one of the liveliest controversies in economics was the conflicting evidence on consumption from time series and cross section data. The latter data rather consistently indicated that the average propensity to consume declines as income increases. Studies of the time series, however, showed that the consumption function was linear about the origin, the average propensity to consume therefore being constant. The relative income, permanent income, and life cycle theories of consumption were attempts to explain the inconsistency in the two types of data. Regarding the question of the relationship between aggregate consumption and income over time, all of these theories suggest that cross section data are misleading and give us biased estimates of the average propensity to consume. As these aggregates have grown over time, the consumption propensity has remained fairly close to that predicted by a consumption function estimated from time series data.

But what happens if, at a moment of time, there is a redistribution of income between income classes? Will there be short run or intermediate run impacts on aggregate spending? A consumption function which reveals the relationship between aggregate spending and aggregate income over the long run may not aid us in predicting the effect of a redistribution of income. The question now becomes: At any moment of time, would high income families spend a different (presumably lower) percentage of an increment of income compared to low income families? If the consumption function is nonlinear with

the marginal propensity to consume declining with income, then a redistribution of income from higher to lower income families would increase aggregate spending.

Reaganomics and Redistribution of Incomes

The economics of the Reagan administration has given this issue greater significance. Reaganomics emphasizes the other side of this coin. If higher income families have a lower marginal propensity to spend (higher marginal propensity to save), then redistributing income in favor of high income families would result in increased saving in the aggregate, and (it is hoped) increased investment. The economic policy of the Reagan administration depends critically on this assumption of differential marginal propensities to consume by income class.

New Data

Evidence from the 1960-61 Survey of Consumer Expenditures (Bureau of Labor Statistics, 1965) along with time series data has been presented by the author (Husby, 1971) and it suggests that the consumption function is nonlinear and that redistributions of income would have impacts on aggregate spending and saving. Recently, data from the 1972-73 Consumer Expenditure Survey have become available. In this paper, these new data are used to retest the hypothesis that the consumption function is nonlinear.

Cross Section Estimates

Using these new cross section data, a simple linear regression was run with the following result:

$$(1) \qquad \underset{(293)\ (.023)}{c = 3045 + .503y}, \ \bar{R}^2 = .977, \ SE = 622, \ D\text{-}W = .961,$$

where $\underline{c}$ is average current consumption expenditures and $\underline{y}$ is average income after taxes (U.S. Department of Labor, 1978) for 12 income brackets (see Table 1), the numbers in parentheses are the standard errors of the estimated coefficients, $\bar{R}^2$ is the adjusted percentage of variation explained, SE stands for the standard error of the estimator, and D-W is the Durbin-Watson statistic. The latter statistic is usually meaningless for cross-section regressions, but since the data are arranged by increasing values of income, it is a test for nonlinearity. In fact, the residuals and the Durbin-Watson statistic from (1) indicate nonlinearity, so the following specification was run:

$$(2) \quad c = \underset{(70)}{1815} + \underset{(.012)}{.756}\, y - \underset{(.00000037)}{.00000812}\, y^2, \ \bar{R}^2 = .9995, \ SE = 89, \ D\text{-}W = 1.73.$$

The statistically significant coefficient for the squared income term, the improved $\bar{R}^2$ and standard error, and the Durbin-Watson statistic, now being in the neighborhood of 2, all indicate that the relationship is curvilinear rather than linear.

The Complete Model

The complete model proposed in this paper is the same variation of the permanent income hypothesis that this author used in the previous study (Husby, 1971). Consumption is a nonlinear function of disposable income, both past and present:

$$(3) \quad c_t = a + b_1 y_t + b_2 y_{t-1} + b_3 y_{t-2} + \ldots + e_1 y_t^2 + e_2 y_{t-1}^2 + e_3 y_{t-2}^2 + \ldots + u_t.$$

Making the distributed lag assumption (of the geometric decay type) and performing a number of algebraic manipulations, it can be shown that (3) reduces to

$$(4) \qquad c_t = \alpha + b_1 y_t + e_1 y_t^2 + \gamma c_{t-1} + (u_t - \gamma u_{t-1}).$$

where $\alpha = (a - \gamma a)$.[1]

Cross section data, however, do not allow one to estimate a coefficient for the lagged consumption term in (4). A mixed estimation technique is therefore used whereby both time series and cross section data are utilized. Time series regressions provide an estimate for γ, the coefficient of the lagged consumption term. This coefficient can then be used as prior information in a cross section regression to determine the coefficients of the other variables.

Time Series Estimates

Using annual data from 1948 to 1980, we find that

$$(5) \qquad C = \underset{(4.61)}{8.87} + \underset{(.007)}{.903}\ Yd,\ \bar{R}^2 = .998,\ SE = 8.60,\ D\text{-}W = 1.28,$$

where C is aggregate personal consumption expenditures and Yd is aggregate disposable personal income, expressed in billions of constant 1972-73 dollars (U.S. Department of Commerce, 1980 and 1981). Residual autocorrelation is indicated by the Durbin-Watson statistic. Using the same assumption as used in the discussion of the complete model, namely that consumption is a function of disposable income,

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[1] For the derivation of (4), see Husby (1971), p. 77.

both past and present, with the influence of disposable income declining systematically for past periods, yields a consumption function with income and lagged consumption as the explanatory variables:

$$(6) \qquad \underset{(4.33)}{C_t = 6.33} + \underset{(.104)}{.630\ Yd_t} + \underset{(.119)}{.313\ C_{t-1}}$$

$$\bar{R}^2 = .998,\ SE = 7.88,\ D\text{-}W = 1.51.$$

The improved figures for $\bar{R}^2$, the standard error, and the Durbin-Watson statistic in (6) all suggest that (5) is a misspecified function[2] and that (6) more closely captures reality. The results of the time series analysis are quite consistent with typical time series results: The consumption function appears to be linear about the origin and to depend on both present and past values of income.[3]

Mixed Estimation Results

The time series results have yielded an estimate for γ of approximately 0.3. We can use this estimate as prior information to estimate the coefficients of the complete model.[4]

$$(7) \quad \underset{(50)}{c_t - 0.3c_{t-1} = 1291} + \underset{(.0086)}{.5379y_t} - \underset{(.000000264)}{.000005776y_t^2},\ \bar{R}^2 = .995,\ SE = 63.4.$$

$$D\text{-}W = 1.73.$$

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[2] Care must be exercised in interpreting the improvement in the Durbin-Watson statistic since it is biased toward 2 when the lagged dependent variable is included (see Nerlove (1966)).

[3] Testing for nonlinearity, a regression like (6) but with Y^2 added as a variable was run. However, both the coefficient of the squared term and the lagged term was insignificant at the 5% level.

[4] The prior information used in equation (7) is an exact linear restriction. See Goldberger (1964).

The cross section data used is for one time period only: For each family interviewed, information was gathered either for the 1972 year or the 1973 year, but not both. Therefore, in equation (7), a proxy variable was constructed for consumption in period t-1.[5]

Implications of the Results

All of the coefficients in (7) including the coefficient for the income squared term are significant at the one percent level (2-tail t-test). We therefore rewrite the equation as

$$(8) \qquad c_t = 1291 + .538y_t - .00000578y_t^2 + .3c_{t-1}.$$

It might be well to summarize the findings to this point. It is being suggested here that the consumption function at any point in time is a nonlinear function of income. However, as incomes on average increase over time, the consumption function is shifting upward, in such a way that the relationship between aggregate consumption and aggregate income over time is linear. The fact that consumption is a function of both present and past values of income is the explanation for the function shifting upward over time.

This same conclusion was made in my earlier (1971) article. It is interesting to see just how far the function has shifted up after 12

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[5] Per capita personal consumption expenditures in 1972 dollars increased by 4.6% between 1971 and 1972 and by 3.2% between 1972 and 1973, an average of 3.9% (Economic Report of the President, Feb. 1983, U.S. Government Printing Office, Washington, 1983, p. 191). Consumption expenditures (c) was therefore reduced by 3.9% to arrive at the variable c_{t-1}.

years. Estimating the same relationship using the 1960-61 data, the result is as follows:

$$(9) \qquad c - 0.3c_{-1} = 362 + .630_{y} - .00000802y^{2}$$

The coefficients for income and income squared are similar to (8). The value of the shift variable (constant term), however, has increased from $362 to $890 (in constant dollars) over that 12 year period. The marginal propensities to consume, both short run (SRMPC) and long run (LRMPC), are presented in Table 1 for the 1960-61 period and the 1972-73 period.

TABLE 1. Propensities to Consume Implied by Equations (8) and (9)

Income Bracket	Ave. Income*	Ave. Cons.*	1972-73 SRMPC	1972-73 LRMPC	1960-61 SRMPC	1960-61 LRMPC
0-3000	$ 1,636	$ 3,211	.52	.74	.60	.86
3-4000	3,347	4,172	.50	.71	.58	.83
4-5000	4,252	4,774	.49	.70	.56	.80
5-6000	5,084	5,400	.48	.68	.55	.79
6-7000	5,928	6,023	.47	.67	.53	.76
7-8000	6,715	6,501	.46	.66	.52	.74
8-10,000	7,911	7,332	.45	.64	.50	.71
10-12,000	9,491	8,284	.43	.61	.48	.69
12-15,000	11,485	9,388	.41	.58	.45	.64
15-20,000	14,541	11,065	.37	.53	.40	.57
20-25,000	18,370	13,073	.33	.47	.34	.49
> 25,000	30,461	17,290	.19	.27	.14	.20

*Source: U.S. Department of Labor, Bureau of Labor Statistics (1978), Consumers Expenditure Survey: Integrated Diary and Interview Survey Data, 1972-73, Bulletin 1992, "Total Expenditures and Income for the United States and Selected Areas," Table 1, pp. 24-35.

Interpreting the Results

The low values for the marginal propensities to consume are somewhat disturbing but not unexpected. From many studies of consumption as well as the results of the time series regressions above, we

know that consumption on average is 90% or more of disposable income. Thus the range of long run marginal propensities from 73 to 26 percent (1972-73) and 86 to 20 percent (1960-61) appear to be downward biased. (But that is to be expected since we have ample evidence that cross section estimates of the consumption function give downward biased estimates of the marginal propensity to consume.)

On the other hand, all of the evidence in this study as well as the earlier one by this author suggests that marginal propensities to consume (save) decrease (increase) with income. A related study (Husby, 1973) based on the estimated marginal propensities from my earlier consumption paper (Husby, 1971) concluded that a negative income tax that would guarantee a family of four $4,800 annually in 1966 would cause aggregate demand to increase by 1.1% (assuming labor supply to be unaffected by the redistribution of income). The decrease in saving from the same redistribution would have been 6.3 percent of 1966 total private saving. To put it another way, a redistribution of income of the same magnitude but away from the poor and in favor of the rich would have caused savings to increase by 6.3 percent. A similar study (Moeller, 1981) suggests redistributional effects of roughly the same magnitude.[6]

Conclusion

There has been considerable publicity during the Reagan administration that the revitalization of the U.S. economy depends on

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[6]As Moeller points out in his article, he finds that consumption increases by 10 to 20 percent of the amount of the redistribution while this author found the increase to be 12 to 15 percent, labor supply held constant and multiplier effects ignored.

putting more income into the hands of those who save, high income individuals. This allegation implies that the marginal propensity to save of the high income classes is greater than that of lower income classes.

Most research on the consumption function, however, has concentrated on linear models which imply marginal propensities to consume that are invariant across income classes. Thus, there has been the tacit assumption on the part of economists that redistributions of income would have negligible impacts on aggregate saving and investment. The evidence presented in this paper suggests that advisors to President Reagan are correct in assuming that redistributing the tax burden so as to lighten the load for high income taxpayers will cause aggregate saving to increase. Whether this increased saving will result in increased real investment in plant and equipment is another question and one that is not addressed in this paper.

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