NBER WORKING PAPER SERIES

THE ROLE OF CONSUMPTION IN ECONOMIC FLUCTUATIONS

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Working Paper No. 1391

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 1984

Presented at the NBER's Conference on Business Cycles, Puerto Rico, March 23 to 25, 1984. I am grateful to Olivier Blanchard and Ben Bernanke for comments and to Valerie Ramey for expert assistance. The research reported here is part of the NBER's research program in Economic Fluctuations. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

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ABSTRACT

Consumption and income tend to move together; the correlation of their first differences is about 0.4. In most accounts, the correlation is attributed to the upward slope of the consumption function. When the public is better off, they consume more. But in the microeconomic theory of the household, income is a variable chosen by the household. Choosing to work more, and therefore to consume less time away from work, is a sign of diminished well being. The structural relation between earnings and consumption should have a ***negative*** slope. The explanation of the observed positive correlation of consumption and income must rest on shifts of the consumption-income relation, not movements along it. An examination of data for the U.S. in the twentieth century shows that the slope of the consumption-income relation has been approximately zero. Shifts in consumer behavior explain the positive observed correlation; they are an important, but not dominant, source of overall fluctuations in the aggregate economy.

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1. The issues

Consumption is the dominant component of GNP. A one percent change in consumption is five times the size of a one percent change in investment. This paper investigates whether the behavior of consumers is an independent source of macroeconomic fluctuations, or whether most disturbances come from other sectors.

Informal commentaries on the business cycle put considerable weight on the independent behavior of consumption. It is commonplace to hear of a business revival sparked by consumers. On the other hand, all modern theories of fluctuations make the consumer a reactor to economic events, not a cause of them. Random shocks in technology are generally the driving force in fully articulated models.

This paper develops a framework where the distinction between a movement along a consumption schedule and a shift of the schedule is well defined. Application of the framework to 20th century American data shows that shifts of the consumption schedule have probably been an important cause of fluctuations but have probably not been the dominant source of fluctuations.

I consider three sources of disturbances to the economy:

1. Shifts of the consumption schedule

2. Shifts of the schedule relating spending in categories other than consumption and military spending

3. Shifts in military spending

The reason for the explicit examination of military spending is that such spending is the only plainly exogenous major influence on the economy. Movements in military spending reveal t e slopes of the consumption and other spending schedules.

My basic strategy is the following. Fluctuations in military spending reveal the slope of the consumption-GNP schedule. GNP rises with military spending--quite stably, GNP has risen by about 62 cents for every dollar increase in military spending. This conclusion is supported by data from years other than major wars when resource allocation by command may have made the consumption schedule irrelevant. But when GNP rises under the stimulus of increased military spending, consumption actually falls a little--the same dollar of military spending has depressed consumption by about 7 cents.

Under the reasonable assumption that higher military spending does not shift the consumption schedule, but only moves consumers along the schedule, we can infer the slope of the schedule from the ratio of the consumption change to the GNP change. The slope is essentially zero.

Equipped with this knowledge, we can measure the shift of the consumption schedule as the departure of consumption from a schedule with the estimated slope. My main concern is the absolute and relative importance of these shifts.

The effect of a consumption shift on GNP depends on the slope of the consumption schedule and also upon the slope of the schedule relating other spending to GNP. For this reason, it is necessary to carry out a similar exercise for other spending. Again, the way other spending changes when military spending absorbs added resources is the way the slope can be inferred. Historically, other spending has declined when military spending has risen; investment, net exports, and non-military government purchases are crowded out by military spending. For each dollar of added military spending, other spending declines by about 30 cents. The inference is that the schedule relating other spending to GNP has an important negative slope.

Over the period studied here, the correlation of the change in consumption and the change in GNP has been strong; the correlation coefficient is 0.59. Similarly, the correlation of the change in other spending and the change in GNP is strongly positive at 0.61. The results of this paper explain *all* of the correlation of consumption and GNP in terms of the unexplained shifts in the two schedules and *none* as the result of movements along the consumption function. Even more strikingly, the results explain the strong *positive* correlation of other spending and GNP in spite of the *negative* slope of the schedule relating the two.

Stated in terms of the scale of the economy in 1982, the standard deviation of the annual first difference of GNP for the period was $90 billion. The standard deviation of the component associated with the shift of the consumption function was $28 billion; for other spending including military, $72 billion. The decomposition between the two schedule shifts is ambiguous because they are quite highly correlated, but, by assumption, both are uncorrelated with the shift in military spending.

Because the slightly negative slope found for the consumption function in this work contradicts the thinking of many macroeconomists on this subject, I have repeated the exercise for two assumed values for the slope of the consumption-GNP schedule. One, which I think of as Keynesian, assumes a value of 0.3. The standard deviation of the consumption shift effect on GNP is $26 billion. The shifts in the consumption function are estimated to be smaller in this case, but their contribution to movements in GNP is larger because the multiplier is larger.

A second case derives from equilibrium models of the business cycle. It interprets the consumption-GNP schedule as the expansion path of the consumption-labor supply decision of the household. The slope of the schedule should be *negative* since presumably both consumption and leisure are normal goods. Any events that make people feel that it is a good idea to consume more should also cause them to take more leisure and therefore work less. A reasonable value for the slope of the consumption-GNP schedule under this interpretation is -1. When this is imposed on the problem, the consumption shifts appear much larger, since this is a long step away from the regression relation. The standard deviation of the effect of consumption on GNP is $47 billion, comparable to the effect of shifts in other spending, $46 billion.

2. Earlier research

Modern thinking about the possible role of shifts in the consumption function in overall macro fluctuations began with Milton Friedman and Gary Becker's "A Statistical Illusion in Judging Keynesian Models" (1957). They pointed out that random shifts in the consumption function could induce a positive correlation between consumption and income, which in turn could make the consumption look more responsive to income than it really was and also make the consumption function more reliable than it really was. However, neither Friedman and Becker nor other workers on the consumption function pursued the idea that shifts in the consumption function might be an important element of the business cycle.

More recently, Peter Temin's *Did Monetary Forces Cause the Great Depression?* (1976) argued forcefully for a role for shifts of the consumption function in explaining the contraction from 1929 to 1933. Temin focusses particularly on the residual from a consumption function in the year 1930 and suggests that the shift in consumption in that year was an important factor in setting off the contraction. His results are strongly supported in this paper, which finds large shifts in the consumption-GNP relation in all the years of the contraction.

Temin's critics, Thomas Mayer (1978) and Barry Anderson and James Butkiewicz (1980) confirm that consumption functions of various types had important negative residuals in 1930. It is a curious feature of Temin's work and that of his critics that no attention has been paid to the issue of finding the true slope of the consumption-income schedule. If the history of the U.S. is full of episodes where consumption shifts affected GNP, then the observed correlation of consumption and income is no guide at all to the slope of the consumption function. Temin considerably understates the power of his case by looking for departures from the historical relation between consumption and income, which is not at all the same thing as the slope of the structural relation. The historical relation summarizes numerous other episodes where a spontaneous shift in consumption had important macro effects. Temin only looks at the excess in 1930 over the usual amount of a shift, when his argument logically involves the whole amount of the shift.

Because of my use of military spending as the exogenous instrument that identifies the structural consumption function, the paper spends some effort in understanding how a burst of military purchases influences the economy. Robert Barro (1981) has examined the theory of the effect of government purchases in an equilibrium framework and has studied U.S. data on the effect on GNP. He found a robust positive effect of all types of government purchases, with an especially large coefficient for temporary military spending. My results here are in line with Barro's, though I do not attempt to distinguish permanent and temporary purchases. Barro notes that higher government purchases should *depress* consumption as a matter of theory (p. 1094) but does not examine the actual behavior of consumption. Barro and Robert King (1982) point out the difficulties of creating a theoretical equilibrium model in which the covariance of consumption and work effort is anything but sharply negative.

Joseph Altonji (1982) and N. Gregory Mankiw, Julio Rotemberg, and Lawrence Summers (1982) use the observed positive covariation of consumption and hours of work to cast doubt on the empirical validity of equilibrium models. However, neither paper considers the possibility that feedback from shifts in household behavior creates an econometric identification problem. The results of this paper give partial support to their conclusion. With a serious treatment of the identification problem, the structural relation between work and consumption appears to be flat or slightly negatively sloped, but not nearly enough negatively sloped to fit the predictions of the equilibrium model.

This paper examines the importance of fluctuations in consumption as an interesting question in its own right. Its finding of important shifts in the consumption function is important as well for recent research on consumption and related issues in finance. As Peter Garber and Robert King (1983) point out, shifts in preferences or other sources of unexplained fluctuations in consumption behavior invalidate the Euler equation approach used by myself and others in studying the reaction of consumers to surprises in income and to changes in expected real interest rates. The hope that the Euler equation is identified econometrically without the use of exogenous variables depends critically on the absence of the type of shift found in this paper. My findings suggest that the Euler equation is identified only through the use of exogenous instruments, just as most other macroeconomic structural relations.

3. A simple structural relation between GNP and consumption

Keynesian theory denies consumers choice about the level of work effort. The effective demand process dictates the amount of work and the corresponding level of earnings. Consumers choose consumption so as to maximize satisfaction given actual and expected earnings. In general, the resulting relationship between earnings and consumption can be complicated--consumers will use the information contained in current and lagged earnings to infer likely future earnings and thus the appropriate level of consumption. Traditional Keynesian thought has emphasized the strength of the contemporaneous relation between income and consumption. Liquidity constraints probably contribute to the strength. Recent tests by myself and Frederic Mishkin (1982) and by Marjorie Flavin (1981) have rejected the optimal response of consumption in favor of excess sensitivity to current income (however, these tests are likely to be contaminated by shifts in consumer behavior of the type investigated in this paper).

Otto Eckstein and Allen Sinai's paper for this conference (1984) provides a reasonable estimate for the slope of the GNP-consumption schedule. In their Table 7, they estimate the effects on GNP and consumption of an exogenous increase in government purchases. The ratio of the change in consumption to the change in GNP is an estimate of the slope of exactly the schedule considered in this paper. The ratio is

Quarters after increase	GNP	Consumption	Ratio
4	1.26	0.41	0.32
8	0.94	0.28	0.30
12	0.81	0.18	0.22
16	0.64	0.10	0.16
24	0.56	0.10	0.18

I will use an estimate for the year-to-year marginal propensity to consume of 0.3 on the basis of this evidence about the overall behavior of a fully-developed Keynesian model.

Equilibrium thinking about the consumption-GNP schedule

In an equilibrium model consumers are free to choose the most satisfying combination of hours of work and consumption of goods, subject to the market tradeoff between the two:

$$\max_{\{c_t, y_t\}} \sum D^t u(c_t, y_t)$$

$$\text{subject to } \sum R_t(p_t c_t - w_t y_t) = W.$$

My notation is:

- D: Time preference factor
- u(): One-year utility function
- c_t: Consumption in year t
- y_t: Employment in year t
- R_t: Discount factor
- p_t: Price of consumption goods in year t
- w_t: Wage in year t
- W: Initial wealth

I will work with one aspect of the overall problem, the consumption-work choice in year t. The first-order condition for that choice is:

Marginal rate of substitution = real wage

or

$$-\frac{\partial u/\partial y_t}{\partial u/\partial c_t} = \frac{w_t}{p_t} = \omega_t$$

Define the expansion path, $f(y_t, \omega_t)$, by

$$-\frac{\partial u(f(y,\omega),y)/\partial y}{\partial u(f(y,\omega),y)/\partial c} = \omega$$

Other aspects of the overall choice problem determine the point the consumer chooses on the expansion path. These include wealth and the timing of consumption and work. With the real wage held constant, higher wealth moves the consumer to a point of higher consumption and lower work. Again with the real wage held constant, a higher real interest rate moves the consumer to a point of lower consumption and more work. Joseph Altonji (1982) pointed out the usefulness of examining the joint behavior of work effort, consumption, and the real wage; his paper presents many more details on the derivation of their relationship.

It should be apparent that the expansion path slopes downward, so long as consumption and leisure are normal goods.

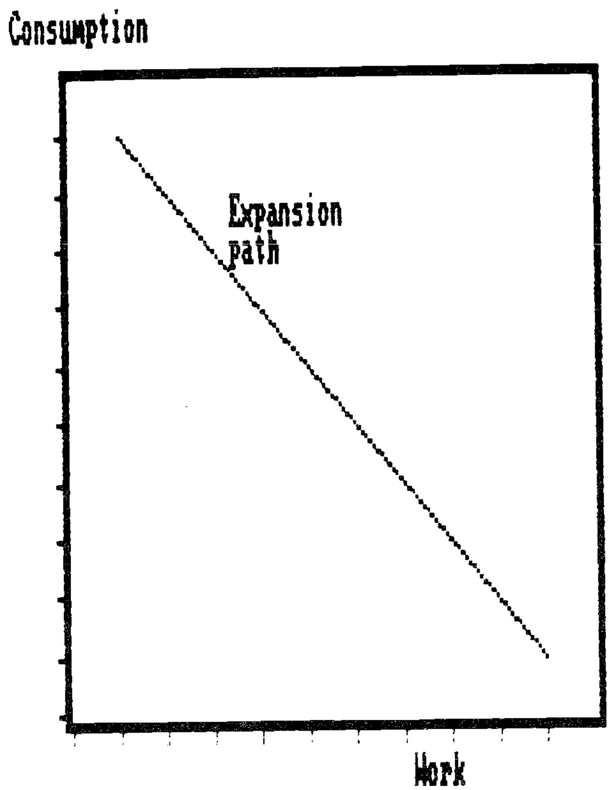

Figure 1. The expansion path. For a given real wage, consumption and work occur in combinations given by the path. The real interest rate and the level of wealth determine the position on the expansion path chosen by the consumer.

The expansion path shifts downward if the real wage declines. Consequently, a higher tax rate depresses consumption given the level of work effort. On the other hand, the expansion path is unaffected by an increase in government purchases of goods and services or by lump-sum transfers or taxes. These latter influences will move the consumer along the expansion path, but will not shift the path.

The slope of the expansion path can be estimated as the negative of the ratio of the income effect in the demand for consumption goods to the income effect in the labor supply function. Estimated income effects for labor supply run on the order of $0.50 less in earnings for each $1.00 in increased non-labor income. That is, an increase in non-labor income of $1.00 raises total income by only $.50. If all of the increase in total income is applied to goods consumption, sooner or later, then the income effect for goods consumption is also $.50 per $1.00 of non-labor income. The resulting slope of the expansion path is -1.

The structural relation in the equilibrium model refers to consumption and work effort. For the purposes of this paper, I think the best measure of the change in work effort from one year to the next is the change in real GNP. In the short run, the amount of capital available for use in production hardly changes, though, of course, the intensity of its use cnanges. Almost all changes in output correspond to changes in hours of labor input and in the amount of effort per hour spent on the job (see Hall, 1980, for an elaboration and empirical study of this point). Real GNP is the best available measure of all the dimensions of changes in work effort in the short run.

The structural relation suggested by the equilibrium model has the form

$$c_t = \beta y_t + \gamma \omega_t$$

In addition to the level of work effort, measured by y_t, the after-tax real wage, ω_t, shifts consumption up relative to work effort. In the empirical work carried out here, it is not possible to estimate the coefficients of two different endogenous variables. The best that can be done is to estimate the coefficient of y_t *net* of the part of a real wage movement that is systematically related to y. For example, if the real wage is countercyclical, so that

$$\omega_t = -\delta y_t$$

then it is possible to estimate the net relation,

$$c_t = (\beta - \gamma\delta) y_t$$

Because β is negative, the countercyclical wage movements makes the consumption-GNP relation even more negatively sloped. It seems unlikely that procyclical movements of after-tax real wages are anywhere near large enough to explain the finding of this paper of a zero net slope of the consumption-GNP relation. That finding is probably evidence against a pure equilibrium model.

Synthesis

Equilibrium and Keynesian models agree on a structural relation between consumption and income or work of the form

$$c_t = \beta y_t + \varepsilon_t$$

Here,

β: slope of the structural relation, negative for the equilibrium model (say -1), positive for the Keynesian model (say 0.3)

ε_t: random shift in the c-y relation

4. Other components of GNP

I will assume that military purchases of goods and services, g_t, is an exogenous variable.

I will define x_t as the remainder of GNP, that is, investment plus net exports plus non-military government purchases of goods and services (the latter is largely state and local). x_t has a structural relation to GNP; fluctuations in this relation are a source of fluctuations in almost all theories of the business cycle.

It is not possible to estimate a detailed structural model for x_t for the reason just mentioned--a single exogenous variable limits estimation to a single endogenous variable. Basically, what can be estimated is the net effect of an increase in GNP on investment, net exports, and non-military government purchases. On the one hand, considerations of the accelerator (particularly important for inventory investment) suggest a positive relation between GNP and x. On the other hand, increases in interest rates that accompany an increase in GNP bring decreases in x. For investment, especially in housing, the negative response to interest rates is well documented. For net exports, an increase in GNP raises imports directly. In addition, under floating exchange rates, the higher interest rates brought by higher GNP cause the dollar to appreciate, making imports cheaper to the U.S. and exports more expensive to the rest of the world. It is perfectly reasonable that the overall net effect of higher GNP on investment, net exports, and non-military purchases should be negative.

The following simple relation summarizes these considerations:

$$x_t = \mu y_t + \nu_t$$

The coefficient μ may well be negative, if crowding out through interest rates is an important phenomenon.

5. The complete model

The model comprises three equations:

$$c_t = \beta y_t + \varepsilon_t$$

$$x_t = \mu y_t + \gamma_t$$

$$y_t = c_t + x_t + g_t$$

The solution for GNP is

$$y_t = \frac{1}{1-\beta-\mu}(g_t + \varepsilon_t + \gamma_t)$$

This equation gives a precise accounting for the sources of fluctuations in output. The three driving forces for the economy are military purchases of goods and services, g_t, the random shift in the consumption schedule, ε_t, and the random shift in other spending, γ_t.

6. Identification and estimation

The goals of estimation in this work are threefold:

1. Estimate the multiplier,

$$\frac{1}{1-\beta-\mu}$$

which applies to each of the three components in the decomposition in the last section.

2. Estimate the "propensity to consume," β, in order to compute the residuals, ε_t, in the consumption function.

3. Estimate the "propensity to spend," μ, in order to compute the residuals, γ_t, in the function for other spending.

The solution to the first problem is perfectly straightforward. In the equation for the movement in GNP, military spending appears as a right-hand variable along with two disturbances assumed to be uncorrelated with military spending. Hence, the regression of GNP on military spending should estimate the multiplier directly. Again, the interpretation of the estimated multiplier is net of feedback effects through interest rates.

To estimate the slope of the consumption-GNP schedule, β, note that c and g have the regression relation,

$$c_t = \frac{\beta}{1-\beta-\mu}(g_t + \nu_t) + \frac{1-\mu}{1-\beta-\mu}\varepsilon_t$$

An estimate of β can be computed as the ratio of this coefficient to the multiplier. Alternatively, exactly the same estimate can be computed with two-stage least squares applied to the c-y relation with g as the instrument.

The slope of the x-y relation can be computed analogously either by the ratio of the regression coefficient of x on g to the multiplier, or by applying two-stage least squares to the x-y equation with g as instrument.

The relationships estimated in this paper are approximations to more complicated equations. For example, the complete model does not do justice to the modern Keynesian notion that gradual wage and price adjustment gives the model a tendency toward full employment in the long run. The results are likely to look somewhat different with an estimation technique that gives heavy weight to lower frequencies from those based more on higher frequencies. Because cyclical fluctuations are the focus of this paper, I want to exclude the lower frequencies from the estimation. I have accomplished the exclusion in two ways.

First, I have detrended all of the data in a consistent fashion. Second, I have used first differences in all of the basic estimation. With annual data, first differences puts strong weight on the cyclical frequencies and no weight at all on the lowest frequencies.

7. Data

The data on real GNP in 1972 dollars for 1919-1982 and real personal consumption expenditures for 1929-1982 are from the U.S. National Income and Product Accounts. For 1919-28, data on real consumption are taken from John Kendrick (1961).

I used data on real military purchases of goods and services from the NIPA for 1972 through 1982 and from Kendrick for 1919-53. For 1954 through 1971, nominal military spending is taken from the NIPA and deflated by the implicit deflator for national security spending from the Office of Management and Budget (1983), converted to a calendar year basis.

For some additional results described at the end of the paper, I used the number of full-time equivalent employees in all industries, including military, from the NIPA.

To eliminate the non-cyclical frequencies from the data, I started by fitting a trend to real GNP:

$$\log y_t = 5.14 + .0206\ t + .00014\ t^2$$

(t is one in 1909)

Then I detrended real GNP, real consumption, and real military purchases with this real GNP trend. I preserved the 1982 values of each of the three variables, so the effect of detrending was to raise the earlier levels. For employment, I detrended with a log-linear trend of 1.96 percent per year and rebased the series so that it equals real GNP in 1982.

All of the estimates used the first differences of the detrended series.

8. Results

All of the regressions reported in this paper include intercepts, but the values of the intercepts are not reported because detrending makes them almost meaningless.

Estimation of the multiplier by regressing the change in GNP on the change in military spending for the years 1920 through 1942 and 1947 through 1982 gives the following results:

$$\Delta y_t = \underset{(.16)}{.62}\ \Delta g_t$$

Standard error: $81 billion   DW: 1.48

Because the multiplier is less than one, it is clear that a certain amount of crowding out took place, on the average. Each dollar of military purchases raises GNP by 62 cents, so non-military uses of output decline by 38 cents.

The regression of consumption on military spending is:

$$\Delta c_t = \underset{(.08)}{-0.07}\ \Delta g_t$$

Standard error: $38 billion   DW: 1.50

Because the coefficient is close to zero, with a small standard error, it is clear that the implied slope of the c-y relation will be close to zero as well. Even though periods of wartime controls on consumption have been omitted from this regression, there is strong evidence against the proposition that those increase in GNP that can be associated with exogenous increases in military spending stimulated any important increases in consumption. Similarly, the strong *negative* response of consumption to military spending predicted by the equilibrium model has also been shown to be absent.

The ratio of the two regression coefficients is -.12; this is the estimate of the slope of the consumption-GNP schedule. The same estimate can be obtained by two-stage least squares, together with the standard error of δ and the standard error of the residuals:

$$\Delta c_t = \underset{(.15)}{-0.12}\ \Delta y_t$$

Standard error: \$46 billion DW: 1.39

The confidence interval on the slope of the c-y relation includes a range of values, but excludes the Keynesian value of 0.3 and the equilibrium value of -1 as well. Neither theory is able to explain the lack of a structural association of consumption and GNP.

In the next section, I will make use of consumption equations with two different assumed values of the slope:

<u>Keynesian</u>, $\beta = 0.3$

$$\Delta c_t = 0.3\Delta y_t$$

$$s = \$31 \text{ billion}$$

<u>Equilibrium</u>, $\beta=-1$

$$\Delta c_t = -\Delta y_t$$

$$s = \$117 \text{ billion}$$

The basic results of the paper can be guessed from these results. The residuals in the Keynesian consumption relation are smaller than those for the estimated relation (standard errors of \$31 billion against \$46 billion) and are very much smaller than are those for the equilibrium case (\$117 billion). Even the smaller Keynesian residuals turn out to be important in the overall determination of GNP. GNP and consumption are positively correlated both because the consumption relation slopes upward and because shifts in the relation are an important determinant of both variables.

On the other hand, the equilibrium model sees very large shifts in the c-y relation. When the relation shifts upward, both c and y rise. Because most of the variation in both variables comes from the shifts in the relation, the two are highly positively correlated, even though the relation has a negative slope. The fact that a positive slope gives a better fit in the consumption equation is not evidence against the equilibrium view at all.

Results for other spending, x

The regression of Δx on Δg gives:

$$\Delta x_t = \underset{(.12)}{-0.30}\ \Delta g_t$$

Standard error: $58 billion DW: 2.03

Investment, net exports, and non-military government spending are quite strongly *negatively* influenced by military spending, again during years when wartime controls on private spending were not in effect. The estimate of the slope of the x-y schedule inferred by dividing by the multiplier is -0.48. The same estimate is available from two-stage least squares:

$$\Delta x_t = -0.48 \, \Delta y_t$$
$$\quad\quad (.30)$$

Standard error: $95 billion DW: 1.79

Plainly, the negative effects operating through interest rates dominate the positive effects of the accelerator. Higher GNP depresses non-consumption, non-military spending along this structural schedule.

9. Estimates of the importance of the consumption shift

Because neither of the major schools of business cycle theory is consistent with my estimates of the slope of the c-y relation, I will proceed by making estimates for three different cases:

1. Estimated. The slope of the c-y relation is -.12, the value inferred from the fact that, historically, higher military purchases have raised GNP but not consumption. Consumption is virtually an exogenous variable. It influences GNP but is not influenced by GNP.

2. Keynesian. The slope of the c-y relation is 0.3. When more work is available, people consume more as well.

3. Equilibrium. The slope of the c-y relation is -1. Events that move consumers along their expansion paths leave the sum of GNP and consumption unchanged. Departures of the sum of GNP and consumption are a signal of a shift in the expansion path, possibly associated with a change in the after-tax real wage, but usually a random, unexplained shift.

Though the movements of GNP can be decomposed into three components for the three driving forces listed in the model in section 4 (military purchases, the random shift in the consumption schedule and the random shift in the investment-exports schedule), I will concentrate on the consumption shift on the one hand and the sum of the two other components on the other hand. The consumption component is

$$\frac{1}{1-\beta-\mu} \varepsilon_t$$

ε_t is the residual from the consumption equation. Note that the magnitude of the consumption component depends on the magnitude of the residual and on the magnitude of the multiplier. The other component is just Δy_t less the consumption component.

Figure 2 shows the total change in real GNP and the consumption components for the three cases. As a general matter, the consumption component is most important for the equilibrium case and least important for the Keynesian case. However, it is a significant contributor to GNP fluctuations in all three cases.

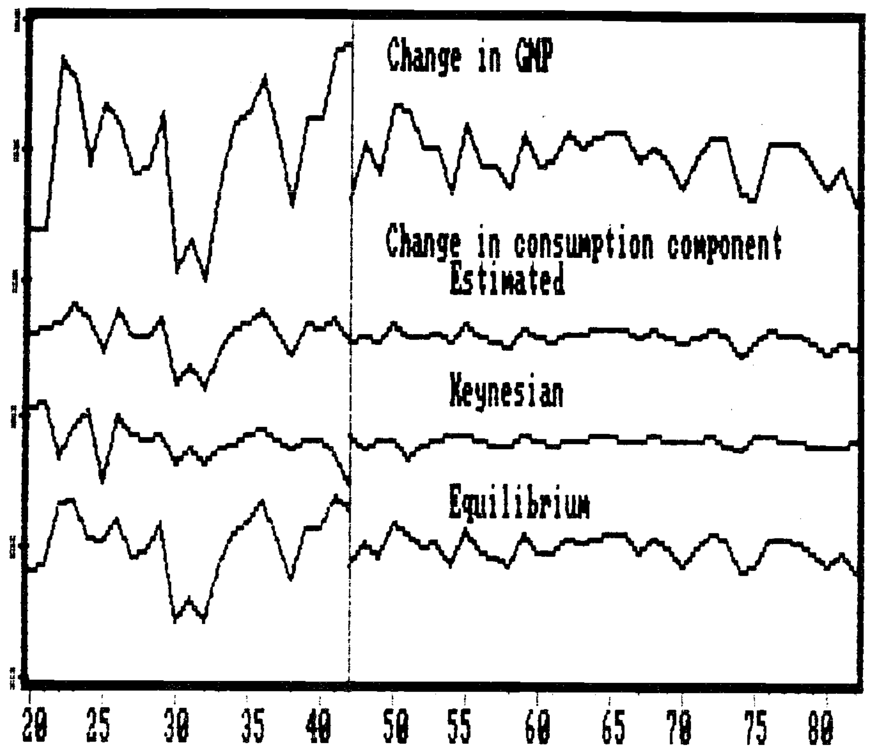

Figure 2. Change in real GNP and the consumption component for the three cases.

Under the estimated results where consumption is effectively exogenous, shifts in the consumption schedule are important, but so are shifts in the other determinants of GNP, especially in the interwar period. Responsibility for the Great Contraction is shared between shifts in the c-y relation and the other sources. However, in the postwar period, shifts in other spending account for the bulk of the movement of GNP. The two large drops of GNP in 1973-74 and 1974-75 are partly the result of drops in consumption. Some of the long contraction since 1978 is the result of a consumption shift as well.

In the Keynesian view, shifts in the consumption function are bound to be less important than in the other two cases. When consumption and GNP drop together, all or part of the decline in consumption can be attributed to the drop in GNP. Still, shifts in consumption are a part of the story of total fluctuations.

For the equilibrium case, the story about the Great Contraction in 1929-32 told by these results will help clarify what the theory is saying. Rescaled real GNP fell by $227 billion in 1929-30, $171 billion in 1930-31, and $243 billion in 1931-32. Of this, $140 billion came from a random shift in household behavior toward less work and less consumption in 1929-30, $97 billion in 1930-31, and $148 billion in 1931-32. The remaining $87 billion in the first year, $74 billion in the second year, and $95 billion in the third year came from changes in military spending and shifts in the investment-export schedule. Of the two, the first was almost negligible. But the most important part of the story of the contraction was a sudden lack of interest in working and consuming, according to the equilibrium model.

Table 1 summarizes the findings for the three cases in terms of simple statistical measures.

Standard deviation of change in	Keynesian	Case Estimated	Equilibrium
Real GNP	90	93	93
Consumption component	26	28	47
Other component	97	72	46
Correlation of two components	−0.40	0.53	0.86

Table 1. Statistical summary. Standard deviations are in billions of 1972 dollars, with quantities rescaled to 1982 magnitudes.

It is interesting to note that the standard deviation of the consumption component for the Keynesian case is slightly higher that it is in the estimated case. Although the residuals in the Keynesian consumption function are smaller than the residuals in the other case, the multiplier is quite a bit higher (0.85 as against 0.62). The big difference between the two cases is in the size of the other component. Again, because the multiplier is lower for the estimated case and higher for the Keynesian case, the other component is larger for the Keynesian case. The Keynesian case reconciles a larger other component with a consumption component of about the same size by invoking a lower correlation of the two components. The negative correlation permits the sum to have the same standard deviation (the known standard deviation of the change in real GNP) even though one of the components is more variable.

10. Other estimates

Estimates for other time periods and other specifications have convinced me that the basic findings of this paper are robust. First, estimates for the entire period, the interwar period, and the postwar period are

Entire period, 1920-82

$$\underset{}{\Delta c_t} = \underset{(.09)}{-.16}\ \Delta y_t$$

Standard error: \$47 billion DW: 1.37

$$\Delta x_t = \underset{(.18)}{-.54}\ \Delta y_t$$

Standard error: \$96 billion DW: 1.78

For both equations, the considerable extra variance from the extraordinary level of military spending during World War II helps to reduce the sampling variation without much changing the coefficients.

Interwar period, 1920-42

$$\Delta c_t = -0.13 \Delta y_t$$
$$(.24)$$

Standard error: $70 billion DW: 1.31

$$\Delta x_t = -.50 \, \Delta y_t$$
$$(.50)$$

Standard error: $144 billion DW: 1.75

Postwar period, 1947-82

$$\Delta c_t = -.11 \, \Delta y_t$$
$$(.20)$$

Standard error: $23 billion DW: 1.78

$$\Delta x_t = -.36 \, \Delta y_t$$
$$(.41)$$

Standard error: $46 billion DW: 1.94

Results for a direct measure of work effort

In his comment on the version of this paper presented at the conference, Angus Deaton suggested that the negative findings for the equilibrium model might be the result of the use of GNP as a measure of work effort. Because GNP might measure the result of other productive factors, including pure good luck, and these other factors might reasonably be positively correlated with consumption, the consumption-GNP relation might be more positively sloped than is the consumption-work effort relation.

To check this possibility, I repeated the analysis with full-time equivalent employment in place of real GNP. I detrended the series by its own exponential trend and rescaled it to equal real GNP in 1982. Application of two-stage least squares to the relation of the first difference of consumption to the first difference of employment, with the change in military spending as the instrument, for the period 1930-42 and 1947-82, is

$$\Delta c_t = \underset{(.18)}{-0.10}\ \Delta y_t$$

Standard error: $41 billion   DW: 0.91

Again, the structural slope is slightly negative, but not nearly negative enough to fit the equilibrium hypothesis. The hypothetical value of -1 is strongly rejected.

11. Conclusions

A simple structural relation between GNP and consumption is a feature of two major theories of economic fluctuations, though the theories differ dramatically in most other respects.

In the Keynesian analysis, the consumption function slopes upward, so, in principle, the positive correlation of GNP and consumption could be explained purely by forces other than shifts in consumption behavior. Nonetheless, the results of this paper show that shifts in the consumption function are a source of overall fluctuations in a Keynesian analysis. In the first place, even the Keynesian consumption function has residuals, though they are smaller than the residuals from the equilibrium or estimated c-y relationships. In the second place, exactly because of the Keynesian multiplier process operating through a positively sloped consumption function, the consumption disturbances are much more strongly amplified than they are in the equilibrium or estimated models.

In the equilibrium theory, the relation is the expansion path of the work-consumption choice. The public is free to pick a point along the path in response to economic conditions. Shifts in government tax and spending policies and shifts in investment and net exports will move the economy along its negatively sloped c-y schedule. If ever GNP and consumption move together, it is the result of a shift in the consumption schedule. Because consumption and GNP frequently move together, random shifts of the consumption-work schedule must be a <u>dominant</u> part of the equilibrium explanation of cyclical fluctuations.

In the Keynesian model, an increase in military purchases should raise GNP and raise consumption. In the equilibrium model, an increase in military purchases should raise GNP and lower consumption. The data for the past six decades examined in this paper seem to split the difference--consumption is unaffected by military purchases, while GNP rises. Hence the estimate of the slope of the c-y relation inferred through the use of military purchases as an instrument is about zero. In the compromise economy (which does not have a theory to go with it), random shifts in consumption are an important source of overall fluctuations.

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