The Effects of Inflation on the Distribution of Economic Welfare

I. INTRODUCTION

In recent years, the restraint of inflation has been one of the most important considerations of macroeconomic policy. On several occasions drastic measures have been taken to halt inflation. Most often these policies have led to significant unemployment and loss of output. But after a quarter century's experience with inflation, most economists and politicians are looking for new and less draconian tools to combat inflationary tendencies.

While most analysts agree that price stability is desirable, there is wide disagreement about the costs of inflation. In general, three reasons for price stability are mentioned. First, price stability encourages a favorable external balance. In an open economy with fixed exchange rates and difficulties of adjusting these exchange rates, there can be little doubt that inflation produces serious social costs. Second, it is sometimes alleged that inflation leads to inefficient resource allocation. There is, however, no evidence that the allocational effects of the mild inflations observed in advanced countries are significant. Third, it is often argued that inflation introduces a significant, arbitrary, and regressive redistribution of income.

The present study is concerned mainly with the third of these costs of inflation. More precisely, we attempt to determine the effects of alternative inflationary policies on the distribution of lifetime income. It is useful to lay out briefly the procedures used.

\[1\] This study follows many others concerned with the same general question. See in particular Bach and Ando [2], Metcalf [13], Schultz [19], Brownlee and Conrad [3], Hollister and Palmer [10], Miler [14], Budd and Seeber [4], and Thurow [22].

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1. The study is basically a simulation study of the effects of inflation; in this respect it follows all the microeconomic studies. Starting with an observed distribution of income and wealth for 1962, movements in variables are predicted and the results analyzed.

2. Most studies examine the effect of inflation on the distribution of income. The concept of income used in the present study is per capita lifetime consumption annuity (or annuity for short). Given wealth and current labor income, it is possible to predict future labor income and hence total lifetime wealth. From this data and from specific assumptions about individual utility functions, the path of potential consumption is then derived.

The *income annuity* of a household is the maximum constant per capita consumption the household could attain over the household’s expected lifetime, subject of course to the household’s lifetime wealth. The *utility-equivalent annuity* is that constant per capita consumption stream which would give the same utility as the optimal consumption plan.

The advantage of using the annuity concept, rather than either income or wealth, is obvious: first, it allows comparison of different age groups and groups with different wealth-income ratios. Since there are very marked differences in the wealth-income ratio with age (especially money-fixed valued assets), it is possible that the distributional effects of inflation may be misstated by looking at other concepts; and, second, it may be argued that the concern of government policy should be with a consumption variable rather than income or wealth variables.

3. Since we are concerned with the long-run effects of inflation (the effects on lifetime consumption rather than the effects of inflation over a few years), we must consider a long-run macroeconomic model. We thus leave aside many important and relatively well-understood details of short-run models and examine the more speculative features of long-run systems.

4. The analysts of inflation do not often agree on the economic mechanism which generates and transmits inflation. For this reason it is crucial to distinguish the effects of inflation in different economic systems. In this study we analyze three different kinds of economies, which we call classical, neoclassical, and Keynesian.  
   a. The classical system considered is one which has a unique equilibrium for all *real* variables independent of the level of prices or the rate of inflation. This system is closely related to competitive, general equilibrium systems which are in continuous long-run equilibrium. In this system inflation alters the distribution of income and wealth according to the relative holdings of money-fixed assets.
   
   b. The neo-classical system examined is a generalization from the classical system

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2 Without a detailed longitudinal study of households it is not possible to infer the effects of inflation. The aggregate, time series studies (such as Schultz [19] and Thurow [22]) do not allow us to disentangle movements of the aggregate distribution of income from movements within the distribution.

3 A more complete formal description of this procedure is given in section II.

4 These titles are merely suggestive and, as will be seen, do not correspond exactly to any author or school of thought.
in that it explicitly introduces production and savings functions and a mechanism for income distribution. The level of utilization of resources is constant. In this regime, inflation affects capital accumulation and, via the neoclassical production and distribution system, inflation changes real wages and real interest rates. These lead to changes in income, wealth, and consumption.

The Keynesian system imposes on the neoclassical system a very simple cyclical mechanism. Over the cycle, inflation varies inversely with unemployment as in the well-known Phillips curve. The distributional effects of an inflationary package can be examined, where the employment and inflationary effects are combined.

We assume that any inflation initially occurring is fully anticipated. The system is then shocked by an inflationary episode, and the anticipated inflation gradually adjusts to the new inflation rate. In the classical and neoclassical models, the systems are completely neutral to fully anticipated inflation, while in the Keynesian system the level of inflation is associated with a given level of unemployment. In Section II of the paper we analyze more carefully the concepts and measurement of the personal distribution of the annuity concepts. Section III then analyzes the effects of inflation in the three economic systems under consideration.

II. THE DISTRIBUTION OF ECONOMIC WELFARE

It is customary to discuss the effect of policies on "the distribution of income." Almost any standard, income is a rudimentary concept to employ in serious studies of policy effects. The objections to income are well-known. Which definition of income should be used? How can one measure and how should one correct for the transitory component in income? How should wealth be included? Should some be lifetime or annual, total or per capita?

It may appear that too much importance has been attributed to income in distributional studies. This is particularly surprising in light of the general philosophical situation of economists that consumption, not production or receiving income, is the goal of economic activity. A man's economic welfare should be measured by his consumption activities, or potential consumption, not by his income.

The income-based measure of economic welfare has a great many problems which operate if a utilitarian, consumption-based, concept is used. Other problems arise, however. The most important problem involves the form of the utility function.

A. The Theoretical Propositions

1. The Simplest Case.—We consider the simplest case of a single consumer with a lifetime of $T$ years and an iso-elastic utility function. His total lifetime utility is

Neutral means that the real variables of the system are independent of the rate of fully anticipated inflation.
\[ U = \int_0^T u \left[ c(t) \right] e^{-\delta t} \, dt \] (1)

where \( \delta \) is the subjective discount rate and \( u = AC^\beta/\beta \) is the instantaneous utility function, where \(-\infty < \beta < 1\).\(^6\) In this simplest formulation, bequests, taxes, and transfers are ruled out.

The household has flows of labor income \((y_L)\) and property income \((y_p)\), so conventionally measured income \((y)\) is given by

\[ y = y_L + y_p. \] (2)

In addition the household has initial wealth, \(K_0\). Assuming a constant real rate of return on wealth of \(\rho\), we can calculate discounted income, or lifetime wealth, \(W^*\), as follows:

\[ W^* = K_0 + \int_0^T y_L(t) e^{-\rho t} \, dt. \] (3)

Our household is assumed to maximize lifetime utility, that is the household maximizes (1) subject to (3). Integrating (1) for constant growth rates of consumption gives

\[ U = A \frac{c^\beta}{\beta} \frac{1 - e^{(g - \delta)T}}{\delta - g\beta}. \] (4)

The wealth constraint is independent of the consumption plan. We thus have the budget constraint:

\[ W^* = \int_0^T c_0 e^{(g - \rho)t} \, dt = \frac{c_0 \left( e^{(g - \rho)T} - 1 \right)}{g - \rho} \] (5)

or

\[ c_0 = \frac{(\rho - g)W^*}{1 - \exp [(g - \rho)T]} . \]

Substituting (5) into (4):

\[ U = A \frac{(\rho - g)}{\beta} \frac{1 - \exp [(g - \rho)T]}{1 - \exp [(g - \rho)T]} \frac{1 - \exp [(g\beta - \delta)T]}{\delta - g\beta} (W^*)^\beta. \] (6)

\(^6\)In the case of \( \beta = 0 \), the formulae below must be changed so that \( u[c(t)] = A \log[c(t)] \). When \( \beta = 1 \), we get a corner solution.
Maximizing (6) with respect to the rate of growth of consumption, \( g \), yields:

\[
U'(g) = \frac{\beta U}{\delta - g \beta} - \frac{\beta U}{\rho - g} + \frac{\beta TU \exp \left[ (g - \rho) T \right]}{1 - \exp \left[ (g - \rho) T \right]} - \frac{\beta TU \exp \left[ (g \beta - \delta) T \right]}{1 - \exp \left[ (g \beta - \delta) T \right]}. 
\]

Thus

\[
0 = \beta U \left[ \frac{1}{\delta - g \beta} - \frac{1}{\rho - g} \right] + \beta TU \left[ \frac{\exp \left[ (g - \rho) T \right]}{1 - \exp \left[ (g - \rho) T \right]} - \frac{\exp \left[ (g \beta - \delta) T \right]}{1 - \exp \left[ (g \beta - \delta) T \right]} \right].
\]

It can easily be verified that \( (\rho - g) = \delta - g \beta \) is the only solution such that \( U'(g) = 0 \) for all lifetimes \( T \). Thus:

\[
\rho - g = \delta - g \beta
\]

or

\[
g = \frac{\rho - \delta}{1 - \beta}. \tag{7}
\]

The consumption profile is given by

\[
c(t) = \frac{(\rho - g) W^* \exp (\rho t)}{1 - \exp \left[ (g - \rho) T \right]} \tag{8}
\]

Actual wealth at a point of time \( (K(t)) \) is then given by

\[
K(t) = K(0) e^{\rho t} + \int_0^t \left[ y_L(v) - c(v) \right] e^{\rho (t-v)} dv. \tag{9}
\]

The case of varying rates of return is easily handled. Let \( \rho(t) \) be the instantaneous rate of return and let \( R(t) = \int_0^t \rho(v) dv \) be the total rate of return to time \( t \). Then lifetime wealth is

\[
W^* = K_0 + \int_0^T y_L(t) \exp \left[ -R(t) \right] dt. \tag{3'}
\]

The optimal consumption trajectory then implies

\[
c(t) = c(0) \exp \left[ \frac{R(t) - \delta t}{1 - \beta} \right] = c(0) \exp \left[ G(t) \right] \tag{7'}
\]

where \( G(t) = \int_0^T \left[ (\rho(v) - \delta)/(1 - \beta) \right] dv \). Thus
\( c(0) = W^* \left[ \int_0^T \exp [G(t) - R(t)] \, dt \right]^{-1}. \) (5')

2. The Concepts of Annuity Income (AI) and Utility-Equivalent Annuity Income (UAi).

We now turn to the problem of finding a concept of economic welfare which will allow comparisons of groups with differing life expectancies, wealth-income ratios, and future labor incomes. Since our investigation is oriented toward welfare, it is natural that we choose an index of welfare such that if two individuals have equal utilities they have equal index values. We thus propose the following measures:

As index of economic welfare, we define the annuity income (AI) as that constant annual per capita consumption level which exhausts lifetime income; the utility-equivalent annuity income (UAi) is the value of that constant consumption stream which gives a total utility equal to that of the optimal consumption profile.

The utility-equivalent annuity (c*) is the solution to

\[
\int_0^T (c^*)^{\beta} e^{-\delta t} \, dt = \int_0^T [\dot{c}(t)]^{\beta} e^{-\delta t} \, dt
\]

where \( \dot{c}(t) \) is the optimal consumption profile. Substituting from (8), we have after some manipulation:

\[
c^{\star \beta} = (W^*)^\beta \left( \frac{\delta}{1 - e^{-\delta T}} \right) \frac{(\rho - g)^{\beta}}{\delta - g} \left( \frac{1 - e^{(\delta - \delta)T}}{1 - e^{(\delta - g)T}} \right)^{\beta}
\]

Note that if \( \delta = 0 \), we substitute \( T^{-1} \) for \( \delta/(1 - \exp(-\delta T)) \) in all expressions. Thus UAI is\(^7\)

\[
c^* = \frac{W^*(\rho - g)}{1 - e^{(\delta - \rho)T}} \left( \frac{\delta}{1 - e^{(\delta - \delta)T}} \right)^{1/\beta} \left( \frac{1 - e^{(\delta - \delta)T}}{(1 - e^{-\delta T})(\delta - g)} \right)
\] (11)

\(^7\)With variable rate of return, the formulae for AI and UAI are:

\[ y^* = W^* \left[ \int_0^T \exp [-R(t)] \, dt \right]^{-1} \] (10')

and

\[ c^* = W^* \left[ \int_0^T \exp [G(t) - R(t)] \right]^{-1} \left( \frac{\delta}{1 - \exp(-\delta T)} \right)^{1/\beta} \left( \int_0^T \exp [G(t) - \delta t] \, dt \right)^{1/\beta} \] (11')
where \( g = (\rho - \delta)/(1 - \beta) \). This is more easily understood if the first-order Taylor expansion is taken:

\[ c^* \simeq \left( \frac{\rho - g}{g^\beta - \delta} \left( \frac{\delta}{1 - [1 - \delta T]} \right) \left( \frac{1 + (g\beta - \rho) T - 1}{1 + (g - \rho) T - 1}\right) \right)^{1/\beta} W^*. \]

Thus two households have equal \( AI \) if the maximum (per capita) annuities they can buy with their income are equal. Speaking loosely, they have equal \( UAI \) if the average annual utility levels are equal. For households with equal lifetimes, to have equal \( AI \) means that the value of lifetime wealth of the households are equal, while equal \( UAI \) means that the utility of households are the same.

The concepts can be illustrated in Figure 1 for a two-period problem. \( W^* \) on the horizontal axis represents the value of lifetime wealth, and the budget constraint has slope \(-(1 + \rho)\). At the market interest rate \( \rho \), the household chooses the point \( A \), on indifference curve \( U_2 \), with associated consumption \( \{\hat{c}_1, \hat{c}_2\} \) as his consumption plan. Alternatively, he could have bought an annuity at point \( D \), with consumption \( (AI, AI) \) which would have left him slightly worse off. This is the annuity-income \( (AI) \). The utility-equivalent annuity, along indifference curve \( U_2 \), is \( B \) with consumption \( \{UAI, UAI\} \). This is our definition of utility-equivalent annuity \( (UAI) \).

In the general case, the annuity income \( (y^*) \) is simply the solution to

\[ W^* = \int_0^T y^* e^{-\rho t} \, dt \]
or
\[ y^* = \frac{\rho W^*}{1 - \exp(\rho T)} \]  

or
\[ c^* \equiv \frac{W^*}{T} \quad (12) \]

Thus the level of economic welfare is approximately the lifetime wealth divided by the life expectancy.\(^8\)

3. Extensions. – Varying family size. The cases just examined pertain to a single individual. For a household with varying size, we assume utility is linear in the number of persons times the utility of per capita consumption. If the household has size \( P_t \), total consumption \( C_t \), per capita consumption \( c_t \), the utility function is

\[ U = \int_0^T P_t U \left( \frac{C_t}{P_t} \right) e^{-\delta t} \quad (13) \]

subject to the same budget constraint in (5). Substituting we get

\[ U = \frac{A}{\beta} \int_0^T P_t^{1-\beta} C_t^\beta e^{-\delta t} dt. \]

If \( g \) = the rate of growth of per capita consumption, then

\[ U = \frac{A}{\beta} \int_0^T P_t c_0 e^{(g - \delta)t} dt \quad (14) \]

where

\[ W^* = \int c_t P_t e^{-\rho t} dt = \int c_0 e^{(g - \rho)t} P_t dt \]

or

\[ C_0 = W^* \left[ \int_0^T e^{(g - \rho)t} P_t dt \right]^{-1}. \quad (15) \]

Maximizing (14) with respect to \( g \) subject to (15)

\(^8\)The approximation is not always accurate. If \( \delta = .01, \rho = .06, g = .5, T = 40\), the approximation yields \( c^*/W^* = .025 \), while the correct figure is .09084. The difference between the two values gives some peculiar results in the estimates which follow.
\[
U'(g) = \frac{\int_0^T t\beta e^{(g-\delta)t} P_t dt}{\int_0^T e^{(g-\delta)t} P_t dt} - \frac{\int_0^T \beta e^{(g-\rho)t} P_t dt}{\int_0^T e^{(g-\rho)t} P_t dt} = 0
\] (16)

It is easily seen that \( \delta - \gamma = \rho - g \) is the only solution to equation (16).

We can thus use the results in section II.A.1 above as long as we interpret all variables as per capita magnitudes and replace the original budget constraint by that in (15).

Uncertainty. The treatment of uncertainty is a serious problem. For the most part, we assume that households act on the basis of certainty equivalence rather than expected utility maximization. The latter poses such large computational problems that it is infeasible for us (not to mention the problems it poses for a household without sophisticated computational techniques). The one partial exception to this rule is the household’s investment policy. In the quantitative work to follow, we assume that there are two investment assets, fixed yield and variable yield. The fixed yield assets (called “bonds”) give rate of return \( r \) with subjective certainty, while the variable yield assets (called “equities”) have rate of return \( r \) which is normally distributed with mean \( \alpha \) and standard deviation \( \sigma \).

Under these assumptions, and with the utility function used above, it can be shown that the consumption profile and portfolio composition is completely determined by the parameters of the utility function and security returns. More precisely, the household divides its portfolio in fixed proportions between bonds and equities, with the proportion of equities, \( e^* \), being

\[
e^* = \frac{\alpha - \beta}{\sigma^2 (1 - \beta)}.
\] (17)

The consumption profile is the same as above except that \( \rho \) is no longer the interest rate, but becomes a risk-corrected discount rate.\(^9\)

Future labor income is probably the single most important uncertainty faced by households. Formally, we can think of the problem as uncertainty with an asset that cannot be bought or sold. A reasonable treatment, and the one which is used here, is to have individuals make the best possible point estimate of future labor income.

Demography. Households face two general kinds of demographic uncertainty. First, they do not know the life expectancies of existing household members. Second, they do not know the exact number of new additions which will be made to the household. Here again we have our households behaving according to

\(^9\)More precisely \( \rho \) should now be interpreted as that riskless rate of return which gives the same utility as the optimal portfolio. See Samuelson and Merton [1970] and Merton [1969]. More precisely \( (1 + \rho)^\beta = \int [(1 - e^*)^i + e^*^r] \beta f(r) dr \). To a first-order approximation \( \rho = (1 - e^*)^i + e^*^r \).
certainty-equivalent behavior. For calculations of the life expectancy, we take the average life expectancy of a member of the population with age of the head. Second, we assume no further births, marriage, or divorce in the population. We do, however, account for the process of the separation of children from the household, which is assumed to occur at 21 years of age. The major shortcoming of this procedure is that it may overestimate the per capita lifetime wealth of a young household by underestimating the number of children. The fact that we underestimate future gifts and bequests to young households may offset this underestimate of household size.

Taxes. We have not explicitly calculated the taxes for each household. To do this correctly would require not only an allocation of each of the many kinds of federal, state, and local taxes, but explicit assumptions about the microeconomic incidence of each. This is beyond the scope of the present paper.

To obtain the distribution of after-tax income, we could assume that the present value of lifetime taxes is proportional to per capita lifetime wealth. Given the great uncertainty about the incidence of taxes, and in particular as to whether the total system of taxation (including state and local taxation) is progressive or regressive, this is at least a useful first approximation. Similarly, we assume that the benefit of government expenditures on goods and services is proportional to lifetime wealth.

B. Empirical Estimation of the Distribution of Economic Welfare

1. Sources.—We now present rough estimates of the levels of distribution of economic welfare. The basic data sources are the Federal Reserve Survey of Financial Characteristics of Consumers.

The survey gives reasonably complete and detailed estimates of current wealth and income of 2,557 families. It is necessary to complement this with estimates of future labor income. Variable definitions are given in Appendix A. The parameter estimates used in deriving $AI$ and $UAI$ are given in Appendix B. The details of the estimation of future labor income are given in Appendix C.

2. Results.—Tables 1 and 2 and Figure 2 below give the results of the estimates of the distribution of $AI$ and $UAI$ described above. These are also compared with the distribution of income and net worth as conventionally measured.

Table 1 shows the numerical distribution in 22 groups for annuity income and by age and other groups. Figure 2 shows the Lorentz curves for different measures. Other summary measures are given in Table 2.

As would be expected, the comprehensive measures of economic welfare are more

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10 It was necessary to make some assumptions about the incidence of existing taxes in order to use national income data. We have used the following conventional assumptions about existing taxes: corporate income taxes and labor taxes are absorbed by capital and labor, while all indirect business taxes are completely shifted forward.

11 It should be recalled that personal income taxes constitute only 38 percent of total government revenues. A flat-rate sales tax meets the above assumption.

12 See Projector and Weiss [21].
**TABLE 1**

*Distribution of Annuity, Different Classes, 1962*

<table>
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<th>Income Class</th>
<th>Mean Annuity (Dollars)</th>
<th>Sample Size</th>
<th>Lower Limit of Class (Dollars)</th>
<th>Upper Limit of Class (Dollars)</th>
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<td>Nonwhite</td>
<td>1502.22806</td>
<td>156</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All households</td>
<td>3306.2557</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: The estimates in this table and in Figure 2 correspond to the distribution using the individually estimated $\phi$ with a mean $\phi = 3.6$. The fact that equities are progressively distributed leads to the higher estimates of annuity income than Table 2.*
TABLE 2
Other Measures of Inequality, 1962

<table>
<thead>
<tr>
<th></th>
<th>Income</th>
<th>Net Worth</th>
<th>Per Capita Lifetime Wealth</th>
<th>Annuity Income</th>
<th>Utility-Equivalent Annuity Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (μ)</td>
<td>6377</td>
<td>20,955</td>
<td>28,804</td>
<td>2096</td>
<td>2167</td>
</tr>
<tr>
<td>Standard Deviation (σ)</td>
<td>7297.</td>
<td>124,595</td>
<td>81,022</td>
<td>6453</td>
<td>6620</td>
</tr>
<tr>
<td>Coefficient of variation (σ/μ)</td>
<td>1.144</td>
<td>5.946</td>
<td>2.813</td>
<td>3.077</td>
<td>3.054</td>
</tr>
<tr>
<td>Coefficient of skewness (λ/μ)</td>
<td>2.766</td>
<td>23.20</td>
<td>12.35</td>
<td>11.66</td>
<td>11.68</td>
</tr>
</tbody>
</table>

*Note: If xj is the relevant variable, and wj is the population weight estimated in the Survey [21], then:

\[ \mu = \frac{\Sigma x_j w_j}{\Sigma w_j} \]
\[ \sigma^2 = \frac{\Sigma (x_j^2 - \mu) w_j}{\Sigma w_j} \]
\[ \lambda = \frac{\Sigma (x_j - \mu)^3 w_j}{\Sigma w_j} \]

For this table all concepts were estimated with a constant 5 percent real rate of return on wealth (e.g., ρ = .05).

---

**Fig. 2.** Lorenz Curves for Income, Net Worth, and Utility Equivalent Annuity (Source: Table 1)
unequally distributed than income, but less unequally distributed than wealth.\textsuperscript{13} The reason is that annuity incomes are (complicated) functions of both labor income and wealth. There is no significant difference between the two annuity versions (\textit{AI} and \textit{UAI}).\textsuperscript{14}

C. Measures of the Distributional Incidence of Policies

The conventional measures of inequality are inadequate for a complete assessment of the distributional impact of policies. The usual method of analyzing distributional effects is to examine some aggregate measure (such as the Gini coefficient) or to examine the impact by economic or demographic class. The problems with these measures are (1) that the aggregate measures do not correspond to a reasonable social preference ordering \[1\]; and (2) that the dispersion and statistical significance of the incidence, and general reshuffling of households, is ignored.

For the purpose of the present study, we distinguish two classes of measures of the incidence of inflation.

\textit{Aggregate measures.} For aggregate measures of incidence, we have two sets of calculations. (1) We calculate the first three normalized moments of the distribution mean, coefficient of variation, and coefficient of skewness.\textsuperscript{15} These allow general evaluations of what has happened to the distributions. (2) We have further chosen to value the outcome by an explicit “social welfare function” as an aggregate objective. This allows the policy-maker to make an explicit judgment about the desirability of redistributive policies. We have used the following four social welfare functions:

\begin{equation*}
SW_1 = A + B(\Sigma w_i y_i)
\end{equation*}
\begin{equation*}
SW_2 = A + B(\Sigma w_i \log(y_i))
\end{equation*}
\begin{equation*}
SW_3 = A + B(\Sigma w_i y_i^{1.8})
\end{equation*}
\begin{equation*}
SW_4 = A + B(\Sigma w_i y_i^2)
\end{equation*}

where $SW_i$ is the value of the social welfare function, $w_i$ are the estimated sampling weights of each household given in the Survey \[21\], and $y_i$ is the measure of economic welfare (e.g., per capita annuity income) for household $i$. The four cases correspond to four different assumptions about the marginal social utility of income. With $SW_1$ the function is linear; $SW_2$ is the Bernoulli or logarithmic form; $SW_3$ uses

\textsuperscript{13}The distribution of wealth is much more concentrated with survey estimates than using the conventional estate tax method. The estimate of the share of the top 1 percent of households is 31 percent, while for the same year the estate method gives an estimate of 15 percent. The major differences are the share of the top group and the fact that the estate tax method uses extraneous total wealth estimates while we use those estimated by survey.

\textsuperscript{14}The distribution of annuity by age group shows a feature of distribution which has not been noted before, the dip in age–annuity profile by age in the 60–69 age bracket. This dip may be explained by the effect of the Great Depression.

\textsuperscript{15}See notes to Table 2 for definitions of these terms.
the estimate of the elasticity derived from household behavior; and SW₄ uses the very low value which might come from an extreme egalitarian.\footnote{16}

**Individual measures.** In addition to the aggregate measures of incidence described above, there are three calculations used to measure the impact on individual households. (1) The first set are calculations of the impact of inflation by annuity class and by a few demographic characteristics. In addition to calculating the mean impact by class, we also indicate the variability of that experience. (2) A second set of measures are logarithmic regressions of change in annuity against annuity before inflation. The regression coefficient indicates whether the inflation is significantly progressive or regressive in its impact. We will call the estimated coefficient the coefficient of regressiveness. If the sign is positive, this indicates that higher incomes gain a larger fraction from the inflation than lower incomes, and this is regressive; the converse holds for negative signs. (3) A final measure is the average change in the fortunes of individual households, designated by the coefficient of variation of individual income and called the coefficient of mobility. This indicates the extent to which aggregate changes in distribution are accompanied by a general reshuffling of the economic welfare of households.\footnote{17}

III. THE EFFECT OF INFLATION ON THE DISTRIBUTION OF LIFETIME INCOME

There are widely disparate views on the impact of inflation on individual economic welfare. As in most economic controversies, the differences of opinion stem largely from differing views of the economic process or different time periods under consideration. Virtually all the empirical work on the distributive effects of inflation considers the effects on short-run income, with little consideration of effects on assets; virtually all theoretical work considers long-run effects in equilibrium systems.

The thrust of the present work is long-run considering lifetime income and wealth. Three different mechanisms (classical, neoclassical, and Keynesian) have been used in order to span most current views about the macroeconomic mechanism. Moreover, two different kinds of inflationary episodes are considered: a once

\footnote{16}It should be noted that there is no presumption that the social welfare function uses the same parameter as the individual; the latter embodies no value judgments, but is more usefully interpreted as a representation of a particular ordinal structure of intertemporal choice. To see the extent to which the SW₄ is egalitarian, note that the social marginal utility of income to a man with $10,000 is .0312 times the marginal social utility of a man with income of $5,000.

\footnote{17}Thus if the relation between relative welfare below (y₁) and after (y₂) is \( y₂ = y₀ + \epsilon₁ \), the variance after a policy (or aggregate inequality) is \( \sigma₁² = \sigma₀² + \sigma₁² + 2 \text{cov} \{ \epsilon₀, \epsilon₁ \} \). The variance of individual welfare from original (\( \sigma₂² \)) if \( y₂ = y₀ \) is \( \sigma₂² = \sum(y₂ - y₀ \epsilon + \epsilon₀)² = \sigma₁² + \sigma₀² - 2 \text{cov} \{ y₀, \epsilon₁ \} \). While most social planners wish to reduce aggregate inequality (\( \sigma₁² \)) it is not clear whether individual mobility (\( \sigma₂² \)) is desirable or not. The present author would think it undesirable.

Since \( \sigma₂² = (\sigma₁² - \sigma₀²) + 2\sigma₀(\rho₀ - \rho₁) \), there is a constraint on the amount of redistribution that can occur for a given amount of individual wealth.
and for all burst of inflation of 10 percent in the first year with inflation then returning to the usual rate; we call this "one-shot inflation." The second kind of inflation consists of an increase in the rate of inflation of 1 percent for all future periods above the usual rate; this we call "continual inflation."  

The effect of the two kinds of inflationary episodes on inflationary expectations is of some importance. It is assumed that the expected rate of inflation is determined by an adaptive mechanism. More precisely, the expected rate of inflation adjusts to the actual rate according to the usual geometric distributed lag pattern. (This is explained further in the discussion of equation (1) below.) Let us say that the rate of inflation is originally anticipated to be three percent. Therefore, in the case of a once-and-for-all inflationary episode, the actual rate rises during the inflationary episode to 13 percent annually, then falls back to three percent. The expected rate of inflation first rises as a result of the episode, then gradually falls back toward three percent.

In the case of the continual inflation, the actual rate would rise from three to four percent in the first year and stay at four percent forever. The expected rate of inflation would rise gradually to four percent as the adaptive process worked itself out.

It is important to note, therefore, that the expected and actual rates of inflation are originally equal and eventually again become equal. It is only along the intermediate path that actual and expected inflation are unequal, and therein lies most of the welfare loss.

A. Classical Inflation

1. The Theory.—The first and simplest economic mechanism we consider is the classical mechanism, closely related to current monetarist thought. To oversimplify slightly, inflation makes no difference to the real variables of the system in the long run. The only effects are the transient ones due to incorrectly anticipated inflation.

More precisely, we assume that the system is one where all markets clear instantaneously, and where relative prices of reproducible goods, and labor are unaffected by the level of the real interest rate. There is no outside money or noninterest bearing debt.

We examine a burst of inflation caused by an increase in demand due to a war or shift in expectations. This demand is assumed to be completely and instantaneously choked off by a rise in prices of 10 percent for one-shot inflation, or by an increase in the rate of inflation of 1 percent in the continuous case. There are thus no changes in any real magnitudes except for the distribution of current wealth.

2. The Results.—Given a burst of one-shot inflation of 10 percent we can easily calculate the effect of inflation on the distribution of economic welfare. All "bonds" (i.e., the net value of fixed yield assets) are revalued downwards by the

---

18 These figures were chosen as the approximate magnitude of the differential inflation over the period 1962 to 1971, relative to prior experience.
fraction $1/(1 + .10)$ while the real value of equities and future labor income remains unchanged.\footnote{19}

In the case of continual inflation, the real interest rate adjusts slowly to regain its original value.\footnote{20} Thus bonds have a lower value for consumption than they would have in the absence of inflation.

The results of inflation on annuity income are shown in Tables 3 to 5. Table 3 indicates that there is a very small decrease in average annuity ($\text{AI}$). This decrease is 0.03 percent for both kinds of inflation. $\text{UAI}$, on the other hand, increases substantially.

\begin{table}
\centering
\caption{Effects of Inflation in Classical Regime*}
\begin{tabular}{|l|c|c|c|}
\hline
& No Inflation & One-Shot Inflation & Continual Inflation \\
\hline
\text{Mean:} & & & \\
$\text{AI}$ & 3306. & 3305. & 3305. \\
$\text{UAI}$ & 3921. & 3974. & 3944. \\
\hline
\text{Coefficient of} & & & \\
\text{variation:} & & & \\
$\text{AI}$ & 2.069 & 2.045 & 2.062 \\
$\text{UAI}$ & 1.927 & 1.910 & 1.920 \\
\hline
\text{Coefficient of} & & & \\
\text{skewness:} & & & \\
$\text{AI}$ & 7.332 & 7.209 & 7.295 \\
$\text{UAI}$ & 6.411 & 6.221 & 6.341 \\
\hline
\text{Coefficient of} & & & \\
\text{mobility (percent):} & & & \\
$\text{AI}$ & -- & 4.07 & 1.27 \\
$\text{UAI}$ & -- & 4.06 & 1.40 \\
\hline
\end{tabular}
\footnote{Notes: The definitions of the mean, coefficients of variation, and coefficient of skewness are given in Table 2 above. The coefficient of mobility is defined as the coefficient of variation of individual income.}
\end{table}

\begin{table}
\centering
\caption{Annuity Regressions for Classical Regime, Percent (All Coefficients in Percentages)*}
\begin{tabular}{l}
\textbf{One-Shot Inflation} \\
1. $\ln \text{AI}(1) - \ln \text{AI}(0) = 1.58 - .204 \ln \text{AI}(0)$ \\
\hspace{1cm} (.340) (.041) & $R^2 = .9998$ \\
2. $\ln \text{UAI}(1) - \ln \text{UAI}(0) = .868 - .0817 \ln \text{UAI}(0)$ \\
\hspace{1cm} (.341) (.0407) & $R^2 = .9999$ \\
\textbf{Continual Inflation} \\
3. $\ln \text{AI}(1) - \ln \text{AI}(0) = .456 - .0591 \ln \text{AI}(0)$ \\
\hspace{1cm} (.106) (.0128) & $R^2 = .9998$ \\
4. $\ln \text{UAI}(1) - \ln \text{UAI}(0) = .266 - .0156 \ln \text{UAI}(0)$ \\
\hspace{1cm} (.117) (.0140) & $R^2 = .9999$ \\
\hline
\end{tabular}
\footnote{Notes to regressions (Tables 4, 7, and 11): We have expressed coefficients in percentages to facilitate reading.}
\end{table}

\footnote{19}It is recognized that a certain inconsistency results from this method. Since the net value of fixed-income assets does not net to zero, but rather to an average value of $4423$ per household (2 percent of net worth), there is in addition a small increase in the aggregate real value of wealth (i.e., the Pigou effect). 

\footnote{20}The adjustment of the real interest rate is described below, pp. 482 ff. and in Appendix D.
The result on both measures of inequality is a slight decrease in both the coefficient of variation and the coefficient of skewness. These measures of inequality are reduced from one to 2 percent in the case of one-shot inflation and 0.3 percent for continual inflation.

Finally, the coefficient of mobility indicates that there is a significant amount of reshuffling of annuities, especially for one-shot inflation.

The annuity regressions point to the same general conclusion. According to these, both one-shot and continual inflation are progressive measures as indicated by the

<table>
<thead>
<tr>
<th>Income Class</th>
<th>Instantaneous Inflation</th>
<th>Continuous Inflation</th>
<th>Sample Size</th>
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<tbody>
<tr>
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<td>Mean</td>
<td>Stan. Dev.</td>
<td>Mean</td>
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<td>1</td>
<td>1.03904</td>
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<td>2</td>
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<td>10</td>
<td>0.99955</td>
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<td>1.00006</td>
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<td>11</td>
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<td>0.00041</td>
<td>1.00026</td>
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<tr>
<td>12</td>
<td>1.00225</td>
<td>0.00031</td>
<td>1.00059</td>
</tr>
<tr>
<td>13</td>
<td>0.99845</td>
<td>0.00012</td>
<td>0.99955</td>
</tr>
<tr>
<td>14</td>
<td>0.99966</td>
<td>0.00019</td>
<td>0.9998</td>
</tr>
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<tr>
<td>18</td>
<td>0.98389</td>
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<td>19</td>
<td>0.99107</td>
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<td>0.99767</td>
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<td>20</td>
<td>1.00025</td>
<td>0.00046</td>
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<td>21</td>
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<td>0.99242</td>
</tr>
<tr>
<td>22</td>
<td>0.98664</td>
<td>0.00013</td>
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<table>
<thead>
<tr>
<th>Age Class</th>
<th>Instantaneous Inflation</th>
<th>Continuous Inflation</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.99949</td>
<td>0.00000</td>
<td>0.99865</td>
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<tr>
<td>2</td>
<td>1.01709</td>
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<td>1.00323</td>
</tr>
<tr>
<td>3</td>
<td>1.02098</td>
<td>0.01791</td>
<td>1.0038</td>
</tr>
<tr>
<td>4</td>
<td>1.00264</td>
<td>0.00015</td>
<td>1.00051</td>
</tr>
<tr>
<td>5</td>
<td>0.99995</td>
<td>0.00046</td>
<td>0.99946</td>
</tr>
<tr>
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<td>0.99126</td>
<td>0.00142</td>
<td>0.99711</td>
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<td>0.99574</td>
</tr>
<tr>
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<td>0.00094</td>
<td>0.99541</td>
</tr>
<tr>
<td>9</td>
<td>0.99879</td>
<td>0.00000</td>
<td>0.99981</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other</th>
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<th>Continuous Inflation</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retired</td>
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<td>0.00120</td>
</tr>
<tr>
<td>Widows</td>
<td>42</td>
<td>1.00208</td>
<td>0.01451</td>
</tr>
<tr>
<td>Non-whites</td>
<td>43</td>
<td>1.02356</td>
<td>0.02304</td>
</tr>
</tbody>
</table>
fact that the regression coefficients are less than zero. Except for regression 4, these 
coefficients are significantly less than zero.

B. Neoclassical Inflation

The classical model used above abstracts from some important features of the 
economic system. These features have long been considered crucial in discussing 
distributional effects of inflation. First, steady inflation erodes the real value of 
money-fixed assets. To the extent that these are in the aggregate assets of the 
household sector (as is generally the case), an inflationary episode reduces to the 
real value of wealth. Second, since inflation affects the value of real interest and 
profit rates and the wealth-income ratio, the system will generally be out of long-
run equilibrium. This leads to saving in tangible assets which changes factor prices. 
It is usually thought that this revaluation of wealth and labor income flows will re-
distribute economic welfare toward labor and lower income groups.

The neoclassical regime considers an economy at a fixed level of utilization growing 
according to the principles of a standard neoclassical model.\footnote{For a recent 
exposition, see Solow [20].}

1. The Theory.—To analyze the effects of neoclassical inflation we combine our 
sample of households with a very simple neoclassical macroeconomic model. To 
make the model operational, we have estimated the equations using annual U. S. 
data.

The following assumptions are made about the economy:

1. Inflation is assumed to be generated by conditions of aggregate excess demand 
or supply. In the neoclassical case (like the classical but unlike the Keynesian case) 
the reaction of prices is assumed to be so swift that deflation or inflation wipes out 
excess supply or demand immediately and no change in relative prices takes place. 
In terms of current macroeconomic thought, the short-run Phillips curve is vertical. 
We can in this case treat inflation as an exogenous variable since there is no feedback 
of the system’s equilibrium on the rate of inflation. Whether inflation is a policy 
variable or a true exogenous variable is, from our point of view, unimportant.

What becomes important is the anticipated rate of inflation in the system (\(\pi^e\)); 
this is in turn a geometric distributed lag over past experienced inflation rates:

\[
\pi^e_t = \sum_{i=1}^{\infty} \pi_{t-i} \frac{\theta^t}{\theta^e} (1 - \theta^e)/\theta^e
\]  
(1)

2. Aggregate potential output (\(Q\)) is determined by a Cobb-Douglas production 
function:\footnote{Note that we define potential output to be the level of output at a “normal” rate rather 
than at four percent, which is the customary definition. This definition makes the model compatible 
with a vertical Phillips curve at an arbitrary rate. It also resolves complications which 
arise in the Keynesian regime where the economy functions at alternative unemployment rates.}

\[
Q = AK^{\alpha} [L(1 - \bar{u})]^{1-\alpha} e^{\gamma t}
\]  
(2)
where $K$ is replacement cost of capital, $L$ the labor force, $\bar{u}$ the normal unemployment rate, and $\gamma / 1 - \alpha$ the rate of Harrod-neutral technological change. The rate of profit on capital ($r$) and the real wage rate ($w$) are determined by marginal productivity conditions:

$$r = \alpha Q / K$$

$$w = (1 - \alpha) Q / (L(1 - \bar{u}))$$

3. Employment is a fixed fraction—96 percent—of the labor force.
4. The money value of government debt ($GD$) is given and the money value of debt increases at two percent. Taxation is neutral.\(^{23}\) Wealth is composed of the real value of government debt plus the replacement cost of capital:\(^{24}\)

$$W = \frac{GD}{p} + K$$

5. Discrepancies between potential output and the amount of consumption or investment predicted by the model are assumed to be completely made up by government expenditures neutrally financed.
6. The relation between the rate of profit on capital and the real interest rate is given by the portfolio equation (17) in Section II:

$$i_t = \pi^e_t + r_t + \lambda \left( \frac{K}{K + D} \right)$$

7. The desired wealth-income ratio is determined by the life-cycle consumption model discussed in Section II. The long-run relation is assumed to have constant elasticity with respect to the effective rate of return on assets, $\rho$.\(^{25}\) The short-run relation adjusts with a distributed lag:

$$\frac{W^*}{Q} = B_1 \rho^\beta_1$$

$$\Delta \left( \frac{W}{Q} \right)_t = \beta_2 \left[ \left( \frac{W^*}{Q} \right)_t - \left( \frac{W}{Q} \right)_{t-1} \right]$$

\(^{23}\) A "neutral" tax is defined as one which does not alter the distribution of economic welfare; here the distribution of $c^e$ or of consumption. A comprehensive flat-rate sales or consumption tax is neutral, whereas a flat rate income tax is not.

\(^{24}\) We have overlooked the problem of the effect of inflation on financing the interest payments on government debt. Formally, we can assume that interest payments are financed by a flat-rate sales tax (which is not altogether unreasonable for state issues). For a complete study, the incidence through reduction of the real value of government debt depends on the incidence of the marginal tax payment. This is a speculative issue.

\(^{25}\) See Section II for a discussion of this concept.
Estimates of equations (1) through (8) are shown in Table 9, and methods are discussed in Appendix D.

2. **The Results.**—Tables 6 through 8 show the estimates of the results of neoclassical inflation. The general conclusion is that one-shot inflation is more equalizing and progressive than continual inflation.

In Table 6 the effect of neoclassical inflation on our summary statistics is shown. As in the case of classical inflation, there is a decline in the average annuity and utility-equivalent annuity of households in three of four cases. This reflects the fact that the loss of income due to the lowering of the real interest rate in the early period is not sufficiently offset by the increase in capital and real wages in the later periods resulting from the decline in real government debt. For one shot inflation, there is a decline of 0.1 percent in UAI and no change in AI. The figures for continual inflation are -0.3 percent and +0.5 percent respectively.

The results on the distribution of annuity are very similar to those for the classical

| Table 6 |
| Effects of Inflation in Neoclassical Regime |
|-----------------|-----------------|-----------------|
|                  | No Inflation    | One-Shot Inflation | Continual Inflation |
| Mean:            |                 |                  |                  |
| AI               | 3350.           | 3350.            | 3348.            |
| UAI              | 3887.           | 3876.            | 3907.            |
| Coefficient of variation: |               |                  |                  |
| AI               | 2.083           | 2.065            | 2.069            |
| UAI              | 1.952           | 1.942            | 1.938            |
| Coefficient of skewness: |              |                  |                  |
| AI               | 7.412           | 7.327            | 7.338            |
| UAI              | 6.632           | 6.570            | 6.517            |
| Coefficient of mobility (percent): |          |                  |                  |
| AI               | -               | 7.96             | 6.26             |
| UAI              | -               | 7.81             | 6.23             |

| Table 7 |
| Annuity Regression for Neoclassical Regime (Coefficients in percentages) |

**One-Shot Inflation**

5. \\
\[
\ln AI(1) - \ln AI(0) = -1.89 + .203 \ln AI(0) \\
(669) (.0804)
\]

\[R^2 = .9999\]

6. \\
\[
\ln UAI(1) - \ln UAI(0) = -2.22 + .212 \ln UAI(0) \\
(658) (.0784)
\]

\[R^2 = .9999\]

**Continual Inflation**

7. \\
\[
\ln AI(1) - \ln AI(0) = -1.74 + .187 \ln AI(0) \\
(526) (.0632)
\]

\[R^2 = .9995\]

8. \\
\[
\ln UAI(1) - \ln UAI(0) = -1.99 + .230 \ln UAI(0) \\
(525) (.0625)
\]

\[R^2 = .9999\]
### TABLE 8

Effects of Inflation on Annuity by Annuity, Age and Other Classes

<table>
<thead>
<tr>
<th>Income Class</th>
<th>Instantaneous Inflation</th>
<th>Continuous Inflation</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (Inst.)</td>
<td>Std. Dev. (Inst.)</td>
<td>Mean (Cont.)</td>
</tr>
<tr>
<td>1</td>
<td>1.00551</td>
<td>0.00097</td>
<td>1.00614</td>
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<tr>
<td>2</td>
<td>0.98236</td>
<td>0.00047</td>
<td>0.98988</td>
</tr>
<tr>
<td>3</td>
<td>1.00554</td>
<td>0.00110</td>
<td>0.99775</td>
</tr>
<tr>
<td>4</td>
<td>0.99253</td>
<td>0.00052</td>
<td>0.99328</td>
</tr>
<tr>
<td>5</td>
<td>1.01172</td>
<td>0.00249</td>
<td>1.00320</td>
</tr>
<tr>
<td>6</td>
<td>0.99746</td>
<td>0.00031</td>
<td>0.99426</td>
</tr>
<tr>
<td>7</td>
<td>1.00550</td>
<td>0.00684</td>
<td>1.00070</td>
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<td>8</td>
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<td>0.99863</td>
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<td>0.00077</td>
<td>0.99923</td>
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<tr>
<td>10</td>
<td>0.99940</td>
<td>0.00022</td>
<td>0.99912</td>
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<tr>
<td>11</td>
<td>1.00036</td>
<td>0.00026</td>
<td>1.00025</td>
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<td>0.99930</td>
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<td>15</td>
<td>0.99323</td>
<td>0.00009</td>
<td>0.99608</td>
</tr>
<tr>
<td>16</td>
<td>0.99090</td>
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<td>0.99573</td>
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<td>0.99382</td>
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<td>21</td>
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<td>0.00001</td>
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<tr>
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<td>0.98897</td>
<td>0.00003</td>
<td>0.99641</td>
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</table>

**Age Class**

<table>
<thead>
<tr>
<th>Age Class</th>
<th>Instantaneous Inflation</th>
<th>Continuous Inflation</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-19</td>
<td>1.00215</td>
<td>0.00000</td>
<td>0.99718</td>
</tr>
<tr>
<td>20-29</td>
<td>1.01289</td>
<td>0.00171</td>
<td>1.00502</td>
</tr>
<tr>
<td>30-39</td>
<td>1.00912</td>
<td>0.00264</td>
<td>1.00505</td>
</tr>
<tr>
<td>40-49</td>
<td>1.00142</td>
<td>0.00007</td>
<td>0.99944</td>
</tr>
<tr>
<td>50-59</td>
<td>0.99888</td>
<td>0.00012</td>
<td>0.99766</td>
</tr>
<tr>
<td>60-69</td>
<td>0.99391</td>
<td>0.00020</td>
<td>0.99520</td>
</tr>
<tr>
<td>70-79</td>
<td>0.98824</td>
<td>0.00028</td>
<td>0.99489</td>
</tr>
<tr>
<td>80-89</td>
<td>0.98049</td>
<td>0.00037</td>
<td>0.99510</td>
</tr>
<tr>
<td>90+</td>
<td>0.99857</td>
<td>0.00001</td>
<td>0.99963</td>
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</table>

**Other**

<table>
<thead>
<tr>
<th>Type</th>
<th>Instantaneous Inflation</th>
<th>Continuous Inflation</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retired</td>
<td>0.98792</td>
<td>0.00030</td>
<td>0.99518</td>
</tr>
<tr>
<td>Widows</td>
<td>0.99606</td>
<td>0.00067</td>
<td>0.99849</td>
</tr>
<tr>
<td>Non-whites</td>
<td>1.00452</td>
<td>0.00046</td>
<td>1.00229</td>
</tr>
</tbody>
</table>

In particular, there is a reduction of between 0.5 percent and 1.0 percent in the coefficient of variation. It is noticeable that there is also a fair amount of mobility as a result of neoclassical inflation.

In the regression analysis, the conclusion about the distribution incidence is reversed. In the unweighted regressions, inflation is regressive (as evidenced by the positive sign) and for both \( AI \) and \( UAI \) is significantly so at the 99 percent level.
C. Keynesian Inflation

1. General Considerations.—Although perhaps a step toward reality, the neoclassical simulation overlooks one entire feature of the inflationary process—the role of short-run disequilibrium in the generation and damping of inflation.

In modern macroeconomic thought, inflation is part—and only one part—of the adjustment process that occurs when a system is shocked by exogenous changes or by structural shifts. For example, if an economy is in macroeconomic equilibrium (with whatever inflation is occurring perfectly anticipated) and there is a sudden outbreak of war or an exogenous burst of consumption or investment, part of the adjustment—perhaps most of the adjustment in the very short run—comes through a higher level of output and employment. Only after those markets which are price-adjusters have responded and the response cascades through the system does a larger fraction of the response come from prices.

In terms of the modern theory of the Phillips curve, a higher level of output and employment leads to higher settlements in money and real wages (or wage inflation). As producers pass costs through into prices, the whole structure of prices moves up. If the inflation is gradually choked off, the system settles down to a new system of absolute prices, perhaps with some small adjustments in relative prices.

The importance of considering the Keynesian case is that for the most part inflation does not occur as an isolated incident. If we are to believe the vast outpouring of statistical work on the wage-price problem, then it is clear that inflation (here meaning deviations of the rate of inflation from the historical trend) occurs as a result of, and after, periods of high levels of utilization of the economy. Deflation, conversely, occurs during periods of relative slack. Because of the complicated series of lags relating the wage-price system, it is not easy to disentangle the exact causes or lags in the inflationary process, nor do we know the exact functional form of the trade-off between resource utilization and inflation. There can be little doubt that a trade-off does exist.

In discussing the effect of inflation in the Keynesian system, we must consider the effect of inflationary packages on the distribution of economic welfare. An inflationary package means that inflation is part of the package that comes when resource utilization is very high. The important effects of an inflationary package are the following:
(1) Rates of inflation and price levels are raised.
(2) Employment, hours, and output are raised.
(3) The composition of output shifts, generally toward manufacturing and durable goods.
(4) Depending on the cause of the expansionary program on aggregate demand, there may be effects on interest rates, profit rates, liquidity, and tax rates.

The present study focused on effects (1), (2) and to a certain extent (4). The effects on composition of output is beyond the scope of the present study.

2. The Macroeconomic Model.—The Keynesian model used here constitutes only the most rudimentary modification of the neoclassical model discussed above.
   a. The most important modification is the introduction of a trade-off between inflation and unemployment. For this we use the simplest form of Phillips curve,
### TABLE 9

**Estimated Equations*\(^*\)**

**Neoclassical**

1. \( \pi_t^e = 5. \left\{ \sum_{i=1}^{t-1947} \pi_{t-i} (0.2)^i + (0.04)(0.2)^{t-1946} \right\} \)

2. \( Q_t = 4.13K^{2.3} EN^{0.77} e^{0.153(t-1961)}, EN = LF(1 - \bar{u}) \)

3. \( R = RF = .23 Q/K \)

4. \( W = .77 Q/EN \)

5. \( i = \pi^e + R - 0.35 \left( \frac{K}{K + D} \right) \)

6. \( \ln(W/Q)^* = 1.688 + 0.304 \ln \rho \)

7. \( \Delta (W/Q) = 0.1 (W/Q)^* - (W/Q)_{t-1} \)

8. **Keynesian**

   - \( \pi = -.007299 + .001486 1/\mu \)
   - \( E = .600 - .747\mu + .00031(t - 1930) \)
   - \( RF = .5255 - .0157 (\bar{u} - \bar{u}) \)

   9. \( \bar{u} = 10 \left\{ \sum_{i=1}^{t-1947} \bar{u}^i + (.1)^i + .04(.1)^{t-1946} \right\} \)

*Source: Appendix D.

**Variables:**

1. \( \pi = \) Rate of inflation
2. \( \pi^e = \) Expected rate of inflation
3. \( Q = \) Potential Output
4. \( K = \) Capital
5. \( EN = \) Potential employment
6. \( LF = \) Labor force
7. \( u = \) Unemployment rate
8. \( \bar{u} = \) Normal unemployment rate
9. \( R = \) Rate of profit
10. \( RF = \) Normal rate of profit
11. \( i = \) Nominal interest rate
12. \( D = \) Real Government debt
13. \( W = \) Net worth
14. \( \rho = \) see text

with the rate of inflation inversely related to unemployment and positively related to past inflation:

\[
\pi = a_0 + a_1 \frac{1}{\bar{u}} + \sigma \pi^e \quad 0 \leq \sigma \leq 1
\]

Equation (9) is the Phillips curve with inflation (\( \pi \)) a function of unemployment (\( u \)) and “expected” inflation (\( \pi^e \)). Expected inflation follows the distributed lag over past inflation discussed above.\(^{26}\)

\(^{26}\)As noted in Appendix D, this simple Phillips curve proved unable to distinguish between \( \sigma = 0 \) and \( \sigma = 1 \). We therefore chose \( \sigma = 0 \). Simulations of the macroeconomic model with \( \sigma = 1 \) indicated, not surprisingly, that with rapid reaction speeds (or low \( \theta_2 \) in equation (1) above) the Keynesian model behaves very much like the neoclassical model. Intermediate values of \( \sigma \) or of reaction speeds would lie between the neoclassical and Keynesian results. There does not seem to be much point in trying different values of \( \sigma \).
b. The aggregate employment rate \((E)\) is equal to employment divided by the noninstitutional population over sixteen. This is a function of unemployment and time:

\[
E = j_0 + j_1 u + j_3 t
\]  
(10)

Equation (10) tells us the average fraction of available time worked by the population as a whole.

c. Finally, we recognize that factor rewards are subject to cyclical influences. We continue to assume that full-employment wages, profits, and interest rates are determined as in the neoclassical system above.\(^27\) Moreover, real wages are set at the full-employment marginal product, rather than fluctuating over the business cycle.\(^28\) Since profits are the residual income, the rate of profit on income will vary positively over the cycle. We thus represent this as:

\[
R = \frac{aQ}{K} [\gamma_1 (u - \bar{u}) + \gamma_0]
\]  
(11)

where \(Q\) is potential output and \((u - \bar{u})\) is the difference between unemployment and normal unemployment.

The rate of interest follows the same relation as in the neoclassical model above.

Finally, the normal unemployment rate is a distributed lag over past rates:

\[
\bar{u} = \sum_{t=0}^{\infty} u_{t-1} \theta_u^t
\]  
(12)

3. Individual Behavior.—To translate our simple macroeconomic system into households, the only requirement is that the aggregate employment rate be distributed among the households. There is at present no satisfactory way of calculating the distribution of unemployment and changes in participation rates by the fine classifications we require. In any case, we are unable to translate the reported employment rate of our households (number of months worked in 1962) into a “permanent” or expected unemployment rate; the problem is very similar to that of calculating future labor income.

The technique used here makes the following assumption: the employment response of an individual household is proportional to the amount of unemployed time. Thus if \(E(t)\) is the observed employment rate of household \(i\) in 1962, \(E(t)\) the predicted employment rate in year \(t\), \(E^0\) and \(\bar{E(t)}\) the averages of \(E(t)\) and \(E_i(t)\) for the entire population, then

\(^{27}\) It would be easy to introduce “exploitation” of one factor by the other, if for example labor were paid two-thirds its marginal product.

\(^{28}\) Ignoring the short lag of prices behind wages, the assumption about fluctuations in the real-wage are consistent with the “normal-pricing” hypothesis often used in inflation studies.
\[ E(t) = E^0 + \left( \frac{1 - E^0}{1 - E^0} \right) [E(t) - E^0] \]  

This assumption is easily seen in Figure 3. This shows on the vertical axis how a given household (say \( E_1 \)) responds as a function of the aggregate employment rate on the horizontal axis.\(^29\)

Finally, we assume (as above) that individuals have perfect foresight about incomes and rates of return. This allows us to calculate easily the effect of inflation in the Keynesian model.

To calculate income, we take "normal" labor income (as calculated in Appendix C) and augment this by the ratio of employment rate in a given year over 1962 employment rate.\(^30\) That is,

![Diagram](image)

Fig. 3. Employment Response for Two Households

\(^29\)The assumption about employment rates is probably a good one for those who are continually in the labor force or are out of the labor force for non-economic reasons. For those who are out of the labor force for non-economic reasons (say, sickness, retirement, or school), this is undoubtedly a poor assumption. A recent study [29] indicates the kind of assumption used above is fairly accurate for labor force participation. For the effect of group unemployment on aggregate unemployment, the hypothesis does quite well [30].

\(^30\)The employment rate is calculated in "head-of-household equivalents," where adults are weighted by full-time earnings. Thus for a married couple in which the husband worked 9 months and the wife 2 months, the head-of-household equivalent employment rate is \((9 \times 1 + 2 \times .6)/(12 \times 1 + 12 \times .6) = 0.54\). The 0.6 figure is the ratio of full-time female to male earnings.
where $y^N_{Li}(t)$ is predicted normal labor income of household $i$ in year $t$ from Appendix C, $y^N_{Li}(t)$ is predicted labor income at employment rate $E_i(t)$.

4. The Results. The results of inflation in the Keynesian regime are shown in Tables 10 through 12. The general impression is quite different from that of the classical or neoclassical cases. Keynesian inflation is considerably more equalizing than the other kinds, mainly because of the powerful employment effect associated with inflation.

Whereas classical inflation and neoclassical inflation decreased the real value of annuity and utility equivalent annuity, the Keynesian case had little effect on the one-shot case and a strong increase on annuity in the continual inflation case. The continual inflation case corresponds, in the simulations, to raising the rate of inflation from 2 percent to 3 percent, which lowers the unemployment rate from 5.4

### TABLE 10

<table>
<thead>
<tr>
<th></th>
<th>No Inflation</th>
<th>One-Shot Inflation</th>
<th>Continual Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$AI$</td>
<td>3397.</td>
<td>3404.</td>
<td>3419.</td>
</tr>
<tr>
<td>$UA1$</td>
<td>3942.</td>
<td>3940.</td>
<td>3991.</td>
</tr>
<tr>
<td>Coefficient of variation:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$AI$</td>
<td>2.059</td>
<td>2.038</td>
<td>2.034</td>
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<tr>
<td>$UA1$</td>
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<td>1.918</td>
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<td>Coefficient of skewness:</td>
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<td></td>
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<td>3.89</td>
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<tr>
<td>$UA1$</td>
<td>--</td>
<td>3.15</td>
<td>3.92</td>
</tr>
</tbody>
</table>

### TABLE 11

Annuity Regressions for Keynesian Regime (Coefficients in percentages)

**One-Shot Inflation**

9. $\ln AI(1) - \ln AI(0) = 2.72 - .310 \ln AI(0)$  
   $(2.85)(.0341)$  
   $R^2 = .9998$

10. $\ln UA1(1) - \ln UA1(0) = 2.41 - .296 \ln UA1(0)$  
    $(2.65)(.0316)$  
    $R^2 = .9999$

**Continual Inflation**

11. $\ln AI(1) - \ln AI(0) = 3.64 - .371 \ln AI(0)$  
    $(3.27)(.0392)$  
    $R^2 = .9999$

12. $\ln UA1(1) - \ln UA1(0) = 3.38 - .320 \ln UA1(0)$  
    $(3.30)(.0392)$  
    $R^2 = .9999$
TABLE 12
Effects of Inflation on Annuity by Annuity Class, Age and Other Classes

<table>
<thead>
<tr>
<th>Income Class</th>
<th>Instantaneous Inflation Mean</th>
<th>Instantaneous Inflation Std. Dev.</th>
<th>Continuous Inflation Mean</th>
<th>Continuous Inflation Std. Dev.</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.01240</td>
<td>0.00104</td>
<td>1.02295</td>
<td>0.00173</td>
<td>63</td>
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<td>2</td>
<td>0.99821</td>
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<td>1.01800</td>
<td>0.00126</td>
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<td>4</td>
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<td>1.00791</td>
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<tr>
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<td>0.00010</td>
<td>1.00539</td>
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<td>0.00010</td>
<td>0.99973</td>
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<td>16</td>
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<td>20</td>
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<td>0.98915</td>
<td>0.00003</td>
<td>0.99664</td>
<td>0.00000</td>
<td>2</td>
</tr>
<tr>
<td>Age Class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-19</td>
<td>1.00635</td>
<td>0.00001</td>
<td>1.02968</td>
<td>0.00099</td>
<td>5</td>
</tr>
<tr>
<td>20-29</td>
<td>1.01458</td>
<td>0.00161</td>
<td>1.01656</td>
<td>0.00160</td>
<td>246</td>
</tr>
<tr>
<td>30-39</td>
<td>1.01178</td>
<td>0.00257</td>
<td>1.01680</td>
<td>0.00128</td>
<td>434</td>
</tr>
<tr>
<td>40-49</td>
<td>1.00465</td>
<td>0.00011</td>
<td>1.00936</td>
<td>0.00034</td>
<td>590</td>
</tr>
<tr>
<td>50-59</td>
<td>1.00375</td>
<td>0.00024</td>
<td>1.00637</td>
<td>0.00042</td>
<td>606</td>
</tr>
<tr>
<td>60-69</td>
<td>0.99728</td>
<td>0.00033</td>
<td>0.99919</td>
<td>0.00031</td>
<td>424</td>
</tr>
<tr>
<td>70-79</td>
<td>0.99074</td>
<td>0.00035</td>
<td>0.99802</td>
<td>0.00013</td>
<td>199</td>
</tr>
<tr>
<td>80-89</td>
<td>0.98143</td>
<td>0.00041</td>
<td>0.99592</td>
<td>0.00004</td>
<td>40</td>
</tr>
<tr>
<td>90+</td>
<td>1.00473</td>
<td>0.00009</td>
<td>1.00339</td>
<td>0.00002</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retired</td>
<td>0.98988</td>
<td>0.00037</td>
<td>0.99762</td>
<td>0.00012</td>
<td>231</td>
</tr>
<tr>
<td>Widows</td>
<td>0.99844</td>
<td>0.00072</td>
<td>1.00496</td>
<td>0.00121</td>
<td>282</td>
</tr>
<tr>
<td>Non-whites</td>
<td>1.00957</td>
<td>0.00058</td>
<td>1.01344</td>
<td>0.00090</td>
<td>155</td>
</tr>
</tbody>
</table>

percent to 3.9 percent. This in turn leads to an increase in AI of 0.7 percent and in UAI of 1.2 percent.

The effect on the measures of inequality are considerably more powerful in this continuous case than the most powerful effects in the classical and neoclassical cases. The coefficient of variation is reduced by 1.2 percent and the coefficient of skewness is reduced by two percent.

The coefficient of mobility is lower in the case of Keynesian inflation than neo-
classical inflation, reflecting the fact that the incidence of unemployment is less uneven within annuity classes.

The regressions confirm our a priori notions about the incidence of unemployment. These indicate that for both cases and measures, Keynesian inflation is progressive and significantly so.

D. Inflation and Money

It has been customary to associate the social costs of inflation with the notion that inflation is a tax on real balances. Inflation is a tax because the real rate of return on cash balances is equal to the negative of the rate of inflation (−π in the notation used above).

The present study has completely, but consciously, ignored non-interest-bearing debt. The reason for this omission was that after a little thought it appeared that the empirical importance of the "tax on real balances" was negligible relative to the other costs of inflation. The following considerations led the author to this conclusion.

1. Money is a concern because the yield on non-interest-bearing debt cannot adjust to inflation; any change in the rate of inflation will reduce the real yield on this debt by the same amount. Since the alternative assets have yields, the inflation can be considered a tax on holdings of non-interest-bearing debt, with the difference between zero and alternative yields on assets accruing to the government in the form of expenditure foregone.

2. This problem has both a distributive and an allocative aspect. The long-run distributional impact of inflation will be uneven insofar as the interest-elasticities of the demand for real balances differ across income or annuity classes. (The short-run distributional impact is, in principle, estimated above.) The long-run allocational effect relies on a reallocation of resources from socially costless real balances to socially scarce substitutes (trips to the bank, etc.). This effect will be significant only if there is a significant aggregative interest-elasticity of the demand for real balances.

3. Although the data are not conclusive, it appears that the empirical significance of these effects discussed in paragraph 2 above is negligible.

The survey used for our data estimated demand deposits to be $409 per household. If we apply the observed aggregate currency-demand deposit ratio of 27 percent for 1962, we get an estimate of $110 of currency per household, for a total money holding of $520. This is about 0.5 percent of household lifetime wealth (see Table 2 above).\(^3^2\)

It appears very unlikely, however, that the entire holding of money is the appropriate tax base. In the long run, it seems quite likely that a sizable fraction of the rise in yields will show up in the implicit yields on demand deposits. The relevant tax base is thus currency. Using the numbers given above, per capita currency is about $30.

\(^3^1\)This section was written in light of the discussion at the conference.
\(^3^2\)Survey [21], Appendix.
A rise in the rate of inflation of the order contemplated in this paper is one percent per annum. Viewed as a tax, this amount of inflation would involve a dead-weight loss of at most $0.30 per year per capita. This is about 0.001 percent of average per capita annuity income.

By comparison with the estimates given above on the cost of inflation, we see: The “tax on real balances” coming through inflation is on the order of one-tenth to one-hundredth as important as other effects considered.

4. All of the above assume the demand for real balances is quite elastic. It also ignores the question of whether the “inflation tax” is an efficient tax in an economy where the government must raise considerable revenue. If the demand for real balances is inelastic, the estimates of efficiency loss are overstated. Moreover, if the demand is sufficiently inelastic, inflation may be a very efficient way of collecting revenue.

The considerations outlined above implies that the importance of the effect of inflation on real balances has been greatly overemphasized.

IV. CONCLUSION

We have described a method for estimating the long-run effects of inflation on the distribution of economic welfare. It should be noted that the technique used is quite complicated, is sensitive to the assumptions, and makes severe demands on the survey data employed. The author feels, however, that without this or a similar method of estimation, calculating the effects of inflation may be quite misleading.

We can summarize the results in Tables 13 and 14. Table 13 shows the effects of inflation for our six cases on both the average annuity and the coefficients of varia-

<table>
<thead>
<tr>
<th>TABLE 13</th>
<th>Summary Effects of Inflation*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Classical</td>
</tr>
<tr>
<td>Percentage change:</td>
<td></td>
</tr>
<tr>
<td>Mean annuity income (AI)</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>C</td>
</tr>
<tr>
<td>-.03</td>
<td>-.03</td>
</tr>
</tbody>
</table>
| Mean utility equivalent annuity income (UA/)
| O         | C         | O     | C     | O     | C     |
| 1.35      | .58       | -.28  | +.51  | -.05  | 1.24  |
| Coefficient of variation AI |
| O         | C         | O     | C     | O     | C     |
| -1.16     | -.34      | -.86  | -.67  | -1.02 | -1.21 |
| -.88      | -.36      | -.51  | -.72  | -.67  | -1.19 |
| Other Statistics: |
| Coefficient of mobility (percent) AI |
| O         | C         | O     | C     | O     | C     |
| 4.07      | 1.27      | 7.96  | 6.26  | 3.39  | 3.89  |
| 4.06      | 1.40      | 7.81  | 6.23  | 3.15  | 3.92  |
| Rate of regressiveness (percent) AI |
| O         | C         | O     | C     | O     | C     |
| -.204     | -.059     | .203  | .187  | -.310 | -.317 |
| -.082     | -.016     | .212  | .230  | -.296 | -.320 |

*Sources: Tables 3, 4, 6, 7, 10, and 11. O = once and for all inflation of 10 percent. C = continual inflation of 1 percent.
### Table 14
Values of Social Welfare Function

<table>
<thead>
<tr>
<th>Value of $\alpha$</th>
<th>Classical</th>
<th>Neoclassical</th>
<th>Keynesian</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$O$</td>
<td>$C$</td>
<td>$O$</td>
</tr>
<tr>
<td>$\alpha = 10000 \log (SW_a/SW_b)$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$AI$</td>
<td>$-2$</td>
<td>$-1$</td>
<td>$-1$</td>
</tr>
<tr>
<td>$UAI$</td>
<td>$133$</td>
<td>$57$</td>
<td>$-29$</td>
</tr>
<tr>
<td>$\alpha = 0$</td>
<td>$10000 (SW_a - SW_b)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$AI$</td>
<td>$107$</td>
<td>$-38$</td>
<td>$202$</td>
</tr>
<tr>
<td>$UAI$</td>
<td>$1351$</td>
<td>$735$</td>
<td>$-958$</td>
</tr>
<tr>
<td>$\alpha = -1.8$</td>
<td>$10000 (SW_a - SW_b)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$AI$</td>
<td>$33$</td>
<td>$46$</td>
<td>$368$</td>
</tr>
<tr>
<td>$UAI$</td>
<td>$24$</td>
<td>$41$</td>
<td>$387$</td>
</tr>
<tr>
<td>$\alpha = -5$</td>
<td>$10000 (SW_a - SW_b)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$AI$</td>
<td>$45$</td>
<td>$28$</td>
<td>$89$</td>
</tr>
<tr>
<td>$UAI$</td>
<td>$40$</td>
<td>$27$</td>
<td>$91$</td>
</tr>
</tbody>
</table>

*Notes: $O =$ once and for all inflation of 10 percent, $C =$ continual inflation of 1 percent. We have used four trial values. $\alpha = 1$ implies the function is linear, or that the marginal social value of income is constant; $\alpha = 0$ implies a Bernoulli or logarithmic utility function, $\alpha = -1.8$ is the estimated elasticity of individual utility functions, $\alpha = -5$ is the value which might be used by an extreme egalitarian.

...tion and mobility and the rate of regressivity. Table 14 shows the results of calculating the value of the social welfare function $W = \Sigma ay^\alpha$ discussed above in Section II.

Subject to the limitations of the methods used here, the overall conclusions are the following:

1. In all three systems examined and for both kinds of inflation, inflation is an equalizing factor. Both coefficients of variation and skewness are reduced.

2. Associated with the reduction of aggregate inequality we find a high degree of individual mobility. For every one percent reduction in the aggregate inequality (as measured by the coefficient of variation) we find from three to ten percent mobility of individuals. There is a considerable amount of unsystematic reshuffling of individual fortunes.

We can calculate the following coefficients of efficiency of redistribution for the different regimes (Table 15). The efficiency of a redistributive policy varies from unity for a progressive tax on annuities to zero for a "neutral" or flat-rate consumption tax or random poll taxes. Although we have no realistic standards of comparison, it would appear that (from a purely redistributive point of view) inflation is an inefficient means of redistributing economic welfare.

3. The judgment as to the desirability of the aggregate distribution of annuities resulting from inflation depends on the curvature of the objective function. Keynesian inflation (of the magnitude discussed here) is desirable for all social welfare functions except one.

Moreover, the two more egalitarian distributions approve of all six inflationary

---

33 For definitions of these, see Section III. The rate of regressiveness is the coefficient of $\ln AI$ or $\ln UAI$ in the regression equations above. A positive coefficient indicates that the measure has a larger percentage impact on higher incomes, and conversely so for a negative coefficient.
TABLE 15  
Efficiency of Redistribution of AI*  

<table>
<thead>
<tr>
<th></th>
<th>Classical</th>
<th>Neoclassical</th>
<th>Keynesian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once-and-for-all</td>
<td>.29</td>
<td>.11</td>
<td>.30</td>
</tr>
<tr>
<td>Continual</td>
<td>.27</td>
<td>.11</td>
<td>.31</td>
</tr>
</tbody>
</table>

*Note: the efficiency of a redistributive policy is calculated as the ratio of the change in coefficient of variation of the aggregate ($\sigma_1$) to the coefficient of variation of individuals ($\sigma_2$). The relationship is shown in footnote 17.

cases, for the egalitarian zeal of these outweighs any income loss. In the two less egalitarian functions, there is a mixed evaluation, with classical inflation generally approved and neoclassical inflation generally disapproved.

Whatever other conclusions may come from this study, it demonstrates that the policy conclusions depend crucially on both the economic mechanism one has in mind and the methods of evaluation.

It seems unlikely that we can completely support or completely condemn inflationary policies, except those in depression, without some consideration of the type of inflation, the macroeconomic response, and the criterion function.

LITERATURE CITED

27. Survey of Current Business, various issues.
APPENDIX A: VARIABLE DEFINITION OF VARIABLES FOR HOUSEHOLDS

The items in the column of definitions correspond to the variables in the Survey [21].

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage and salary income</td>
<td>Wage and salary income</td>
</tr>
<tr>
<td>Business income</td>
<td>Earnings from profession, partnership, farm and closely held corporations</td>
</tr>
<tr>
<td>Total labor income</td>
<td>Wage and salary income plus Business Income minus (0.05 X Business Assets)</td>
</tr>
<tr>
<td>Total income</td>
<td>Wage and salary income, Business Income, Earnings on Fixed and Variable Priced Assets, Income from Trusts and Estates</td>
</tr>
<tr>
<td>Business assets</td>
<td>Market value or book value, profession, partnership, farm, or closely held corporation</td>
</tr>
<tr>
<td>Net money fixed assets (&quot;bonds&quot;)</td>
<td>(Demand deposits, balances in savings accounts, credit balances in brokerage accounts, preferred stock, bonds, mortgage assets, loans) less (debt).</td>
</tr>
<tr>
<td>Net variable assets (&quot;equities&quot;)</td>
<td>Common stock, real estate, shares in mutual funds, estates, consumer durables, market value of residences, business assets, and miscellaneous nonliquid assets</td>
</tr>
<tr>
<td>Net worth</td>
<td>Net money fixed assets plus net variable assets</td>
</tr>
</tbody>
</table>

APPENDIX B. VALUE OF PARAMETERS FOR HOUSEHOLDS

The lifetime wealth of a household depends on current wealth, future labor income, and the rate of return on wealth (\( \rho \)). Thus annuity income \( A_I \) depends only on the assumption about \( \rho \). To calculate \( UAI \), we need in addition the parameters \( \beta, \delta, \) and \( g \). The parameters are constrained by equation (7) so that \( g = (\rho - \delta) / (1 - \beta) \). The following calculations give the parameters:

**Rate of return (\( \rho \)).** Recall that \( \rho \) is interpreted as the risk-corrected rate of return on wealth. (See note 9). For quantitative work, we have assumed that \( \rho \) is a weighted average rate of return on wealth, with weights equal to the aggregate relative shares of "bonds" and "equities." For 1962 the real rates of return on bonds (as measured by the AAA rate less the rate of change of the GNP deflator) and equities (as measured by the ratio of after-tax capital earnings to replacement cost of private capital) were 2.1 percent and 6.3 percent respectively.\(^{34}\) We thus calculate \( \rho = 2.1 \times .17 + 6.3 \times .83 = 5.6 \) percent.

\(^{34}\)Data are from The Economic Report of the President [5] and IISR [11].
Rate of growth of consumption \( g \). A second parameter which can be directly observed is the rate of growth of per capita consumption. Using several surveys of income and savings we can calculate consumption by cohort over the last 20 years.\(^{35}\) Time series indices of consumption by cohort were constricted and --using estimates of family size by age--per capita consumption paths were calculated. The average rate of growth of per capita consumption was calculated to be 2.0 percent per annum.

Subjective parameters \( \beta \) and \( \delta \). Given estimates of \( \rho \) and \( g \), equation (7) constrains \( \beta \) and \( \delta \). For \( \rho = 5.75 \) and \( g = .02 \) the following sets of parameters meet the constraints:\(^{36}\)

\[
\begin{array}{cc}
\beta & \delta \text{ (percent)} \\
1.0 & 5.6 \\
0.0 & 3.6 \\
-1.8 & 0.0 \\
-2.5 & -1.4 \\
\end{array}
\]

In a different context \( \beta = -2.5 \) has been found by Fellner and Tobin [23] and Nordhaus and Tobin [16] use \( \beta = 0.0 \).

In the present work, we use \( \delta = 0.0, \beta = -1.8 \). This particular assumption is important for calculating utility-equivalent annuity, but does not affect any of the other calculations.

APPENDIX C. CALCULATIONS OF FUTURE LABOR INCOME

1. Lifetime wealth estimates are very sensitive to the assumptions made about future labor earnings. The basic problem is to decide whether observed labor income can be used as permanent income or whether it has a large transitory component. The method of projection used here rejects the idea that labor income will remain constant in the future, but it recognizes that the transient component has a high degree of autocorrelation.

The problem can be seen more easily if we assume that a household’s income \( y_t \) is determined by three components: observed constant exogenous variables, \( z_t \) (such as sex, age,\(^{37}\) education, and race); unobserved constant exogenous variables, \( x_t \) (such as intelligence, personality, or quality of education); observed endogenous variables (such as months worked, region or city size, or occupation) and other variables (such as luck or experience), \( u_t \). Scaling variables so that each contributes unit income, we have:

\(^{35}\)For useful summaries, see the Survey [21] and Friedman [7].

\(^{36}\)There is, perhaps, one further constraint--the elasticity of the wealth income ratio (or of the savings rate) with respect to the rate of return \( \sigma \). In studies cited above \( \eta \) is much higher than empirical estimates. Since \( \eta \) is positively associated with \( \beta \) a lower \( \beta \) is probably preferable to a higher one. \( \beta = 0 \) and \( \beta = 1 \) are, strictly speaking, limiting cases of the formulae since the formulae do not hold for these values.

\(^{37}\)Strictly speaking, of course, age is exogenous but not constant. The treatment of age is to predict labor income in the future as a function of age, where age moves forward over time.
\[ y_i = z_i + x_i + u_i \]  \hspace{1cm} (C1)

We assume all variables are independent.

The variables \( z_i \) and \( x_i \) are fixed and can be considered "permanent income," while \( u_i \) is "transitory income." For a given year \( \theta \) years ahead, expected income is:

\[ E \{ y_i(t + \theta) \} = z_i + x_i + E \{ u_i(t + \theta) \} \]  \hspace{1cm} (C2)

The \( u_i(\theta) \) is assumed to be a stationary moving average process with constant variance.

The correlation of incomes of identical households \( \theta \) years apart is:

\[ \rho(\theta) = \frac{\text{cov} \{ y_i(t), y_i(t + \theta) \}}{\sigma[y_i(t)] \sigma[y_i(t + \theta)]} \]

\[ = \frac{\sum_i \{ z_i + x_i + u_i(t) \} \{ z_i + x_i + u_i(t + \theta) \}}{\sigma_y^2} ; \]

\[ \rho(\theta) = \alpha_z + \alpha_x + \rho_u(\theta) \alpha_u \]  \hspace{1cm} (C3)

where \( \alpha = \sigma_z^2/\sigma_y^2 \) and \( \rho_u(\theta) \) is the autocorrelation of the \( u \) component \( \theta \) years apart. Since \( E \{ u(t + \theta) \} = \rho_u(\theta) u(t) \), expected income in \( \theta \) years is:

\[ E \{ y_i(t + \theta) \} = z_i + x_i + \rho_u(\theta) u_i(t) \]  \hspace{1cm} (C4)

To make this definition operational, we assume that we have an unbiased estimate of \( z_i \) from the labor income regression below. We therefore have an unbiased estimate of the residual:

\[ v_i = x_i + u_i \]  \hspace{1cm} (C5)

Moreover, we assume that for all households \( v_i \) is divided between \( x_i \) and \( u_i \) in the same proportion:

\[ \begin{cases} 
  x_i = k v_i, & \text{all } i \\
  u_i = (1 - k) v_i, & \text{} 
\end{cases} \]  \hspace{1cm} (C6)

To calculate expected future labor income in (C4) we need \( k \) and \( \rho_u(\theta) \). To get \( k \) we introduce one final assumption: the autocorrelation of the transient component is zero after six years.38 Define \( \tilde{\rho} = \rho(\theta) \) for \( \theta \geq 6 \). If this is so, from (C3), \( \tilde{\rho} = \alpha_z + \alpha_x \), or

38The reason for this assumption is given in the explanation to Table C1 below.
\[ \alpha_x = \tilde{\rho} - \alpha_z. \] (C7)

This states that the autocorrelation in household income after six years is due entirely to the permanent component: for periods less than six years, the autocorrelation will be higher than \( \tilde{\rho} \) because of the autocorrelation of the transient component. Since:

\[ \alpha_u = \alpha_x = 1 - \alpha_z, \]

we have:

\[ k = \alpha_x / (\alpha_u + \alpha_x) = (\tilde{\rho} - \alpha_z) / (1 - \alpha_z). \] (C8)

Finally, we calculate expected future labor income as:

\[
E[y_i(t + \theta)] = z_i + x_i + \rho_u(\theta) u_i \\
= \tilde{z}_i + \tilde{x}_i + \rho_u(\theta) (1 - k) \tilde{u}_i \]

\[ \hat{y}_i = \hat{z}_i + \hat{x}_i [k + \rho_u(\theta) (1 - k)] \] (C9)

2. The empirical estimates of future labor income depend crucially on the regression chosen.

The first question—and a perennial problem for distributional studies—is the question of allocation of business income between labor and capital. The method of allocation was to assume that business capital earns the same rate of return as other equities, about five percent.\(^{39}\) This imputed capital income was then subtracted from business income to derive estimated labor income in business. This was added to wage and salary income to obtain total labor income.

The second question involves choice of determining variables (the \( z_i \) in the discussion above). The procedure outlined above indicates that only exogenous variables should be included. Endogenous variables (such as months worked, region, or occupation) are clearly one of the important determinants of (and reason for autocorrelation in) transitory income.

The following regression was chosen as the permanent labor income equation:\(^{40}\)

\[
y = 7.15 + 0.0822 x_1 + 0.0349 x_2 - 0.000416 x_3 - 0.987 x_4 \\
[3.08] [0.73] [1.57] [2.97] [3.20]
\]

\(^{39}\)This procedure does not flow naturally from the data. A cross-section regression of business income (\(y_B\)) on business assets (\(A_B\)) yields:

\[
y_B = 3601 + 0.0094 A_B \quad R^2 = 0.03 \quad SEE = 16442. \quad \bar{y}_B = 4117.
\]

\(^{40}\)Whatever the rate of return on business wealth is, this shows that the rate of withdrawals rises quite slowly.

\(^{40}\)The regression was run for the entire sample with unweighted observations. The unweighted form is preferable if the purpose is to predict individual labor incomes with minimum error.
\[-1.60 x_5 + 1.31 x_6 + 0.240 x_7 - 0.232 x_8 + 0.260 x_9 - 0.625 x_{10} + 0.288 x_{14} \]
\[
[5.50] \quad [5.15] \quad [2.56] \quad [0.75] \quad [1.08] \quad [2.23] \quad [0.66]
\]
\[-0.870 x_{12} - 0.0239 x_{13} + 0.0212 x_{14} \]  \hspace{1cm} (C10)
\[
[0.66] \quad [0.34] \quad [1.06]
\]

\[ R^2 = 0.392, \quad \text{SEE} = 3.19 \quad \bar{y} = 7.55 \]

where

\[ y = u_n \] (labor income)
\[ x_1 = \text{age of head of household} \]
\[ x_2 = x_1^2 \]
\[ x_3 = x_1^3 \]
\[ x_4 = \text{Dummy variable (} x_4 = 0 \text{ if age < 65, } x_4 = 1 \text{ if age } \geq 65) \]
\[ x_5 = \text{Sex of head of household, } (x_5 = 1 \text{ if male, } x_5 = 2 \text{ if female}) \]
\[ x_6 = \text{Marital status (} x_6 = 1 \text{ if married, spouse present; } x_6 = 0 \text{ otherwise}) \]
\[ x_7 = \text{Years of education, head} \]
\[ x_8 = \text{Dummy variable (} x_8 = 0 \text{ if } x_7 < 8, x_8 = 1 \text{ if } x_7 \geq 8) \]
\[ x_9 = \text{Dummy variable (} x_9 = 0 \text{ if } x_7 < 12, x_9 = 1 \text{ if } x_7 \geq 12) \]
\[ x_{10} = \text{Dummy variable (} x_{10} = 0 \text{ if } x_7 < 16, x_{10} = 1 \text{ if } x_7 \geq 16) \]
\[ x_{11} = \text{Dummy variable (} x_{11} = 0 \text{ if } x_7 < 20, x_{11} = 1 \text{ if } x_7 \geq 20) \]
\[ x_{12} = \text{Race (} x_{12} = 1 \text{ if white, } x_{12} = 2 \text{ if nonwhite}) \]
\[ x_{13} = \text{Race-education interaction (} x_{13} = x_{12} \cdot x_7 \) \]
\[ x_{14} = \text{Race-age interaction (} x_{14} = x_{12} \cdot x_7 \) \]

The equation explains income variations reasonably well, especially given that it omits any endogenous variables. When variables for months worked, occupation, region, and city size are added, the \( R^2 \) improves to 0.65.

3. The calculation of expected labor income uses the predictions of the labor income regression in (C10). The autocorrelations and the fraction of the residual added back is shown in column (3) of Table C1.

The important figures for our purpose are the last column in Table C1. These show the fraction of the residual in the labor income equation should be added back to calculate expected labor income. This calculation yields a sizable figure for the transitory component, perhaps larger than one might first expect.

There are a large number of reservations about the procedure followed. The assumptions above may be incorrect, especially independence of the components and equal discrepancy between the \( x \) and \( u \) components. The data problems are also serious. Moreover, in the period covered (1929–35), there were larger than usual macroeconomic disturbances. The correlations reported are for incomes rather than logarithms of incomes. Finally, the incomes included property incomes whereas we consider only labor incomes.
TABLE C1
Fraction Regression to Permanent Income

<table>
<thead>
<tr>
<th>Years between Observation (θ)</th>
<th>Correlation Between Incomes of Identical Units ρ(θ)</th>
<th>ρθ(θ)</th>
<th>Fraction of Regression to Permanent Income [k + ρθ(θ)(1 - k)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.83</td>
<td>.45</td>
<td>.71</td>
</tr>
<tr>
<td>2</td>
<td>0.78</td>
<td>.29</td>
<td>.68</td>
</tr>
<tr>
<td>3</td>
<td>0.76</td>
<td>.23</td>
<td>.60</td>
</tr>
<tr>
<td>4</td>
<td>0.71</td>
<td>.07</td>
<td>.52</td>
</tr>
<tr>
<td>5</td>
<td>0.70</td>
<td>.03</td>
<td>.50</td>
</tr>
<tr>
<td>6</td>
<td>0.69</td>
<td>.00</td>
<td>.49</td>
</tr>
<tr>
<td>More than 6</td>
<td>0.69</td>
<td>.00</td>
<td>.49</td>
</tr>
</tbody>
</table>

*Source: Column (1) is the correlation of the arithmetic levels of incomes of Wisconsin families over the period 1929-35 calculated in Hanna [8].

Column (2) = (1 - ρ(θ))/(1 - β), where β = 0.69. The value for more than 6 is assumed constant in light of the constancy of ρ(θ) after 4 years.

Column (3) is derived from equation (C - 9) and equals k + ρθ(θ)(1 - k), where k = (β - ρ2)/(1 - ρ2) = (0.69 - 0.392)/(1 - 0.392) = 0.49.

APPENDIX D: PARAMETER ESTIMATES FOR MACROECONOMIC MODELS

In this appendix we discuss very briefly the sources and methods of estimating our macroeconomic models.

All aggregate income data are from official national income statistics. Replacement cost of the capital stock and government debt for 1953 to 1968 are from IISR [11], and the Federal Reserve Bulletin. Labor Force employment and population are from ERP [5]. The price index is the 1958 based GNP deflator. The rate of interest is the AAA bond rate.

The rate of profit is after-tax property income divided by the replacement cost of capital. Property income equals rental income, corporate profits after tax, and 40 percent of proprietors’ income.

1. Neoclassical Equations

Equations (2,3,4). The production function for potential output was estimated by the method of relative share (for a discussion of this technique, see Netlove [15]).

The coefficient of capital was estimated as the full-employment pre-tax share of profits in national income. The other coefficients (A and γ) were estimated by taking 1953 and 1968 and fitting a line through these.

Equation (6). The parameter λ is such that the equation fits exactly over the period 1960-70.

Equations (7 and 8). Although most studies indicate little interest-elasticity (β1) of the desired wealth-income ratio, Wright [24] found time series elasticity of consumption with respect to the interest rate of -0.025, while Tobin [23] and Nordhaus and Tobin [16] used a priori estimates of the elasticity of the desired wealth-income ratio with respect to the interest rate of about 3 in a model similar to the one used here.
TABLE D1
Estimates of Effects of Inflation on Long-Term Interest Rates

<table>
<thead>
<tr>
<th>Author</th>
<th>Mean Lag (years) $(1/\theta)$</th>
<th>Fraction of Reaction ($\mu$)</th>
<th>Sample Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fisher [1930]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.A.</td>
<td>7.3</td>
<td>n.a.</td>
<td>1900–27</td>
</tr>
<tr>
<td>Great Britain*</td>
<td>8.0</td>
<td>n.a.</td>
<td>1820–1924</td>
</tr>
<tr>
<td>2. Sargent [1969]</td>
<td>30.†</td>
<td>0.116†</td>
<td>1902–1940</td>
</tr>
<tr>
<td>3. Yohe and Kurnosky [1969]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>0.78</td>
<td>0.803</td>
<td>1961–69</td>
</tr>
<tr>
<td>B</td>
<td>1.9</td>
<td>0.834</td>
<td>1961–69</td>
</tr>
<tr>
<td>4. Gordon [1970]</td>
<td>1.1†</td>
<td>0.193†</td>
<td>1952–69</td>
</tr>
</tbody>
</table>

†These coefficients are not directly noted but are reasonably clear from presentation of author.
‡Version A excludes any variables but inflation, while B includes real income, change in real income, and deflated money supply.
*Figure for Great Britain is average of 3 subperiods.

Using our own data, we obtain the equation in Table 3. This estimate is compatible with Wright’s. The response rate is assumed a priori.

Equation (1). The expected inflation equation determines the distributed lag reaction of interest rates to inflation. There are two indirect methods of inferring this. The first is the speed and magnitude of the response of money interest rates to inflation. The second (which becomes important in the Keynesian case) is the response of money wage rates to inflation. Several studies have been performed of the former and some are reported in Table D1. There is clearly little consensus on either the average lag or the fractional response. We have chosen an intermediate length lag—mean lag 5 years—and assume complete response, $\mu = 1$.

2. Keynesian Equations

Equation (9). For this equation we tested simple regressions of rate of change of the GNP deflator on unemployment and expected inflation as defined by equation (1). The expected inflation term was insignificantly different from either zero or one. We used both these regressions, with the following result:

\[
\pi = -0.00730 + 0.149 \frac{1}{u} \quad R^2 = 0.20 \quad (9A) \\
(0.0151 \quad (0.065)
\]
\[
\pi - \pi^e = -0.0300 + 0.128 \frac{1}{u} \quad R^2 = 0.13 \quad (9B) \\
(0.072)
\]

(9-A) is the equation used. (9-B) was tested for purposes of comparison.41

Equation (10), $E$ is employment over population, $u$ the civilian unemployment rate. The equation used is:

41See note 26.
\[ E = .600 - .747u + .0311(T - 1929) \quad R^2 = .80 \]
\[
\begin{array}{c}
\text{.086} \\
\text{.014}
\end{array}
\]

Equation (11). This equation was estimated as

\[
\left( \frac{r}{r^*} \right) = .9023 - .0157(u - u^*) - .0120(T - 1930) \quad R^2 = .79
\]
\[
\begin{array}{c}
\text{.0078} \\
\text{.0013}
\end{array}
\]

where \( r^* = \alpha Q/K \) = estimated full employment rate of profit.\(^{42}\)

Equation (11). The movement in the expected rate of unemployment is an attempt to show how producers and factor markets respond to changing levels of utilization of the economy. The quantity \( LF(1 - \bar{u}) \) in equation (2) is the planned employment of plant, and full employment marginal products are calculated at this level of employment. Since the average age of plant and equipment is approximately ten years, a value of 0.1 for \( \theta_u \) seems appropriate.

\(^{42}\)The constant term for 1962 is 0.60 instead of 1.0 because the rate of return is calculated net of capital and profit taxes, but gross of income taxation.
The Effects of Inflation on the Distribution of Economic Welfare, *A Comment by Oswald Brownlee*

Many of the previous studies of the effects of inflation on the distribution of economic welfare have assumed that the real values of income are essentially unaffected by the change in the general level of prices and that inflation therefore redistributes wealth from those who hold net positive amounts of nominally fixed assets to those who hold net negative amounts of such assets. It is generally known that there may be a net loss from the rise in the income: cash balance ratio due to economic units using things other than money to perform functions which can better be performed by money, but this loss usually has not been allocated since it is trivial in comparison with the gross wealth redistribution that usually accompanies inflation. There also may be a much larger loss due to the controls which often are imposed to try to alleviate some of the distributional effects of inflation. This has been particularly true in South America and in the rent controls in New York City. However, these impacts also are not usually distributed.

Using current income as the basis for evaluating relative economic status, many of these studies found that, on the average, the net nominal credit position was inversely related to income, i.e. that richer persons on the average incurred more nominally fixed debt than did poor ones. However, the variance within income classes was very large; i.e. the correlation between net debt and income was rather low. In fact, it would be difficult to state from these data that there was a really significant redistribution effect from inflation.

Nearly everyone recognized that current income was not a good index of economic well being. Mr. Nordhaus has attempted to devise a better index. However, since he has a sample for only one year, he must estimate the annuity equivalents using characteristics of the population such as age, sex, race, and education. About thirty-five percent of the variance in current labor income remains unexplained by his regression.

His results do not differ very much from those of most of the previous studies when he assumes a “classical inflation,” i.e. one in which inflation makes no difference in the real variables. The decreases in the coefficients of variations and skewness probably are small, and if the world is classical, inflation is a very inefficient redistributor.

When inflation is assumed to reduce profit and interest rates and increase the share of income going to labor (the outcome of the “neoclassical inflation”), the redistribution effect is again small. The biggest difference from previous studies,

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although again not very large, arises when inflation is assumed to raise the level of employment.

It is certainly legitimate to analyze the effects of a situation in which inflation reduces the level of unemployment. However, the outcome depends upon faulty expectations, i.e. upon the government convincing the population that it intends to pursue a policy that will lead to less inflation than it actually will try to achieve. I find such a policy morally repulsive, but I also do not believe that the government can fool the people permanently with respect to the rate of inflation. Indicators such as the rate of change in the money supply will be analyzed for trend (for example) so that the government’s statements will be ignored and its actions predicted from time series data. Thus, that a “Keynesian inflation” could exist for any long period I consider to be highly unlikely.

I consider Mr. Nordhaus’ contribution to be a confirmation of what we already believed to be the outcome of inflation—a reshuffling of wealth with very little change in the size distribution of annuity equivalents—plus a rather clever way of estimating the distribution of an income concept that is useful in comparing relative income positions.
The Effects of Inflation on the Distribution of Economic Welfare. A Comment by Reuben A. Kessel

Professor Nordhaus' paper provides a very imaginative method for estimating the effects of inflation upon the distribution of wealth in our society by using the income and wealth distributions for 1962 and simulating two kinds of unanticipated inflation. He does not preclude anticipated inflation. His analysis presupposes that unanticipated inflation is superimposed on whatever anticipated inflation occurs, and he analyzes the effects of unanticipated inflation. He considers two states of the economy, one in which output and employment are invariant with inflation, and the other in which output and employment are positively related to inflation.

He finds that inflation in the economy for which output and employment varies inversely with the rate of inflation is significantly different from its effects on an economy in which there is no unemployment. Inflation has a powerful equalizing effect when it reduces unemployment, an important, if not our most important, source of inequality.

The model in which unemployment varies inversely with the degree of unanticipated inflation is of great interest to those who regard inflation as a means of restoring full employment in the face of downward rigidities of wages and/or prices, and I would like to spend the bulk of my time discussing this case. I would also like to introduce the view that anticipated inflation introduces inefficient resource allocation. Here I disagree with Nordhaus when he says that there exists little evidence that inflation leads to inefficient resource allocation. The work of Cagan and Bailey among others, indicates that anticipated inflation can have powerful and important allocative effects. As a consequence of anticipated inflation, they find that holdings of real cash balances are reduced, and more expensive resources are substituted for cash balances as a means of holding wealth and in carrying out transactions. Therefore there is an efficiency loss produced by the discrepancy between the private and the economic or social costs of cash balances that is largely ignored by Nordhaus. If we introduce these costs into his analysis, I believe that his conclusions would be substantially altered.

The reductions in unemployment are brought about by unanticipated inflation. However, over time, unanticipated inflation becomes converted into anticipated inflation. Hence, to achieve any specified level of unanticipated inflation requires more and more anticipated inflation over time. As a consequence the efficiency losses of restoring full employment through unanticipated inflation will increase

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secularly. As these efficiency losses increase over time, they will approach and perhaps overtake the output gains attributable to the restoration of full employment and must be offset against the redistributive advantages of a more equalitarian income.

Presumably there will exist some upper limit to inflation as a social policy for restoring full employment and achieving the equalitarian effects Nordhaus' model predicts because the demand for real cash balances is not completely insensitive to the cost of holding these balances. Hence, secularly there is a reason for arguing that inflation is not an option that will be available to society for restoring full employment.

This does not, I believe, in any way contradict Nordhaus' conclusion that depression, i.e., less than full employment, constitutes the circumstances wherein we can more easily support a social policy of inflation. What my argument says is that the more inflation we have and the more inflation we build into expectations, the greater the social cost of using inflation as a means of combating inflation.

Consequently, it seems to me that there exists an argument for economizing on the existence of inflation, given Nordhaus' results, during times of full employment. This will reduce the costs of inflation as a means of restoring full employment, i.e., when the case for inflation is strongest.

Changes in the degree of anticipated inflation, more specifically going from three to say six percent anticipated inflation, produces redistributions of income and wealth very much like the redistributions caused by unanticipated inflation. Hence, even if efficiency costs of anticipated inflation are ignored, there must still be an accounting of the redistributive effects of changes in expectations of inflation. For this accounting, it matters who the debtors and creditors in our society are.

The government is obviously one of the big gainers from inflation by virtue of its enormous debts. Hence how the proceeds of the inflation tax are distributed matters for assessing the distributive effects of inflation. Will it be used to reduce taxes? If so, what form will the tax reduction take? How will the benefits of the gains of the government be distributed among the taxpayers?

If Nordhaus is to be interpreted as producing his employment effects with anticipated inflation, then questions can be raised about (1) his theory of income and employment and (2) what happens to the economy as it moves to anticipated inflation. How does inflation restore full employment if there is no discrepancy between anticipated and realized rates of change of prices, if nominal rates of interest reflect accurately rates of change of prices? In any case, there must be unanticipated wealth redistributions in going to anticipatory inflation unless one is willing to postulate that the market anticipates future changes in the rate of change of prices.