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Postwar British Economic Growth and the Legacy of Keynes

Thomas F. Cooley

University of Rochester and University of Pennsylvania

Lee E. Ohanian

University of Minnesota, University of Pennsylvania, and Federal Reserve Bank of Minneapolis

The policies used by Britain to finance World War II represented a dramatic departure from the policies used to finance earlier wars and were very different from the policies used by the United States during the war. Following Keynes's recommendations, Britain taxed capital income at a much higher rate than the United States during the war and for much of the postwar period. We analyze quantitatively the policies designed by Keynes using an endogenous growth model and the neoclassical growth model. We also evaluate the implications of tax-smoothing policies. We find that the welfare costs of Keynes's policies were very high relative to a tax-smoothing policy and argue that Britain's poor macroeconomic performance in the early postwar period is a consequence of the high tax rates levied on capital income.

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I. Introduction

Between 1940 and 1959, annual per capita growth of real output in the United Kingdom was only 0.9 percent, and the rate of physical investment was among the lowest in developed countries. Over that same period the average ex post tax rate on capital income was 36.7 percent. From 1965 to 1980 the growth rate of output was about 1.9 percent, which is very comparable to that of the United States. Over the same period the average ex post tax rate on capital income was 20.6 percent. Although a number of studies have addressed the issue of Britain's slow economic growth in the earlier period, tax policies are seldom mentioned as a possible factor. Britain's fiscal policies in the immediate postwar period were very similar to the war finance policy used during World War II—a policy that relied on heavy taxation of factor incomes, particularly the taxation of capital income. That policy differed sharply from fiscal policies used to finance earlier wars in the United Kingdom. In this paper, we examine how the fiscal policies used to finance World War II influenced Britain's postwar macroeconomic performance. We study this episode using a dynamic general equilibrium growth model. We calibrate the model to observed features of the postwar U.K. economy and simulate it to provide a quantitative assessment of the macroeconomic effects of British fiscal policy between 1940 and 1980.

To understand why the fiscal policies used to finance World War II represented a watershed in public finance, one must first understand that for over 200 years, through World War I, wars in the United Kingdom had been financed largely by issuing debt. As the problem of financing another war became an issue in the late 1930s, Britain adopted a different policy by raising income taxes significantly. Some of the pressure to do this came from Dennis Robertson and Josiah Stamp, advisors to the British Treasury who pressed for higher taxes to finance the war. Despite these tax increases, it became clear that substantial government borrowing was going to be an important component of war finance. Beginning in late 1939, the official policy of debt finance came under very sharp attack from John Maynard Keynes in a series of articles that were first published in the *London Times* and were later modified and extended in his monograph *How to Pay for the War: A Radical Plan for the Chancellor of the Exchequer* (1940). Keynes argued for more careful financial planning for the war. In particular, he argued for substantially higher taxes to finance the war *without* relying on debt issue and seigniorage. Moreover, he argued that several of these wartime changes in taxes should become a permanent part of U.K. fiscal policy.

Although there was initial resistance within the Treasury to Keynes's war finance proposals, many of his recommendations were ultimately adopted, and they influenced British fiscal policy for much of the immediate postwar period. The character of the fiscal policies adopted by Britain reflected Keynes's emphasis on the use of a balanced budget policy to finance the war, with sharply higher taxes on capital income. While Keynes was the principal architect of World War II fiscal policy, not all of his recommendations were followed. The most important of those that were not adopted was a proposal for a large compulsory savings policy to help finance the war that was to be repaid with a preannounced postwar capital levy.

Our objective in this paper is to analyze the effects of this striking change in public finance on wartime and postwar economic growth in Britain. This episode of economic history provides important evidence on the impact of fiscal policy on macroeconomic performance. The changes in tax policy that were proposed by Keynes and implemented during the war were among the most dramatic that have been observed in recent history. A number of studies of economic growth (e.g., Stokey and Rebelo 1995) have concluded that there is little evidence of important empirical links between growth and policy choices. The study of British war finance offers another source of evidence on this issue.

We construct a two-sector convex model of endogenous growth of the type proposed by Jones and Manuelli (1990) and King and Rebelo (1990). We calibrate the model to key features of British long-term growth and use this model to analyze the macroeconomic effects of the British approach to financing World War II. We do this by simulating the model under a set of policies that approximate as closely as possible the actual tax policies used by the United Kingdom over World War II and the postwar period. We then contrast the macroeconomic effects of the observed U.K. policy, which included several of Keynes's recommendations, with two counterfactual policies: (1) the *complete* set of tax policy changes recommended by Keynes in *How to Pay for the War,* including the compulsory savings policy and capital levy, and (2) a tax-smoothing policy. The tax-smoothing policy is a natural counterfactual experiment because this was the basic policy used to finance earlier U.K. wars. We find that the actual U.K. policies were very costly: tax-smoothing policies would have led to much higher welfare and output. Moreover, the full Keynesian policy would have had much higher costs than the actual policy.

For comparative purposes, we also evaluate these three policies using the exogenous one-sector (Cass-Koopmans) growth model. Our findings are qualitatively similar: the policies advocated by

Keynes and adopted by the United Kingdom were very costly, whereas the full Keynesian policy would have resulted in much lower welfare and forgone output.

In Section II, we provide a summary of U.K. war finance through World War I and discuss Keynes's role in developing the very different policy used during World War II. In Section III, we present data on investment, consumption, output, and tax rates from the United Kingdom and the United States since 1940. Section IV presents the two model economies. The calibration and computation of equilibrium are discussed in Section V. Section VI presents our findings, and a summary and conclusions are in Section VII.

II. Keynes and British War Finance

Between 1700 and 1920 Britain fought eight major wars. World War I was the most expensive of these wars, and the conflicts with France, which stretched from the late 1700s to 1820 and include the Napoleonic Wars, lasted the longest. Britain's war finance policies during these episodes were fairly uniform and have been documented carefully by Barro (1987), who reports changes in Britain's fiscal deficit and its relation to military spending over all these episodes. The principal method of U.K. war finance during this period was that the government borrowed to finance temporarily high expenditures during the war and gradually paid off the debt following the end of the war. The gold standard was suspended in two of these eight episodes (1797–1821 and 1914–18), and the inflation tax was a factor in financing these two wars. The size of government expenditures for the wars with France led England to suspend the gold standard in 1797 and institute an income tax in 1799 (Bordo and White 1994).[1] Although income and property taxes also played a role in financing World War I, debt issue was the principal method of finance during this episode.[2] The conclusion that emerges from Barro's analysis of all these episodes is that U.K. war finance over this 200 plus–year period is well characterized as a tax-smoothing policy.

John Maynard Keynes joined the British Treasury in 1915 and was deeply involved in the design and implementation of the policies

[1] In this episode, Britain also raised a larger portion of wartime expenditures by taxes (including excise and customs taxes). Bordo and Kydland (in press) estimate that 58 percent of the wartime expenditures were financed by taxes. This estimate is based on data in O'Brien (1967) and is higher than the estimate implied by Barro (1987).

[2] According to the statistics in Mitchell (1962), the ratio of the net debt created to government spending is .69 and the ratio of the deficit to government spending is .7 over the period of the war. These data suggest that about 70 percent of war expenditures were financed by debt issue.

used to finance World War I. In the early stages of World War I, the prevailing view in the Treasury was that the conflict and Britain's direct involvement were likely to have a limited duration and that the war would be settled diplomatically rather than by decisive military conflict. The government financed World War I much as it had financed earlier conflicts: by issuing debt. As is well known, the conflict lasted longer than anyone had foreseen and required far greater direct military involvement and many more resources. At the beginning of the war, the British Treasury was mainly involved in helping European allies to finance their wartime deficits. By the end of the war, Britain was transformed from being the financial center of the Allied war effort to depending entirely on American war loans to meet its own military needs. Britain raised some additional revenues by increasing income taxes, introducing an excess profits tax, and making use of the inflation tax (the price level doubled over the course of the war). In spite of these measures, Britain and its European allies were saddled with significant debts at the end of the war.[3]

The war was followed by a brief period of high inflation. Prices rose sharply during 1919 and the early part of 1920. In early 1920, partly on Keynes's advice, the Treasury raised bank rates and taxes. During this period, output fell by 15 percent and unemployment rose to 22 percent. By 1922, prices had returned to the level of 1916.

These events, combined with the postwar difficulties associated with repayment of debts and reparations among some countries, influenced Keynes considerably. He was not an advocate of wartime inflationary finance since he believed that the inflation/deflation cycle associated with wars caused a redistribution of wealth that was "unpredictable and capricious." In *A Tract on Monetary Reform* (1923), he argued that the uncertainty and redistribution caused by the wartime inflation had done much to destroy the economic underpinnings of middle-class British life.

In Keynes's view, an important goal of war finance was to avoid the high inflation that had occurred during World War I (letter to *The Times* [November 14, 1939]). He predicted that inflation would increase as wartime output and incomes rose, while resources were diverted away from the production of consumer goods and services. To prevent inflation, he argued that the only viable options were to institute price controls, to borrow, or to tax away consumers' spending power.[4] Keynes was concerned about the distributional conse-

[3] Between 1913 and 1920, Britain's net liabilities increased substantially. The debt/gross national product (GNP) ratio rose from .3 to 1.1.

[4] He dismissed two other "pseudo-remedies": rationing and antiprofiteering measures.

quences of these options. He was strongly opposed to financing the war by borrowing, which had been standard practice in earlier conflicts. His argument against the use of debt was that it would benefit the wealthy, since they would be the principal holders of government debt. He also argued that there was a safe limit to how much could be borrowed from abroad and raised from the sale of foreign assets. In his view, the safe limit was only about 20 percent of expected financing needs during the early stages of the war.[5] Instead, Keynes recommended that taxes be raised substantially to finance the war and that these taxes should be borne by the wealthy. One clear justification for this balanced-budget policy was that it advanced his social objectives, a view he made explicit in the preface and on the first page of *How to Pay for the War:*

> I have endeavored to snatch from the exigency of war positive social improvements. The complete scheme (tax policy) now proposed . . . embodies an advance toward economic equality greater than any which we have made in recent times. [P. iii]
>
> [I] propose a plan conceived in a spirit of social justice, a plan which uses a time of general sacrifice, not as an excuse for postponing desirable reforms, but as an opportunity for moving further than we have moved hitherto towards reducing inequality. [P. 1]

The only problem with relying on taxes, in his view, was that it would not raise sufficient revenue without involving taxing the income of the "working classes." Keynes's solution to this problem was to propose a system of sharply rising levies on all incomes in excess of a small minimum, with the highest incomes paying 85 percent marginal rates. For the working classes, these levies were to be regarded as *compulsory savings,* credited to a savings institution of the individual's choice, which would be rebated with interest after the war beginning in the first postwar recession.[6] The rebates were to be financed by a *preannounced capital levy* (wealth tax) that would begin in the first "boom" following the war. In his analysis, there was little concern about the incentive effects of distorting taxes or the long-run effects of these types of policies.[7]

[5] Keynes does not justify this specific limit on foreign borrowing/asset sales.

[6] On the basis of his estimate of the cost of the war (which was low relative to the actual cost), he proposed that roughly one-third of government war expenditures would be regarded as deferred pay (compulsory savings).

[7] It is worth noting that at the time he began writing about the problem of war finance, no one knew how long the war would last, whether the United States would

Keynes worked hard to persuade Treasury officials that the standard war finance policy of debt issue should be replaced by his proposals. Moggridge (1992, p. 629) describes it as "the most sophisticated and successful of his many campaigns as a publicist." The proposals in *How to Pay for the War* did not go unchallenged, however, nor were they wholeheartedly adopted by the government. John Hicks, in correspondence with Keynes, argued that Keynes's enthusiastic support of higher taxes ignored the possibility of dissaving by wealthy households to maintain consumption. To this Keynes replied, "I doubt if people are often as actuarially minded as your calculation makes them" (Moggridge 1978, p. 110). Keynes's proposals also received a mixed reception in the government. The Treasury initially rejected the proposals in *How to Pay for the War,* fearing that higher taxes might jeopardize the need for greater production. Elsewhere in the government, his campaigning with the chancellor and the key budget committee was effective, and it became clear that higher taxation was to be the key to financing the war. The culmination of Keynes's efforts was the 1941 budget statement. The budget included most of the ingredients Keynes had fought for, including sharp increases in income taxes with a standard rate of 50 percent and a top marginal rate of 97.5 percent, an excess profits tax of 100 percent, and a very modest compulsory savings scheme that promised rebates of a small portion of the taxes paid at the end of the war. Keynes was pleased with the outcome: "I am as well satisfied with the budget as I could reasonably expect; . . . the logical structure and method of a wartime budget is really a revolution in public finance" (Moggridge 1978, pp. 353–54).

Keynes's approach to wartime finance was indeed revolutionary in that it was based first on constructing a consistent set of national income accounts capable of providing the structure needed to understand the public finance problem presented by the war. This important contribution was developed further by James Meade and Richard Stone. The tax policies embodied in the budget of 1941, however, represented a revolution in another sense as well. In 1938, the top 289,000 households in the United Kingdom had an average after-tax income of nearly £2,000. By 1949, the top 11,000 households had an average after-tax income (in 1938 pounds) of just over £2,000. This represents a 96 percent decline in the number of households at that net income level.[8]

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become involved, or even whether Britain would emerge intact. Keynes's view, however, was that Britain would survive.

[8] These statistics were constructed from *National Income and Expenditure,* 1946–50, pp. 22 and 29.

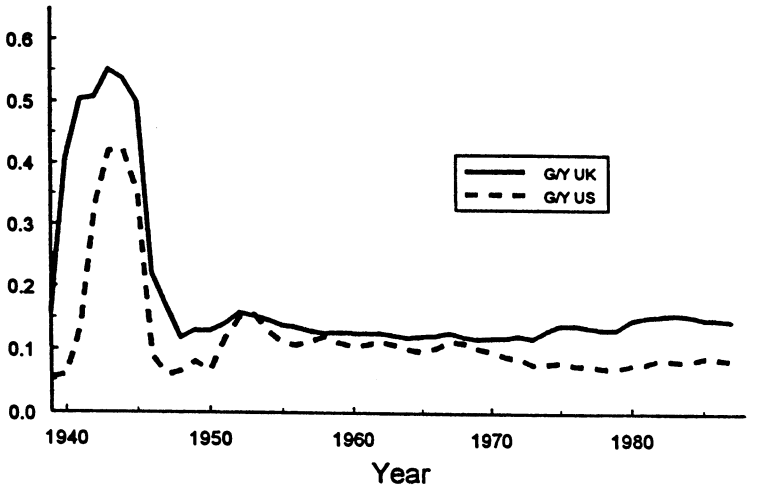

FIG. 1.—Government spending/output

III. U.K. Fiscal Policy in Perspective

In this section we present some basic observations that summarize the scope of the public finance problem faced by the United Kingdom during World War II. For comparative purposes, we also present these observations for the United States.

The public finance problem faced by both countries was staggering. In 1938, central government expenditures were roughly 9 percent of U.K. GNP (valued at factor cost). By 1944, the peak year of military expenditures, government purchases had risen to 54 percent of GNP. In the United States the problem was similar. In 1938, federal government expenditures were about 7 percent of GNP. By 1944, government expenditures in the United States had also increased to nearly 50 percent of GNP. For the United Kingdom this represented roughly a sevenfold increase in real central government expenditures, whereas real per capita output increased by a factor of about 1.2. For the United States it represented about an 11-fold increase in federal government expenditures, and output in the United States increased by a factor of about 1.8. Figure 1 shows the ratio of government expenditures to GNP for the United Kingdom and the United States.

Although the magnitude of the public finance shock was substantial in both countries, the output response to these shocks was very different. As noted above, output increased much more in the United States from 1938 to the peak of the war, and output growth

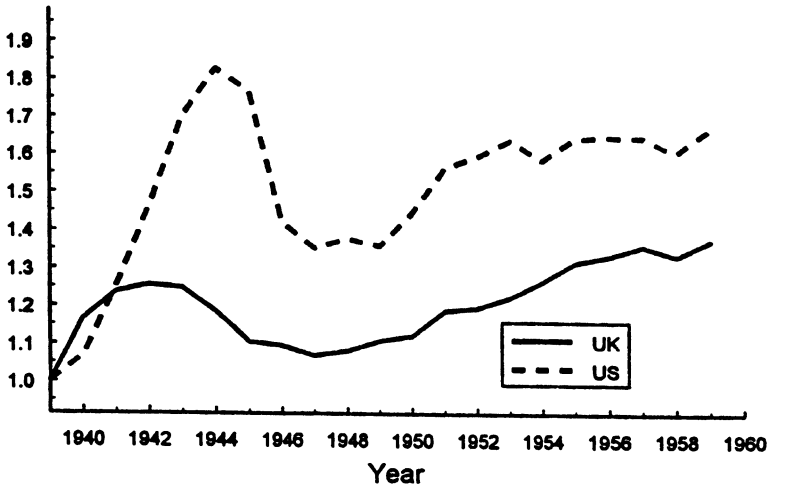

FIG. 2.—Normalized output, 1939–59

in the United States was higher for much of the period from 1938 until 1960. Figure 2 shows U.S. per capita output and U.K. per capita output between 1939 and 1959. For both countries, output has been normalized by dividing each observation by its value in 1939, so that the data are defined as output relative to 1939 output. Between 1939 and 1959, a large gap in output between the two countries emerges. This gap grows considerably during the war, narrows after the war as U.S. output falls significantly, and widens somewhat in the 1950s. Between 1939 and 1959, the United Kingdom grew at a rate of 1.5 percent, and the U.S. economy grew at the rate of 2.8 percent. Figure 3 presents output in the two countries for the period 1960–87. In this figure, output has been normalized by dividing each observation by its value in 1960, so that the data are now defined as output relative to 1960 output. Renormalizing output in 1960, we observe that a small gap develops between the two countries, but it narrows by the end of the 1960s. From the 1970s on, growth rates were very similar.

In both the United States and the United Kingdom, capital stocks declined significantly during the war and the average age of the existing capital stock increased. This reflected a sharp decrease in physical investment, with the investment/output ratio falling to just 2 or 3 percent at the peak of the war. Similarly, the consumption/output ratio fell in both countries. The consumption/output and investment/output ratios for the period 1940–87 are presented in figures 4 and 5 for the United States and figures 6 and 7 for the

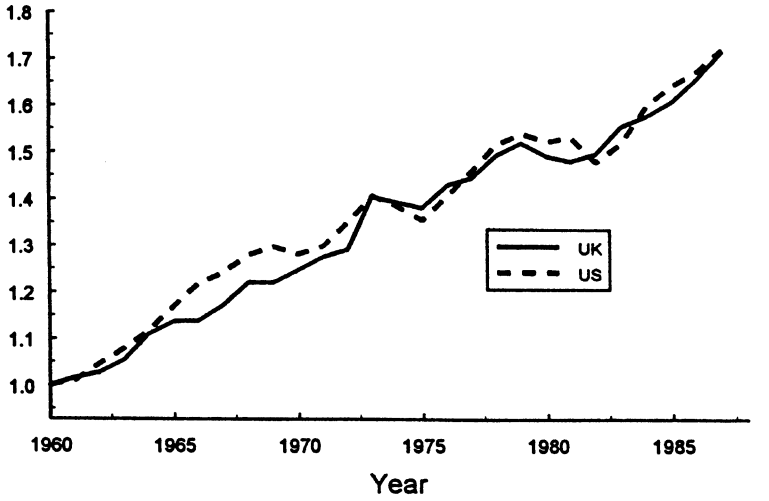

FIG. 3.—Normalized output, 1960–87

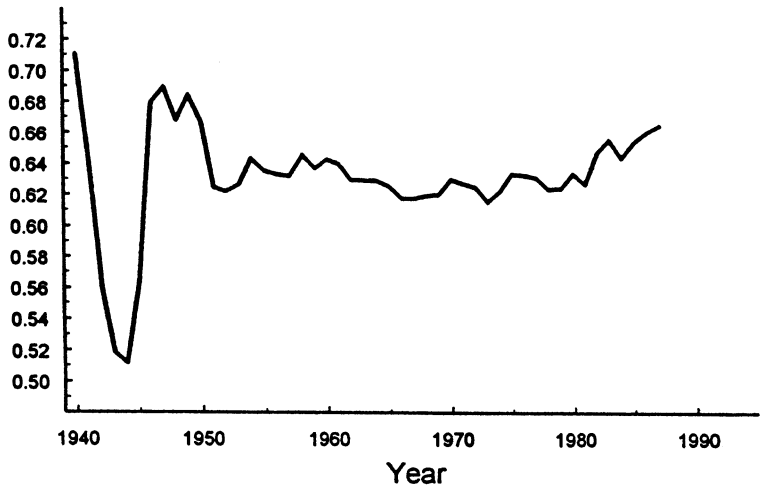

FIG. 4.—U.S. consumption/output

United Kingdom. Perhaps the most striking feature of these data is the very different pattern in these ratios across countries after the war. In the United States, the ratio of consumption to output rose immediately after the war and then returned quickly to what looks like fluctuations around a steady-state ratio. The behavior of the investment/output ratio is similar, rising sharply after the war and then fluctuating around a steady-state ratio.

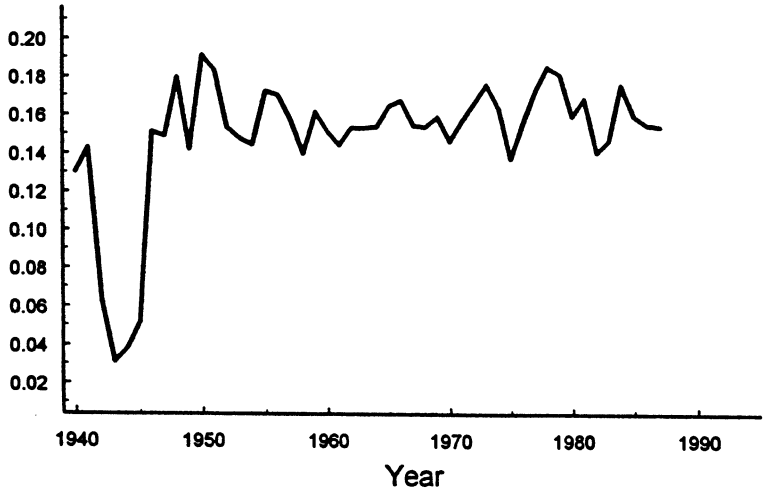

FIG. 5.—U.S. investment/output

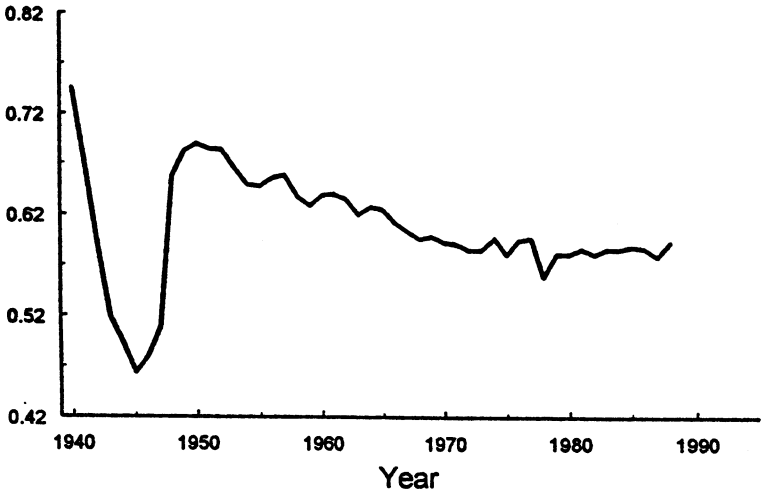

FIG. 6.—U.K. consumption/output

These key ratios are clearly very different in the United Kingdom. Consumption surged immediately after the war to nearly 70 percent of output. The consumption/output ratio then declined almost monotonically over the balance of the postwar period. There was a modest increase in the investment/output ratio at the end of the war in the United Kingdom, and this ratio increased almost monotonically over the postwar period.

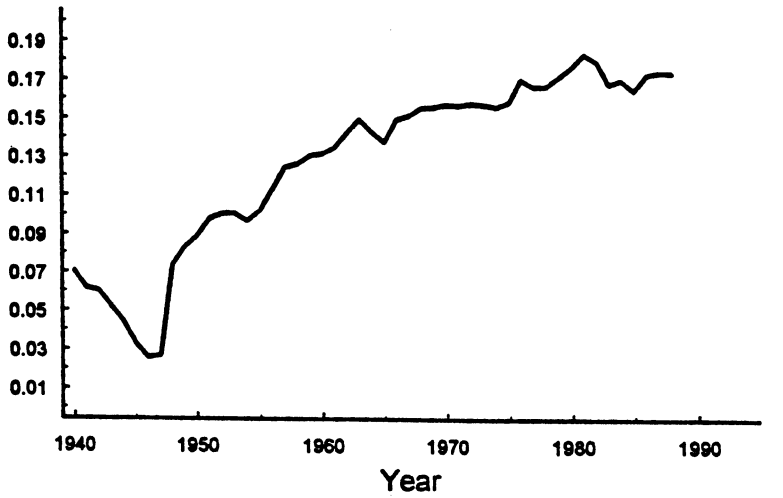

FIG. 7.—U.K. private investment/output

Initially, the U.K. observations for the time paths of consumption/output and investment/output over this period seem puzzling from the perspective of standard theory. Given the relatively low capital stock in place after the war, it would be reasonable to expect that the value of the marginal product of capital would tend to be high relative to the steady state. This would result in an initially *high* ratio of investment to output and an initially *low* ratio of consumption to output, with both objects converging monotonically to the steady-state ratio.[9] Of course, the predicted behavior of these ratios is exactly the *opposite* of the U.K. observations.

In this paper, we focus on the effects of tax policy on British growth and macroeconomic performance over this period. Figure 8 shows the behavior of ex post average U.K. tax rates on capital income between 1940 and 1987. These tax rates were constructed by dividing capital income tax revenue by gross capital income.[10] Perhaps the most remarkable feature of these data is the very high rate of taxation of capital income during World War II and the early

[9] Convergence would generally be monotonic in this environment with the class of preferences that is consistent with steady-state growth, and with no further shocks.

[10] We also calculate similar rates for consumption taxes by calculating the ratio of consumption tax revenues to consumption expenditures and for labor by dividing labor tax revenue by labor income. The basic source of these data is *National Income and Expenditure* (various issues), which is prepared by the Central Statistical Office and reports the national accounts data for the United Kingdom. Among other data, the publication presents tax revenue attributable to labor income and tax revenue attributable to capital income.

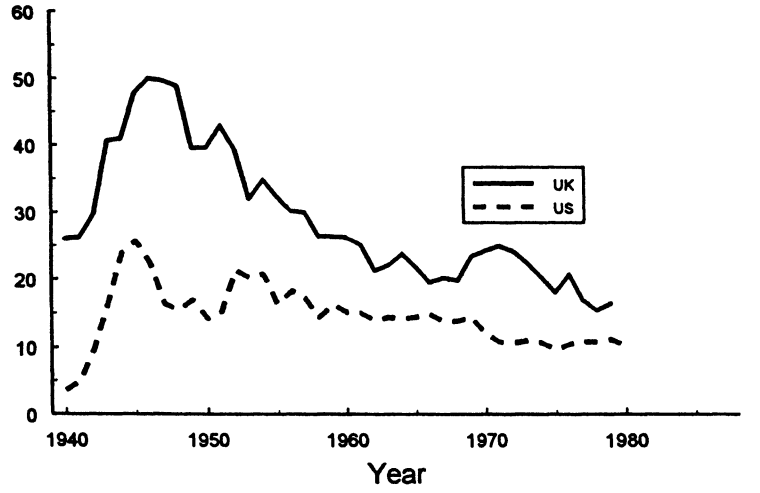

FIG. 8.—Capital tax revenue/capital income

postwar period, followed by a gradual, almost monotonic, decline in capital income taxation over the balance of the period. After the end of the war in 1946, nearly 50 percent of *gross* capital income was collected as tax revenue by the government; by 1980, only about 15 percent of gross capital income was collected.[11] For comparison, figure 11 below also includes a constructed U.S. capital tax rate (also based on gross capital income).[12] Although capital income taxation has been very similar in recent years in both countries, the differences during and immediately after World War II are striking. For most of the period up until 1960, average capital income taxes were dramatically higher in the United Kingdom than in the United States. These observations appear to be a direct legacy of Keynes's wartime finance policies.

IV. The Model Economies

In this section, we describe the two model economies used to study this historical episode. In subsequent sections we describe the results

[11] Given observations from the national accounts on tax revenues attributable to capital income taxation, a calculation of the capital tax rate on the basis of capital income net of depreciation would imply a much higher tax rate. The apparent increase in the constructed capital tax rate after 1980 largely reflects tax payments from North Sea oil, which are included in the national accounts as capital tax revenue.

[12] The U.S. capital tax rate is constructed on an annual basis from *Statistics of Income* (various issues), published by the U.S. Treasury Department, Internal Revenue Service. Capital income includes dividends and interest; corporate profits; profits from sole proprietorships; and partnerships, rents, royalties, and capital gains.

of calibrating and simulating these models under different fiscal policies to gain a quantitative understanding of the effects of different approaches to financing the war on output, growth, and welfare. The first model described is a convex growth model along the lines of Jones and Manuelli (1990) and Rebelo (1991). We construct a two-sector model with a linear component in physical capital in one of the production technologies. In the linear technology, the marginal product of capital is constant, which implies that taxes on capital income have important effects on capital accumulation. This is a simple model that highlights the economic effects of the striking changes in capital income taxation that occurred in the United Kingdom between 1940 and 1980. Moreover, we shall show that this model is consistent with several important observations in the United Kingdom during this period. For contrast, we also consider the standard one-sector exogenous growth model. This model does not capture the behavior of the U.K. economy as well as the linear capital model, but it has similar welfare implications.

In the models we consider, we abstract from several features of wartime economies, including price controls, rationing, black market activity, and international resource flows. It is worth noting that during World War II, as in earlier wars, the United Kingdom ran a sizable current account deficit. To the extent that there are external sources of financing available relative to our closed economy model, the elasticity of labor and capital services will tend to be higher, which implies that temporary periods of high taxation will tend to be even more distorting in an open-economy model.

A Two-Sector Growth Model

We develop a two-sector model in which the first sector produces consumption goods using capital and labor, and the second sector produces investment goods using capital. The technology for producing capital goods is linear in capital, which makes sustained growth possible.

Households in this economy choose consumption, c_t, and the fraction of time spent working, n_t, to maximize the discounted value of their stream of utility. The household also owns the capital stock, which is rented to firms for the production of either consumption goods or new capital goods. Household choices are denoted by lowercase letters, and aggregate per capita objects are denoted by capital letters. Primes are used to denote next-period values.

The household's problem is

$$\max \sum_{t=0}^{\infty} \beta^t [\log(c_t) + \gamma \log(1 - n_t - a_t)], \quad 0 < \beta < 1, \quad (1)$$

subject to the following sequence of constraints:

$$(1 - \tau_n - \tau_d)wn + d + (1 - \tau_k r - \tau_w)pk + (1 + i)b + T_t \geq (1 + \tau_c)c + b' + px \tag{2}$$

and

$$x = k' - (1 - \delta)k \geq 0, \tag{3}$$

where c is consumption, n is hours worked, p is the price of capital in terms of the consumption good, k is total household capital, a is exogenously determined time spent in the military, w is the wage rate, d is previously earned labor income repaid (with interest) by the government today as deferred pay, r is the rental rate of capital, τ_n is the tax rate on labor income, τ_d is the fraction of current labor income taken by the government but to be repaid in the future as deferred pay, τ_k is the tax rate on capital income, τ_w is the capital levy rate (the tax rate on wealth), τ_c is the tax rate on consumption, b is matured government debt held by the household, i is the one-period interest rate on government debt between dates $t - 1$ and t, T is a transfer from the government, and x is investment (net of the capital levy). Household income, measured in units of consumption, includes net wage income, net rental income on capital, principal and interest on matured government debt, and the transfer. Income is used to finance consumption, purchases of new government debt, and investment.

The consumption good is produced by a competitive firm from a constant returns to scale neoclassical technology using labor and capital.

The firm's problem is to maximize profits:

$$\max_{N, K_1} [f(K_1, N) - wN - rpK_1]. \tag{4}$$

New capital is produced by a competitive firm from a constant returns to scale technology that utilizes capital. Growth is introduced by assuming that there is a linear component in capital in the technology.

The problem of the firm producing investment goods is

$$\max_{K_2} [pAK_2 - rpK_2]. \tag{5}$$

A government exists to finance a sequence of exogenously required expenditures consisting of government purchases of goods $\{G_t\}_{t=0}^{\infty}$ and to make transfer payments to households. The government obtains revenue by taxing consumption expenditures, by taxing labor and capital income, by issuing new debt, and by imple-

menting the deferred pay policy. Given Keynes's plan to repay deferred pay exclusively with the capital levy, there are two period constraints faced by the government and two present-value constraints. The period government budget constraint is

$$G + (1 + i)B + T = B' + (\tau_n + \tau_d)wN + \tau_k rpK + \tau_c C. \quad (6)$$

We also assume that the government must satisfy a present-value budget balance restriction and a present-value deferred pay restriction. The budget balance restriction is given by

$$\sum_{t=0}^{\infty} R_t(G_t + T_t) = \sum_{t=0}^{\infty} R_t(\tau_{nt} w_t N_t + \tau_{kt} r_t p_t K_t + \tau_{ct} C_t),$$
$$R_t = \prod_{j=0}^{t} \frac{1}{1 + i_j}. \quad (7)$$

When we analyze Keynes's complete plan, there is also a period deferred pay constraint, which states that revenue from the capital levy (wealth tax) is sufficient to finance the amount of deferred pay from the war rebated at date t. Defining t^* as the first postwar date on which deferred pay is returned to households, we have

$$\pi_{t^*} = \sum_{j=0}^{t^*} \frac{\tau_{dj} w_j N_j}{R_{t^*-j}}, \quad (8)$$

$$\tau_{wt} p_t K_t = \alpha_t \pi_t \quad \forall\ t \geq t^*, \quad (9)$$

and

$$\pi_{t+i} = \frac{\pi_{t+i-1}(1 - \alpha_{t+i-1})}{R_{t^*+i}} R_{t^*} \quad \forall\ t \geq t^*,\ i = 1, 2, 3, \ldots, \quad (10)$$

where α_t is the fraction of the value of deferred pay that is distributed at date t, $0 \leq \alpha \leq 1$.

The present-value deferred pay restriction is

$$\lim_{t \to \infty} \pi_t = 0. \quad (11)$$

Feasibility in the two sectors requires

$$f(K_1, N_1) \geq G + C,$$
$$AK_2 \geq K' - (1 - \delta)K. \quad (12)$$

In the second technology, which is linear homogeneous in physical capital, we have abstracted from labor input. To include labor input in this technology and maintain constant returns to scale, the production function can be written as in Jones and Manuelli (1990)

as

$$h(K_2, N_2) = AK_2 + g(K_2, ZN_2), \tag{13}$$

where $g(\cdot)$ is linear homogeneous, and Z is exogenous labor-augmenting technical change. If the growth rate of Z is the same as the steady-state growth rate of capital, a steady-state growth path exists with $N_{2t} = \bar{N}_2$. Alternatively, if the growth rate of Z is less than the growth rate of capital, then $N_2 \to 0$ as $t \to \infty$. We have found that the implications of this type of model are fairly similar to our basic formulation that abstracts from labor input in the second technology.

Profit-maximizing input choices by the two firms imply that factor prices equal the value of marginal products:

$$\begin{aligned} w &= f_N, \\ r &= A = \frac{f_{K1}}{p}. \end{aligned} \tag{14}$$

Efficient choices by the household yield

$$\frac{\gamma}{1-n} = \frac{1-\tau_N}{1+\tau_C}\frac{w}{c} \tag{15}$$

and

$$\frac{pc'(1+\tau_{c'})}{p'c(1+\tau_c)} = \beta[(1-\tau'_K)r' + (1-\delta)]. \tag{16}$$

Market clearing implies

$$1 + i' = \frac{(1+\tau_{c'})c'}{\beta(1+\tau_c)c}. \tag{17}$$

We now consider the asymptotic properties of this model. We assume that A is large enough that the capital stock and output grow over time. To analyze the steady-state growth path, we assume that, after the war, government expenditures grow at the same rate as consumption and that tax rates, τ_N, τ_K, and τ_c, are fixed over time. Since we shall not consider a permanent wealth tax, the long-run values of τ_w, τ_d, and d are zero. We choose $f(K, N)$ to be Cobb-Douglas: $f(K, N) = K^\theta N^{1-\theta}$.

Since the time endowment is bounded, the steady-state growth rate of market time is zero: $\phi_N = 0$, where the notation ϕ_m denotes the growth rate of the variable m. The resource constraint from sector 2, combined with the efficient choice for capital input in sector 1,

yields the following steady-state growth rate for capital:

$$\phi_K = \phi_{K1} = \phi_{K2} = \beta[(1 - \tau_K)A + (1 - \delta)] - 1. \quad (18)$$

Since government spending requirements (government purchases and transfers) are assumed to grow at the same rate as consumption, the growth rate for consumption can be calculated from the resource constraint in sector 1, and the growth rate of the wage can be calculated from the household's first-order condition governing the allocation of time between market work and other activities, which yields

$$\phi_c = \phi_w = \theta\phi_K. \quad (19)$$

This model displays two features that are consistent with recent observations in U.S. and U.K. data: the relative price of capital in this model falls along the steady-state growth path,

$$\phi_p = (\theta - 1)\phi_K, \quad (20)$$

and the growth rate of capital exceeds the growth rate of output. These observations have been analyzed by Gordon (1990) and Greenwood, Hercowitz, and Krusell (1997) for the U.S. economy.

We define the following objects that are used in our definition of equilibrium.

A *government policy* in this economy is the collection of sequences of tax, capital levy, and deferred pay rates $(\{\tau_{wt}\}_{t=0}^{\infty}, \{\tau_{kt}\}_{t=0}^{\infty}, \{\tau_{nt}\}_{t=0}^{\infty}, \{\tau_{dt}\}_{t=0}^{\infty}, \{\tau_{at}\}_{t=0}^{\infty}$, and $\{\alpha_t\}_{t=0}^{\infty})$, government expenditures $\{G_t\}_{t=0}^{\infty}$, government transfers $\{T_t\}_{t=0}^{\infty}$, and time spent in the military $\{a_t\}_{t=0}^{\infty}$.

A *price system* in this economy is the collection of sequences of prices $(\{w_t\}_{t=0}^{\infty}, \{r_t\}_{t=0}^{\infty}, \{p_t\}_{t=0}^{\infty}, \{i_t\}_{t=0}^{\infty}$, and $\{R_t\}_{t=0}^{\infty})$.

An *allocation* in this economy is the collection of sequences of *household choices* $(\{c_t\}_{t=0}^{\infty}, \{n_t\}_{t=0}^{\infty}, \{k_t\}_{t=0}^{\infty}$, and $\{b_t\}_{t=0}^{\infty})$ and *firm choices* $(\{N_{1t}\}_{t=0}^{\infty}, \{K_{1t}\}_{t=0}^{\infty}$, and $\{K_{2t}\}_{t=0}^{\infty})$.

Equilibrium

Given k_0 and b_0 and a government policy A, *perfect-foresight competitive equilibrium* for this economy consists of an *allocation* and a *price system* such that (1) the allocation solves (i) the household's lifetime utility maximization problem and (ii) solves the firms' profit maximization problem at every date; (2) aggregate consistency is satisfied for all t: $k_t = K_{1t} + K_{2t} = K_t$, $n_t = N_{1t} = N_t$, $c_t = C_t$, and $b_t = B_t$; (3) present-value budget balance and deferred pay balance are satisfied; (4) period government budget and deferred pay constraints are satisfied for all t; (5) the allocation is feasible for all t: $f(K_{1t}, N_{1t}) = G_t + C_t$,

$AK_{2t} = K_{t+1} - (1 - \delta)K_t$, $N_t \leq 1 - a_t$, K_{1t}, K_{2t}, N_{1t}, C_t, $D_t \geq 0$; and (6) market clearing is satisfied for all t.

The One-Sector Exogenous Growth Model

Many aspects of our environment remain the same in the exogenous growth model. The household's problem is

$$\max \sum_{t=0}^{\infty} \beta^t[\log(c_t) + \gamma \log(1 - n_t - a_t)], \quad 0 < \beta < 1, \quad (21)$$

subject to the following sequence of constraints:

$$\begin{aligned}(1 - \tau_n - \tau_d)wn + d + (1 - \tau_k r - \tau_w)k + (1 + i)b + T_t \\ \geq (1 + \tau_c)c + b' + x\end{aligned} \quad (22)$$

and

$$x = k' - (1 - \delta)k \geq 0, \quad (23)$$

where the variables are defined above.

The single good is produced by a competitive firm from a constant returns to scale production function using labor and capital as inputs. The firm maximizes profits taking factor prices as given. With constant returns, profits are zero in equilibrium.

The problem facing the firm is

$$\max [f(K_1, N_1) - wN_1 - rK_1]. \quad (24)$$

A government exists to finance a sequence of exogenously required expenditures consisting of government purchases of goods $\{G_t\}_{t=0}^{\infty}$ and to make transfer payments to households. The government obtains revenue by taxing consumption expenditures, by taxing labor and capital income, by issuing new debt, and by implementing the deferred pay policy. The period government budget constraint is

$$G + (1 + i)B + T = B' + (\tau_n + \tau_d)wN + \tau_k rK + \tau_c C. \quad (25)$$

The present-value budget balance constraint is

$$\begin{aligned}\sum_{t=0}^{\infty} R_t(G_t + T_t) &= \sum_{t=0}^{\infty} R_t(\tau_{nt} w_t N_t + \tau_{kt} r_t K_t + \tau_{ct} C_t), \\ R_t &= \prod_{j=0}^{t} \frac{1}{1 + i_j}.\end{aligned} \quad (26)$$

The period deferred pay constraint is

$$\pi_{t^*} = \sum_{j=0}^{t^*} \frac{\tau_{dj} w_j N_j}{R_{t^*-j}}, \tag{27}$$

$$\tau_{wt} K_t = \alpha_t \pi_t \quad \forall\ t \geq t^*, \tag{28}$$

and

$$\pi_{t+i} = \frac{\pi_{t+i-1}(1 - \alpha_{t+i-1})}{R_{t^*+i}} R_{t^*} \quad \forall\ t \geq t^*,\ i = 1, 2, 3, \ldots, \tag{29}$$

where α_t is the fraction of the value of deferred pay that is distributed at date t, $0 \leq \alpha_t \leq 1$. The present-value deferred pay restriction is

$$\lim_{t \to \infty} \pi_t = 0. \tag{30}$$

Feasibility requires

$$f(K_1, N_1) \geq G + C + K' - (1 - \delta)K. \tag{31}$$

Profit-maximizing input choices imply that factor prices equal the value of marginal products:

$$\begin{aligned} w &= f_N, \\ r &= f_K. \end{aligned} \tag{32}$$

Efficient choices by the household yield

$$\frac{\gamma}{1 - n} = \frac{1 - \tau_N}{1 + \tau_C} \frac{w}{c} \tag{33}$$

and

$$\frac{c'(1 + \tau_{c'})}{c(1 + \tau_c)} = \beta[(1 - \tau'_K)r' + (1 - \delta)]. \tag{34}$$

Market clearing implies

$$1 + i' = \frac{(1 + \tau_{c'})c'}{\beta(1 + \tau_c)c}. \tag{35}$$

Since the equilibrium concept is identical, we omit the definition of equilibrium for this economy.

V. Model Calibration and Experiments

To simulate the model economies just described, we choose parameter values for the model and calculate tax rates on capital and labor

income and consumption expenditures. The strategy for choosing the model parameters follows the principles described in Cooley and Prescott (1995). In addition to the estimated tax rates over the period, we consider alternative fiscal policies that would have financed the same level of government spending and transfer requirements. We describe these tax policies first.

Tax Policies

The strategy in the three experiments consists of two steps. (1) For each experiment, feed in the specified sequences of tax rates on capital and labor income and consumption over the wartime and postwar periods. (2) For each experiment, it is also necessary to set tax rates in the future. Future tax rates on capital and labor income and consumption are assumed to be constant: this is required if the economy is to converge to a steady-state growth path. In all experiments, we assume identical long-run capital tax rates. This ensures that the long-run growth rate of the economy will be identical across all three experiments. We also assume identical long-run consumption tax rates in the three experiments. Long-run labor tax rates across the three experiments will be different. This reflects the fact that the value of outstanding government debt at the end of the postwar period across the three experiments will differ, which implies that tax rates must be adjusted to satisfy present-value budget balance that we require to hold across the three experiments.[13]

Baseline Policy (Historical Tax Rates)

For the baseline simulations, we feed in computed annual tax rates on capital and labor income and consumption tax rates for the 1940–80 period. We choose 1980 as the terminal period for estimated tax rates because it appears from U.K. observations that most of the changes in average tax rates have been completed by this date. The tax rate calculations are based only on central government taxes, not on state and local taxes. The U.K. national accounts itemize tax revenue attributable to labor and capital income. To calculate the average labor tax rate, annual tax revenue from labor income is divided by labor income, which has averaged about two-thirds of GNP in the United Kingdom. The average capital tax rate is calculated analogously by dividing tax revenue from capital income by gross capital income, which is about one-third of GNP. The computed tax rates on factor incomes are estimates of average, and not

[13] The design of these experiments is similar to that in Ohanian (1997).

marginal, tax rates on labor and capital income. Unfortunately, we have not been able to find a consistent, annual time series of average marginal tax rates for the United Kingdom over the 1940–80 period similar to the one constructed by Joines (1981) for the United States. The consumption tax rate is calculated by dividing consumption tax revenue by consumption expenditures.

For baseline tax rates after 1980, we assume that tax rates are constant, with the labor tax rate .25, the capital tax rate .14, and the consumption tax rate .15. These values are approximately equal to the estimated rates at the end of the period. In the event that present-value budget balance is not achieved in 500 years under this sequence of tax rates, labor tax rates are adjusted. This adjustment consists of changing post-1980 labor tax rates and also changing pre-1980 labor tax rates by a constant percentage such that the 1980 and 1981 labor tax rates are approximately equal.[14]

Counterfactual 1: Tax-Smoothing Policy

In the tax-smoothing policy, we feed in constant tax rates for capital and labor income and consumption beginning in 1940 and continuing in perpetuity. The tax-smoothing alternative is a good benchmark for our analysis since, as Barro (1987) has pointed out, the fiscal policy used by the United Kingdom prior to World War II was a tax-smoothing policy.

For this scenario, the capital tax rate is constant at .14, and the consumption tax rate is constant at .15; these are the asymptotic rates in the baseline policy. The labor tax rate is set at a constant rate so that present-value budget balance is achieved.

Counterfactual 2: Complete Keynesian Policy

There are two principal differences between the baseline policy adopted by the United Kingdom, which was designed by Keynes, and his complete set of policy recommendations. These are (1) the deferred pay plan followed by (2) a preannounced capital levy that would return deferred pay with interest after the war. To implement this in the counterfactual experiment, we follow Keynes's recommendations as closely as possible. In 1939, Keynes recommended that about one-third of government spending be funded by deferred pay (see Keynes 1940, pp. 16, 37). It is not clear from his text whether

[14] An alternative strategy for achieving budget balance would be to adjust only the post-1980 labor tax rates and leave the pre-1980 labor tax rates equal to their historical values. This results in somewhat lower welfare.

the percentage of spending covering deferred pay should rise, fall, or remain constant over the course of the war, particularly since actual wartime expenditures were probably high relative to those predicted. The general tone of his argument suggests that it would be higher. However, we have decided to interpret the Keynes proposal conservatively and assumed that 25 percent of government spending during the war is covered by deferred pay. Thus the labor tax rate, including the deferred pay, in this counterfactual between 1940 and 1945 is the baseline labor tax rate raised by about 13 percentage points.

Keynes recommended that the resources would be deposited in the institution of the household's choice and be repaid with interest after the war with the preannounced capital levy (pp. 43–44). He seemed to favor a gradual collection of the levy, which reflected his belief that "a series of installments . . . would facilitate collection, greatly lessen the disturbance, and have the special merit that it might pave the way for a permanent capital tax which would be a valuable addition to our fiscal machinery and have certain advantages over income tax" (p. 48).

It is important to note that "labor circles" were in favor of an immediate levy, which Keynes rejected, citing administrative costs. In his view, taking assets immediately from households "would be of no assistance whatever to the immediate financial task" (p. 49). Given his preference toward a gradual collection, we implement the Keynes plan for a preannounced capital levy by taking capital from households such that deferred pay is entirely repaid over the 1946–80 period. Most of the repayment is accomplished during the first 15 years of the postwar period.[15] Following 1980, the capital income tax rate is set to .14, as in the baseline experiment, and the capital levy is terminated. As is evident from the quote above, Keynes very much favored a permanent capital tax, but since he was not specific regarding its size, we have not implemented that in our analysis. The tax rates are summarized in tables 1–3.

Government Expenditures and Transfers

Government expenditures and transfers are identical across the three policy experiments. Transfers are set equal to zero during the

[15] Keynes was not specific about how long the levy should be in place or what should be the rate at which it was to be collected. We have used a sequence of wealth taxes that decline exponentially over time at about 10 percent per year, which makes the policy less distorting. Given his expressed views, our approach seems to us to be a reasonable way of implementing his plan. Of course, there are many possible ways to structure the capital levy.

TABLE 1

TAX POLICIES: ENDOGENOUS GROWTH MODEL

	1940–80	Post-1980
	Baseline Policy	
Labor tax	Computed from data	28%
Capital tax	Computed from data	14%
Consumption tax	Computed from data	15%
	Full Keynesian Policy	
Labor tax	Estimated from Keynes's proposals	18%
Capital tax	Computed from data	14%
Consumption tax	Computed from data	15%
Capital levy	Estimated from Keynes's proposals	0%
	Tax-Smoothing Policy	
Labor tax	31%	31%
Capital tax	14%	14%
Consumption tax	15%	15%

TABLE 2

TAX POLICIES: EXOGENOUS GROWTH MODEL

	1940–80	Post-1980
	Baseline Policy	
Labor tax	Computed from data	33%
Capital tax	Computed from data	14%
Consumption tax	Computed from data	15%
	Full Keynesian Policy	
Labor tax	Estimated from Keynes's proposals	16%
Capital tax	Computed from data	14%
Consumption tax	Computed from data	15%
Capital levy	Estimated from Keynes's proposals	0%
	Tax-Smoothing Policy	
Labor tax	26%	26%
Capital tax	14%	14%
Consumption tax	15%	15%

war, with the exception of payments to soldiers. After the war (1946), transfers are set to roughly match the growth rate of transfers in the data and are identical across all three policy experiments. Government spending shocks are identified by analyzing deviations in government purchases from a trend. Following the war, purchases grow at their asymptotic rate. During the war, the fraction of time spent

TABLE 3

WELFARE COSTS OF ALTERNATIVE POLICIES RELATIVE TO TAX SMOOTHING

	MODEL	
	Endogenous Growth	Exogenous Growth
Baseline policy	2.9%	1.8%
Full Keynesian policy	13.2%	7.2%

in the military is defined as the ratio of military personnel to the working age population. Following the war, we assume that time spent in the military is zero.

Linear Capital Model Calibration

We choose δ, the depreciation rate, the discount factor β, the production parameter θ, and the production parameter A to ensure that the steady-state growth path of the model is characterized by an investment/output ratio of .2, a steady-state growth rate of capital of 3 percent, capital's share of income of .33, and a pretax rate of return of about 6 percent. This implies that $\delta = .061$, $\beta = .95$, $A = .14$, and $\theta = .19$. The preference parameter $\gamma = 1.14$ and is chosen so that the household spends about one-third of discretionary time working.

Calibration of the Exogenous Growth Model

The strategy for calibrating the exogenous growth model is similar. Labor-augmenting technical progress is assumed to grow 2 percent annually. Capital's share of income is about one-third in the United Kingdom, which implies that $\theta = .33$ for the exogenous model. The preference parameter $\gamma = 1.28$ and is chosen so that the household spends about one-third of discretionary time working. The discount parameter β is chosen so that the steady-state pretax rate of return is about 6 percent. The depreciation rate δ is chosen so that along the steady-state growth path the investment/output ratio is about .2.

Computing the Equilibrium

The solution procedure for computing the equilibrium for the two model economies is the same. For each experiment, we feed in the sequence of tax rates and government expenditures and compute the equilibrium numerically. When market-clearing conditions are

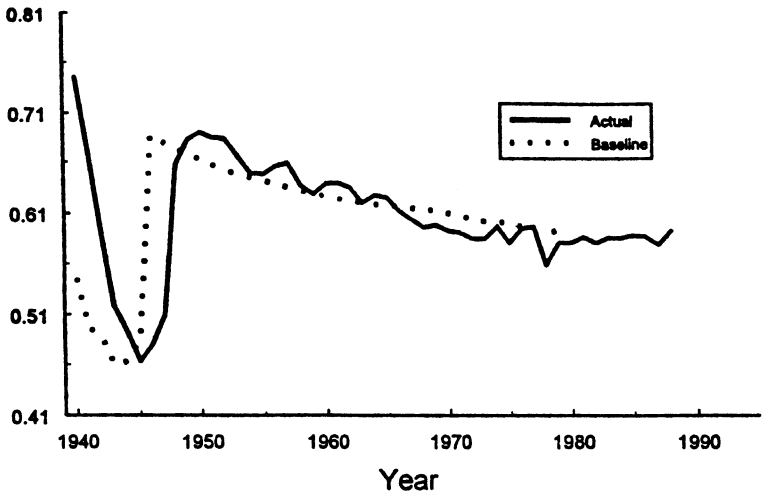

FIG. 9.—U.K. consumption/output

imposed, the equilibrium can be characterized by first-order conditions and resource constraints. Given the perfect-foresight environment and a terminal condition, the solution to the model can be computed by solving N equations in N unknowns. The terminal condition simply involves choosing a date in the future and restricting the economy to be on the steady-state growth path after that date. We then use a nonlinear equation solver to find a solution to the set of first-order conditions over a finite horizon (up to the terminal date) and use the terminal condition to solve for the equilibrium after the terminal date. The terminal date is chosen so that increasing that date does not affect the equilibrium allocations.[16]

VI. Findings

Figures 9–13 summarize the behavior of the linear capital model economy under the various policy assumptions and contrast it to the actual performance of the U.K. economy. Figure 9 presents the consumption/output ratio for the period 1940–80, as it is in the data and as predicted by the *baseline policy* for the model economy. Under the baseline policy, we feed in our estimated annual series of U.K. capital, labor, and consumption taxes between 1940 and 1980.

[16] For some cases, we also use Marcet's (1989) procedure to solve for allocations in the neighborhood of the steady-state growth path. This algorithm reduces the time it takes to compute the equilibrium.

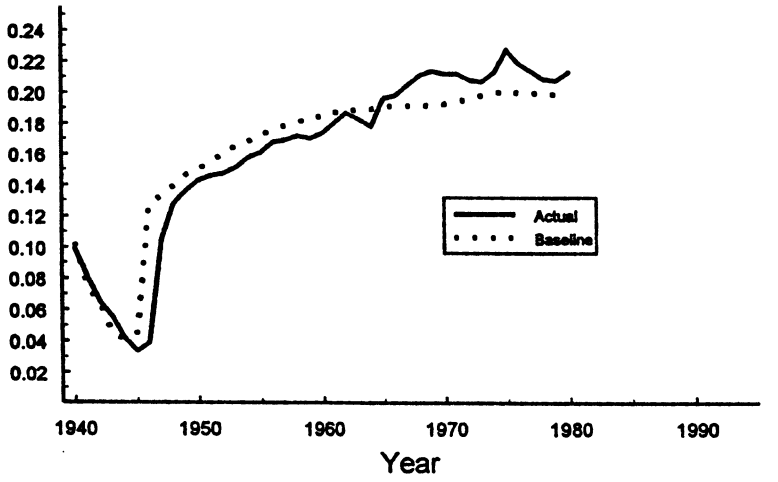

FIG. 10.—U.K. total investment/output

Despite the enormous changes in tax policy and government expenditures that occur over this period, the behavior of the consumption/output and investment/output ratios in the model is very similar to that in the data. Both the data and the model simulation show a sharp decrease in the consumption/output ratio during the war, followed by a substantial increase immediately after the war and a gradual decline over the entire postwar period. Figure 10 presents the investment/output ratio for the period 1940–80 for the data and for the model under the baseline policy. In figure 10, the actual data pertain to total (private plus public) domestic fixed investment. Plotting only private investment produces a similar pattern, but the level is below the baseline prediction of the model. (If private and public capital are good substitutes, then total fixed investment seems to be the most appropriate investment measure from the data to compare to the model.) In both the data and the model simulation, investment relative to output falls during the war, increases after the war, and then gradually recovers toward the steady-state level over the 1946–80 period.

Figures 11 and 12 show the model's predicted response to the baseline policy and the two counterfactual policies. The first counterfactual policy assumes that the same level of government expenditures was financed with tax-smoothing policies. As a result, more of wartime government expenditures are financed with debt. The baseline policy is represented by the dotted line, and the tax-smoothing policy is represented by the dashed line. Figure 11 shows that with

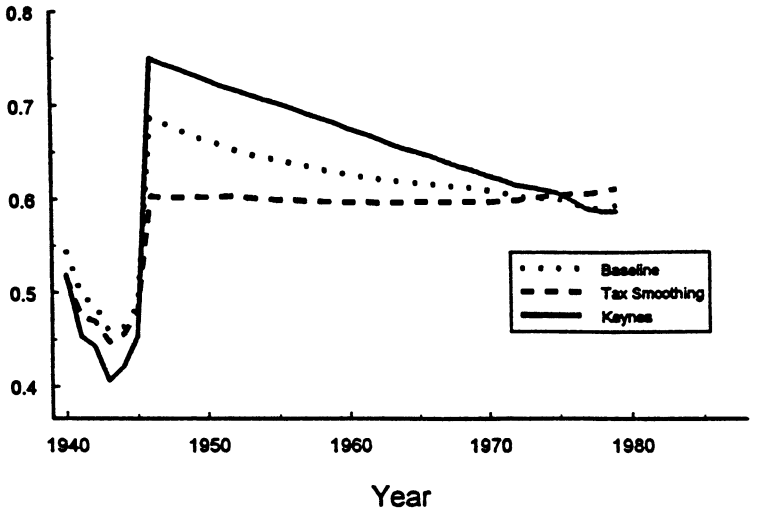

FIG. 11.—U.K. C/Y under alternative policies

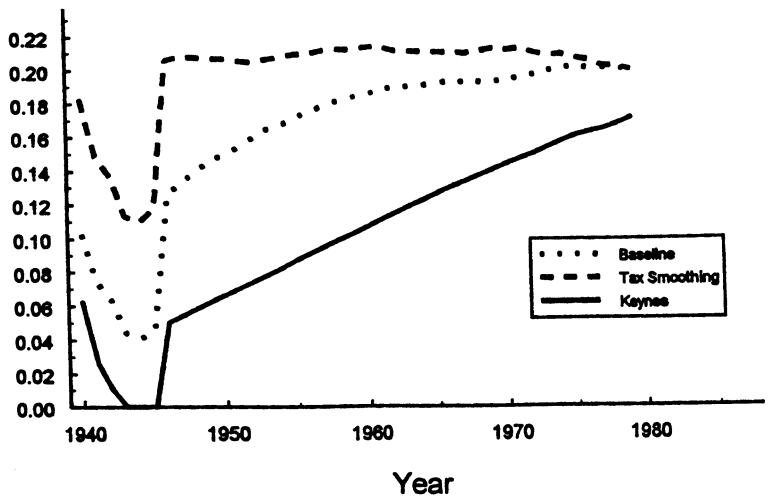

FIG. 12.—U.K. I/Y under alternative policies

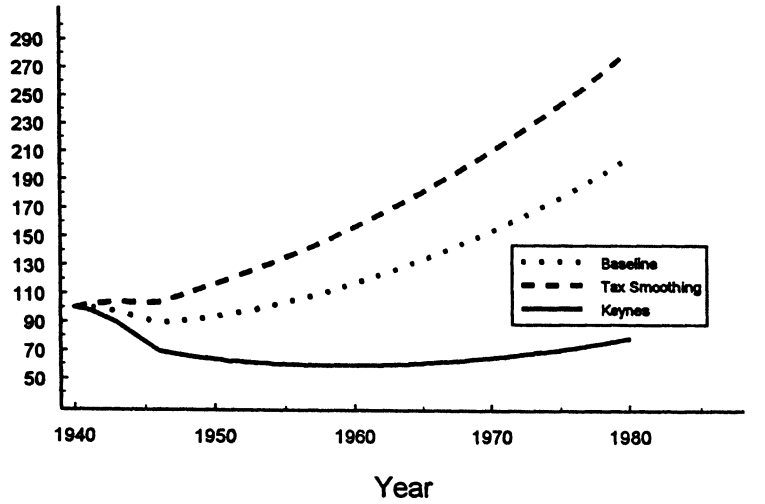

FIG. 13.—Capital stock under alternative policies

the tax-smoothing policy, consumption relative to output would have fallen more during the war but would have recovered to its steady-state level immediately following the war, without the big postwar surge and subsequent decline that are observed in the U.K. data. The most telling effect of this policy is seen in figure 12. With the tax-smoothing fiscal policy, investment would have fallen much less during the war and recovered and settled down to its steady-state value very quickly, much as it did in the United States.

The policy experiment labeled "Keynes" represents our attempt to capture the full extent of Keynes's recommendations. It is represented by the solid line. The Keynesian policy presented here taxes labor income more heavily (as deferred pay) from 1940 to 1945 and also adopts the postwar capital levy described above. Under the Keynesian policy, consumption relative to output would have fallen less during the war, increased much more in the immediate postwar period, and gradually declined. The Keynesian policy has a much more dramatic effect on investment: investment falls considerably during the war and is much slower to recover because of the anticipated postwar capital levy to finance the repayment of deferred pay.

Figure 13 shows the effect of these policies on the capital stock and shows that capital accumulation under the baseline policy is much less than under the tax-smoothing policy. The full Keynesian policy, however, would be very costly. The basic mechanism generating these results is straightforward. With the tax-smoothing policy,

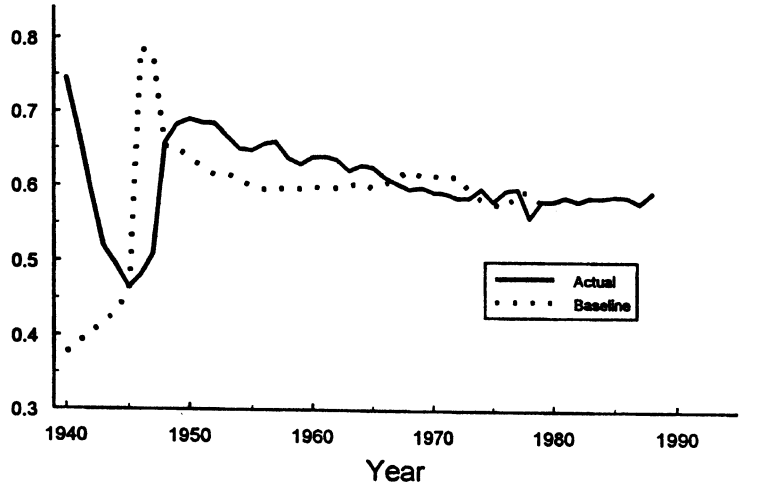

FIG. 14.—U.K. consumption/output: exogenous growth

investment recovers quickly, which results in faster growth in the capital stock and output. With the more distorting baseline and Keynesian policies, investment recovers very slowly as a result of higher taxation of capital income and, in the case of the full Keynesian policy, the capital levy. With the full Keynesian policy the capital stock does not recover to its prewar level until after 1980.

Our findings for the exogenous one-sector model are summarized in figures 14 and 15. Our discussion parallels the discussion of the findings for the endogenous growth model, but to conserve space we do not present figures for the simulation of the counterfactual policies. Unlike the findings of the endogenous growth model, the predictions of the exogenous growth model under the *baseline policy* are not as consistent with U.K. observations. Figure 14 presents the consumption/output ratio for the period 1940–80, as it is in the data and as predicted by the baseline policy for the one-sector exogenous model. With the historical tax rates, the behavior of the consumption/output ratio in this model economy differs from that in the data during the war and in the early postwar period. For example, consumption falls dramatically at the beginning of the war to less than 40 percent of output. This is followed by a sharp increase to nearly 80 percent of output. This rise is followed by a decline to about 65 percent of output and finally decreases fairly quickly to the steady-state ratio of about .6. Figure 15 presents the investment/output ratio for the period 1940–80 for the data and for this model

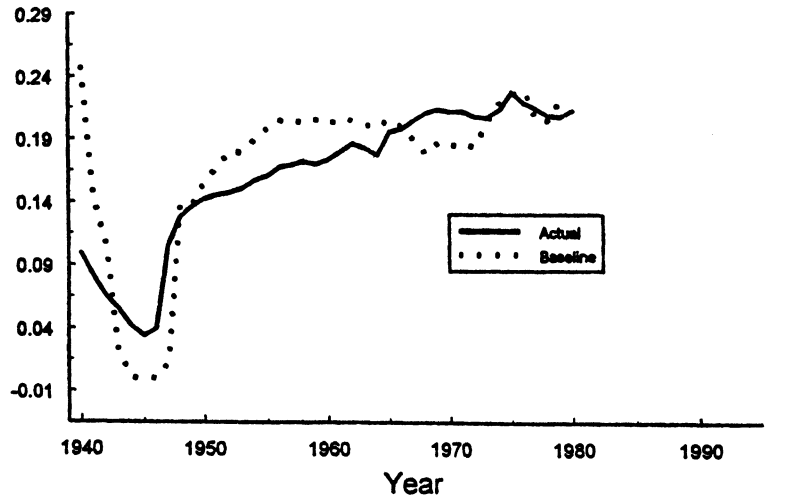

FIG. 15.—U.K. total investment/output: exogenous growth

under the baseline policy. The actual data pertain to total (private plus public) domestic fixed investment. The investment/output ratio predicted by the model at the beginning of the war is much higher than that shown by the data; it then declines substantially so that gross investment is zero at the end of the war. (The constraint that investment cannot be negative becomes binding.) After the war, investment to output rises slightly above zero, followed by an immediate increase to about 15 percent and then a fairly rapid increase to near the steady-state ratio.

The one-sector neoclassical model implies responses to the counterfactual policies that are qualitatively similar to those presented for the two-sector model. With a tax-smoothing policy, consumption relative to output would have fallen even more during the war and would have recovered to its steady-state level fairly quickly following the war. Investment would have been nearly 30 percent of output at the start of the war and would have declined to zero by the end of the war. In the postwar period, a fairly quick and smooth transition occurs.

Under the full Keynesian policy, the behavior of consumption relative to output is similar to that under the baseline policy during the war. After the war, it remains at about 75 percent of output until the early 1950s. Of course, this behavior implies that investment is very low under the Keynesian policy; gross investment would have been zero for eight years.

Welfare Costs

The welfare implications of these alternative tax policies are very different. To measure the welfare costs of the policies, we compute the increment to consumption that would equate utility under each of the different policies. That is, for both model economies, we compute the increment x^i (for policy i) in the expression

$$U^i = \sum_{t=0}^{T} \beta^t \{\log[c_t^i(1 + x^i)] + \gamma \log(1 - n_t^i - a_t)\} = U^*, \quad (36)$$

where U^* is the utility of the tax-smoothing policy, and $T = 500$. In the endogenous growth model, consumption must increase 2.9 percent ($x^i = .029$) under the baseline policy to equalize lifetime utility. In the full Keynesian policy, the increment is equal to 13.2 percent. In the exogenous growth model, the increase in consumption for the baseline policy is 1.8 percent, and for the full Keynesian policy, it is 7.2 percent. These welfare costs are substantial.

It is interesting to point out that the substantial welfare gains from following a tax-smoothing policy occur *despite* the fact that the very early taxation of capital income under the baseline and full Keynesian policies during the war may have been efficient. Under the assumption that capital is inelastically supplied at any single point in time, immediate taxation of capital is equivalent to a lump-sum tax.[17] Perhaps this explains why labor unions enthusiastically supported an immediate capital levy in 1940.

VII. Conclusions

The public finance shock associated with World War II was enormous in the United Kingdom and the United States. The war placed incredible demands on both economies. Rather than follow their 200-year-old policy of tax smoothing, the United Kingdom, following recommendations of John Maynard Keynes, adopted fiscal policies to finance these expenditures that were substantial departures from the standard practice. Moreover, the policies put in place during World War II influenced policies for much of the postwar period. We find that our simple endogenous growth model can account for the relative movements in consumption, investment, and output over the 1940–80 period when driven by the taxes on factor incomes that formed the backbone of Britain's wartime finance. Our analysis of alternative counterfactual wartime fiscal policies suggests that

[17] Chari, Christiano, and Kehoe (1994) discuss this point and also describe how optimal taxation of capital income can be structured in a stochastic world.

Britain suffered more than was necessary because of the war. Tax-smoothing policies, similar to those used to finance earlier British conflicts, would have had much lower welfare costs and promoted a much faster adjustment in the postwar period. Our analysis of the complete set of policies proposed by Keynes, including a preannounced capital levy, suggests that they would have been extremely costly.

We also conducted our analysis using the one-sector exogenous growth model. In contrast to the endogenous growth model economy, we find that the predictions of this model under historical tax rates over the 1940–80 period are not as consistent with U.K. observations. The welfare implications of alternative policies under the exogenous growth model, however, are qualitatively similar to those found using the endogenous growth model: the welfare benefits of following a tax-smoothing policy relative to either the historical policy or the full Keynesian policy would have been substantial.

During the early stages of discussion of his views on fiscal policy with the Treasury, Keynes was disappointed with the Treasury's initial reaction and remarked that "progress has not been made with a few politicians who have not been prepared for anything new" (Moggridge 1992, p. 633). Our study of this fiscal episode suggests that if it were not for these few politicians wary of Keynes's recommendations on how to finance the war and conduct postwar policy, U.K. living standards today might be significantly lower than they actually are.

There may be alternative models that can be used to understand the U.K. experience over this period in which the policies recommended by Keynes, and adopted by the British government, lead to better outcomes. We leave these analyses to future research.

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