

# Macroeconomic Effects of Tax Reform in the United States

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*The provisions of the U.S. Tax Reform Act of 1986 (TRA) have potential effects on labor supply, household consumption and saving, and business fixed investment. The literature on the possible effects of tax reform is surveyed, and a model of U.S. business fixed investment is developed and estimated. The major explanatory influences are real gross national product and the cost of capital, with the latter related to interest rates, inflation, and tax variables. The model is used to provide estimates of the possible effects on business fixed investment of the taxation changes introduced with the TRA.*

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ON SEPTEMBER 27, 1986, the U.S. Congress passed the Tax Reform Act, and on October 22 the President signed the Act into law. The Tax Reform Act of 1986 (TRA) made sweeping changes in the structure of the U.S. tax system, by curbing tax preferences and by using the room thus created to lower marginal tax rates. In this way, it was hoped, incentives to work, save, and invest would be enhanced, and economic performance would be improved. In addition, the elimination of many tax preferences was expected to help equalize the tax treatment of different investments, thus raising the efficiency of investment. The TRA was designed to be neutral in its overall effect on revenue over the period 1987–91, but it would significantly alter the distribution of the tax burden: the tax burden on corporations would increase by US\$120 billion

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over the five-year period, whereas the personal tax burden would decline correspondingly. Receipts were increased substantially in fiscal year 1987 but are expected to be lower than otherwise in fiscal years 1989–91.

The TRA is the most far-reaching revision in the history of U.S. tax law. On the side of personal taxes, the top individual tax rate for 1988—in which year the rate reduction will be fully phased in—will be at its lowest point since 1931, and personal income tax rates will no longer show a steep progression. On the side of business taxation, statutory tax rates are also lowered substantially. Nevertheless, the effective corporate tax burden is increased by repealing or limiting many tax credits or deductions in a way that will more than offset the revenue effect of the reduction in statutory corporate tax rates.

This paper attempts to assess the likely long-term effects of this tax reform, albeit in a necessarily preliminary and tentative way. Section I outlines the major changes implemented by the TRA, followed in Section II by a survey of the literature on the impact of tax reform. Section III presents the results of some empirical work assessing the possible effects of tax reform on business investment. Section IV provides some conclusions.

## I. The Tax Reform Act of 1986

This section of the paper outlines the principal changes to the structure of personal and corporate taxation made under the TRA.

### Changes in the Structure of Personal Income Taxation

The previous tax structure comprised 14 personal income brackets (15 for single taxpayers), with statutory tax rates ranging from 11 percent to 50 percent.<sup>1</sup> The TRA replaced that structure with a two-bracket system, with tax rates of 15 percent and 28 percent effective January 1988 (see Table 1); in 1987, the transitional year, there was a five-bracket system, with rates ranging from 11.0 percent to 38.5 percent.

With regard to *major deductions and exemptions*, the personal exemption was increased from \$1,080 in 1986 to \$2,000 in 1989, and the zero-bracket amount, which was previously built into tax schedules, was replaced with a standard deduction effective in 1987; this standard de-

<sup>1</sup> The peak marginal tax rate had been reduced from 70 percent to 50 percent in the Economic Recovery and Tax Act of 1981.

Table 1. *New U.S. Statutory Marginal Tax Rates for Individuals, by Income Class*

Marginal Tax Rate (In percent)	Income in U.S. dollars	
	Single taxpayer	Married filing jointly (two children)
15	0–17,850	0–29,750
28	17,851 +	29,751 +

Source: Wakefield (1987).

Note: For high-income individuals, the benefits of the 15 percent bracket are gradually reduced over a certain income range, and the personal exemption is phased out in a similar way; this creates a yearly effective marginal tax rate of 33 percent in the \$43,151–\$100,480 income range for single taxpayers and in the \$71,901–\$192,930 income range for married taxpayers.

duction rises from \$3,760 in 1987 to \$5,000 in 1988 for joint returns. Both the standard deduction and the personal exemption will be adjusted for inflation. The special deduction for married couples, both of whom are employed, was repealed along with the income-averaging provision.

The TRA also curbed certain *tax preferences*. In the area of individual retirement accounts, the TRA retained the previous deductibility for contributions to such accounts only for taxpayers not covered by an employer-provided pension plan and for those persons below certain income thresholds. The deduction for consumer interest expenses—chiefly on credit card debt, car loans, and other nonresidential consumer loans—is to be phased out over five years. Interest on second mortgages is made deductible on an unlimited basis only for those mortgages used to finance home improvements, medical expenses, or educational expenses.<sup>2</sup> Preferential treatment for *capital gains* was also eliminated by the TRA. Under the tax reform legislation, capital gains are to be taxed at the same rates as ordinary income effective from 1987, except that the maximum rate was capped at 28 percent in 1987.<sup>3</sup> The base to which capital gains tax is applied continues to be nominal capital gains, without inflation adjustment, which implies that the effective tax rate on real capital gains could rise sharply—as it did in the 1970s—if inflation were to increase significantly.

With regard to *tax shelters and real estate*, the TRA created a new income category, “passive income,” from which losses are not, in gen-

<sup>2</sup> For interest to be deductible, loans for other purposes cannot exceed the homeowner's cash equity.

<sup>3</sup> Under previous law, only 40 percent of long-term capital gains was subject to tax, which thus set the top effective rate at 20 percent.

eral, deductible against other income. Passive income is defined as income generated from business activities or rental real estate in which the taxpayer does not materially or actively participate. Under previous law, high-income taxpayers could invest in deliberately unprofitable real estate investments; use the losses to offset wage, salary, and other investment income; and, thus, reduce tax liabilities.

The impact of the TRA on the distribution of income is difficult to assess. The increases in the personal exemption and in the standard deduction, together with other elements of the reform, boost the amount of income that a family of four can receive before having to pay personal tax—from \$9,574 in 1986 to \$14,480 in 1988. The result is that the number of poor families required to pay federal income tax is estimated to fall by 4.3 million in 1988 under the TRA. Although the TRA substantially reduces the degree of progressivity of statutory tax rates, the impact on effective tax rates across income classes is likely to be much less pronounced because before the reform many high-income earners were avoiding taxation by using tax preferences that have now been removed. According to calculations made by the President's Council of Economic Advisers (United States (1987, p. 85)), the effective average federal tax rate on those with incomes less than \$10,000 should fall from 2.0 percent before reform to 0.9 percent under the TRA, whereas for those with incomes over \$200,000 the corresponding effective personal tax rate would fall from 13.6 percent to 13.4 percent.

A complete discussion of the effect of the TRA on income distribution would also require analysis of the effects of changes in corporate taxation, given assumptions about the incidence of that taxation. Such an effort is beyond the scope of the present paper. It seems likely, however, that a proper imputation of corporate taxes would suggest that the TRA is relatively less favorable to high-income earners than analysis based solely on personal tax liabilities would indicate—given the rise in the corporate tax burden under the TRA and the plausible assumption that high-income earners bear a relatively large share of the burden of corporate taxation.

### Changes in Corporate Income Taxation

As shown in Table 2, the TRA revised the basic tax rate structure for corporations by replacing the previous system of five brackets (from 15 percent to 46 percent) with a system of three brackets (from 15 percent to 34 percent).

The largest effective increase in corporate taxes under the TRA results from repeal of the investment tax credit and a modification of the accelerated cost recovery system (ACRS) of depreciation. The 10 percent

Table 2. *U.S. Statutory Changes in Corporate Tax Rate Structure, by Income Bracket*

Taxable Income (In U.S. dollars)	Corporate Tax Rates* (In percent)	
	Previous law	Tax Reform Act of 1986
0-25,000	15	15
25,000-50,000	18	15
50,000-75,000	30	25
75,000-100,000	40	34
100,000+	46	34

Source: Wakefield (1987).

\*A 39 percent rate is implicitly created in 1988 by the use of a 5 percent surcharge for incomes above certain levels.

investment tax credit (6 percent for some short-lived assets) was repealed, effective January 1, 1986. The modification of ACRS lengthened the periods over which assets could be depreciated for tax purposes and, at the same time, changed the depreciation formulas to a 200 percent declining balance (previously 150 percent) for most machinery and equipment and to a straight-line formula (previously 175 percent declining balance) for the bulk of nonresidential structures.<sup>4</sup> The TRA also made a variety of specific changes (see Wakefield (1987)) including, among other provisions, a revision of the corporate minimum tax to make it more difficult for large and profitable businesses to escape or pay very low taxes, and the cessation of the so-called general utilities rule.<sup>5</sup>

## II. A Survey of the Literature on the Implications of the Tax Reform Act of 1986

The macroeconomic consequences of tax reform in the United States involve effects on both supply and demand. At the risk of oversimplification, it is assumed in the bulk of this paper that deviations from the

<sup>4</sup>Under the new ACRS rules, most types of manufacturing equipment are depreciated over seven years, compared with five years under previous law. Some longer-lived types of equipment are depreciated over ten years (five years previously). Cars and light trucks are depreciated over five years (three years previously). Nonresidential real property is to be depreciated over a 31.5-year period (19.0 years previously), whereas residential rental property is depreciated over 27.5 years (19.0 years previously).

<sup>5</sup>This legal doctrine had generated a substantial tax incentive for corporate mergers and acquisitions. Under the rule, these activities provided a mechanism for liquidating appreciated assets without paying taxes on the gains; the repeal of the general utilities rule took effect at the end of 1986 and may help to explain the surge in mergers and acquisitions in the second half of 1986. A detailed discussion is provided in Steindel (1986).

so-called natural rate of unemployment in the U.S. economy are likely to be reversed eventually, with the result that the demand effects of tax reform should be temporary. The permanent effects would be those leading to enduring influence on the supplies of factors of production, the productivity with which these factors are employed, and the extent to which production and investment are financed by domestic saving. Thus the emphasis is on the supply-side effects of tax reform. In addition, discussion of the impact of tax reform on the real estate sector is provided, and a review is made of available large-scale macroeconomic studies of the effects of tax reform that incorporate both supply and demand effects.

At the outset, one must recognize that the TRA could well have additional macroeconomic implications that are not adequately captured in the essentially partial equilibrium framework employed in this paper and in most other studies. For instance, if the TRA causes a significant reduction in the before-tax rate of interest, as argued by many (discussed below), the consequent narrowing in differentials between U.S. and foreign interest rates (relative to what otherwise would have been) would imply a lower exchange value for the U.S. dollar and, presumably, higher output and profitability in the traded-goods sector. Quantification of such an effect is beyond the scope of the present paper.<sup>6</sup>

Before proceeding further, two preliminary issues need to be addressed, the first of which is the size of the effect of the TRA on marginal tax rates faced by households. According to estimates prepared by the U.S. Treasury Department, the TRA should have a substantial impact on the marginal personal income tax rates faced by the bulk of taxpayers, as illustrated in Table 3. From 1986 to 1988, the Treasury figures show a 7 percentage point reduction in the marginal tax rate faced by a four-person family with median income, a 1 percentage point marginal tax rate rise for a family with half the median income, and a 10 percentage point tax rate reduction for a family with twice the median income.

Calculations based on the TAXSIM model of the National Bureau of Economic Research broadly support the Treasury's estimates of the effect on marginal tax rates.<sup>7</sup> The TAXSIM estimates suggest that, as a result of tax reform, 11 percent of taxpayers will experience a marginal tax rate reduction of 10 percentage points or more, whereas for 48

<sup>6</sup> For a discussion of the importance of the links between tax policy, international capital mobility, and competitiveness, see Summers (1986).

<sup>7</sup> The TAXSIM model computes marginal tax rates and tax payments for a synthetic 1988 population of over 30,000 taxpayers; see Hausman and Poterba (1987).

Table 3. *U.S. Marginal Tax Rates for a Four-Person Family*  
(In percent)

Year	Income Half of Median	Income at Median	Income Twice Median
1960	20.0	20.0	22.0
1970	15.0	19.5	25.6
1980	18.0	24.0	43.0
1985	14.0	22.0	38.0
1986	14.0	22.0	38.0
1988	15.0	15.0	28.0

Source: United States (1987) and data compiled by the U.S. Treasury.

Note: The family is assumed to be at the same relative position in the income distribution at each point of time. All income is assumed to be earned by one spouse.

percent the marginal tax rate will fall by less than 10 percentage points; 14 percent of taxpayers will experience no change in the tax rate. According to these calculations, 23 percent of the taxpayers would see their marginal tax rates rise by less than 10 percentage points, whereas 4 percent would experience a rise of more than 10 percentage points.

The second preliminary issue is the possible impact of tax reform on interest rates. Analysis of the effects of tax changes has often proceeded on the assumption that before-tax interest rates would remain unaffected. It has been widely argued, however, that the TRA would reduce interest rates below what they otherwise would have been, although estimates of the magnitude of the effect vary significantly. According to proponents of this view, the TRA cuts marginal tax rates on personal and corporate income sharply, so that the after-tax rate of return and the after-tax borrowing cost associated with a given before-tax interest rate are increased. The effects can be visualized as a leftward shift of a conventional IS curve, with the vertical axis assumed to represent before-tax interest rates. At the same time, for a given before-tax rate of interest, the fall in marginal tax rates implies a rise in the opportunity cost of holding money, which should imply a rightward shift of a conventional LM curve. Consequently, the effect of the TRA is unambiguously to reduce interest rates.

As to the magnitude of this effect, Prakken (1986) suggested that the TRA may induce a decline in before-tax rates of interest of 1.3 percentage points, whereas Hendershott, Follain, and Ling (1987) suggested a figure of 1 percentage point. Hausman and Poterba (1987) have argued that such estimates were made in a closed-economy framework, and that about half of the fall in interest rates is likely to be offset by an

induced reduction in private capital inflows; thus the effect on before-tax interest rates would be a reduction of  $\frac{1}{2}$  to  $\frac{3}{4}$  percentage point.

### Effect on Labor Supply

Economic theory is agnostic about the sign of the effect of a reduction in marginal tax rates on labor supply because the income and substitution effects work in opposite directions. The bulk of the empirical work on labor supply in the United States (surveyed in Bosworth (1984)) suggests that the labor supply decision of prime-age male workers is only slightly sensitive to changes in the marginal tax rate. By contrast, the labor supply decision of prime-age females—who frequently act as secondary workers, moving in and out of the work force from time to time—has typically been found to be quite sensitive to changes in after-tax wage rates and, thus, to changes in tax rates.

According to the recent *Annual Report* of the Council of Economic Advisers (United States (1987)), the TRA is likely to increase the supply of labor by 3 percent in the long run. This result in turn is the main element behind the Council's estimate that the likely total long-run effect of tax reform is to raise output by 2 percent. The labor supply effect of the TRA suggested by the Council derives from an unpublished research study (cited in its 1987 *Annual Report*) in which a long-run closed-economy growth model is solved numerically under assumptions for various parameters that are considered plausible.<sup>8</sup> Because the basis of the analysis is a theoretical model with assumed parameters, there is no guarantee that the model is capable of reproducing the patterns found in historical data. Another difficulty is that the results may not be robust with regard to variations in the underlying parameter assumptions over a reasonable range.<sup>9</sup>

An alternative estimate of the labor supply effect of tax reform is provided in Hausman and Poterba (1987), based on econometric work in Hausman (1981). For the average prime-age male, the authors estimate that labor supply would rise by 0.9 percent in the long run, whereas for secondary workers labor supply would rise by 2.6 percent. The long-run labor supply effect of the TRA implied by these figures is an increase of roughly 1.5 percent, approximately equivalent to a 1 percent rise in

<sup>8</sup>The Council's *Annual Report* (United States (1987)) notes that the model is adapted from Summers (1981), extended to allow for endogenous labor supply and an unfunded social security system.

<sup>9</sup>The results of the Summers model, of which the Council's model is an extension, have been shown to vary considerably depending on the parametric assumptions; see Evans (1983).



output, other things being equal. It may be noted that the Hausman-Poterba estimates are based on labor supply sensitivities that are in general larger than those found elsewhere in the literature.

### Effect on Saving

The overall impact of the TRA on national saving depends on the legislation's effects on household, corporate, and public sector saving. Since the TRA is supposed to be revenue neutral at the federal level, the effect on federal government saving should be small.<sup>10</sup> With regard to private saving, because the TRA shifts the tax burden away from households toward businesses, and because the average propensity to save for businesses appears to be higher than that for households, tax reform could well have a negative effect on private saving, although the magnitude of this effect is difficult to quantify.<sup>11</sup> To the extent that individuals see through the "corporate veil," such a shifting of private sector income would have little effect on private saving.

The sign and size of the effect of after-tax interest rates on household and private saving remains a subject of controversy (Evans (1983)). Economic theory gives no clear indication about the sign of the effect because the income and substitution effects work in opposite directions. The empirical literature is also inconclusive, with some studies finding no effect on saving from after-tax interest rates, and others finding substantial and significant effects.<sup>12</sup> According to the Council of Economic Advisers' 1987 *Annual Report* (United States (1987)), the overall effect of the TRA is to reduce the supply of private saving slightly because of an increase in the effective tax rate on income from capital.

In the first three quarters of 1987—after the implementation of tax reform—gross private saving fell to 14¾ percent of gross national product (GNP), down from 16 percent in 1986, with corporate saving equivalent to 12½ percent (13½ percent in 1986) and household saving to 2½ percent (2¾ percent in 1986). Historically, gross private saving has been

<sup>10</sup>The TRA generates a revenue bonus for state and local governments by broadening the tax base, so that the effect on the state and local government surpluses could be positive; the magnitude of any such effect would depend on the extent to which state and local governments take offsetting action by raising spending or lowering tax rates.

<sup>11</sup>In 1986, gross private saving amounted to 16.1 percent of gross national product (GNP), of which 2.7 percent was household saving and 13.4 percent was business saving.

<sup>12</sup>The paper by Boskin (1978) is typically cited in favor of the existence of a positive interest elasticity of household saving, whereas that by Friend and Hasbrouck (1983) is frequently cited against that proposition.

relatively stable relative to GNP. Thus the preliminary evidence suggests that tax reform could well have contributed to a decline—substantial by historical standards—in the private saving rate.

### Effect on Business Investment

The standard framework for analyzing the effects of taxation and interest rates on business fixed investment views business investment as determined by a scale variable (output or demand) and by the user cost of capital.<sup>13</sup> The Council of Economic Advisers' 1987 *Annual Report* (United States (1987)) finds that the TRA raises the cost of capital by 62 percent for machinery and equipment investment and by 17 percent for investment in nonresidential structures.<sup>14</sup> According to the Council's *Annual Report*, the long-run effect of this rise in the cost of capital is likely to be a decline in the net capital stock of 0.4 percent. If the adjustment to the new capital stock were completed in five years, business investment during the five-year transitional period would be 2 percent lower, on average, than it otherwise would have been.

Another possible avenue through which tax reform could influence output is through the efficiency, rather than the magnitude, of investment. By reducing or eliminating a large number of tax preferences, the TRA sought to "level the playing field"—that is, to ensure that different investment projects would be taxed similarly, so that investment choices could be made on the basis of economic, rather than tax, considerations. Steuerle (1987), a major contributor to the design of the tax reform, suggested that one of the major benefits from tax reform was the move toward more neutral taxation of real and financial investment, a shift that would remove the rationale for many socially wasteful tax arbitrage transactions and would permit alternative investments to be assessed with less attention to tax consequences. The magnitude of the effect is of course difficult to assess. According to the Council's 1987 *Annual Report*, the investment-efficiency effect of the TRA would likely raise

<sup>13</sup>The classic reference is Hall and Jorgenson (1967). A large volume of subsequent work discusses the impact of earlier tax policy changes on U.S. business investment; see, for example, Cohen and Clark (1984) and Brayton and Clark (1985).

<sup>14</sup>The Council's 1987 *Annual Report* cites two sets of figures, depending on which view is taken on a controversy about the relative importance of taxes on dividends and capital gains for determining the cost of equity capital. The figures cited above are those calculated under the presumption that taxes on capital gains are very important, whereas taxes on dividends are nearly irrelevant.

output by 0.1 percent in the long run, an amount that would roughly offset the effects of the rise in the cost of capital.<sup>15</sup>

In contrast with these results, the paper by Prakken (1986), based on simulations with the Washington University Macro Model (WUMM), found that—even after allowing for a significant induced decline in interest rates—the TRA was likely to have a large long-run negative effect on investment and the capital stock. Specifically, by 1995 the business capital stock was estimated to fall by 8¾ percent, and GNP by 2½ percent, relative to the baseline. The sharp difference between these results and those of the Council reflects in part differences in assumptions about production technology. The WUMM study is based on a Cobb-Douglas production function, and thus assumes unitary elasticity of substitution between capital and labor; as a result, the long-run capital stock is relatively sensitive to changes in the cost of capital. The Council's unpublished report (cited in its 1987 *Annual Report*), in contrast, assumed a technology in which the elasticity of substitution in production is less than unity.

A recent paper by Fazzari (1987) supports a middle view of the impact of TRA on business fixed investment. He found that the impact on the desired capital stock could vary substantially, depending on the assumed value for the elasticity of substitution in production and on the magnitude of the induced decline in interest rates. For a reasonable middle-ground case, his results indicate a 5 percent reduction in the desired stock of equipment and a ½ percent increase in the desired stock of structures.<sup>16</sup>

### Effect on Real Estate

As noted earlier, the TRA contains a variety of provisions that reduce the tax advantages of investment in real estate. With regard to personal taxation, the reduction of statutory tax rates lowers both the average and marginal tax rates at which households can deduct mortgage interest; at unchanged before-tax interest rates, this implies a significant decline in the attractiveness of investment in real estate versus investment in other assets. Moreover, the attractiveness of investment in rental real estate by

<sup>15</sup>Summers (1987) argues that leveling the playing field is an issue of little economic importance, and that even if all nonneutralities were eliminated—which the TRA does not achieve—the gains would total about 0.3 percent of GNP.

<sup>16</sup>For elasticities of substitution in production of 0.55 for equipment and 0.16 for structures, and for an induced interest rate decline of 0.8 percentage point.

households is likely to be substantially reduced as a result of the lengthened depreciation schedules and the new “passive” loss limitations (discussed in Section I).

According to Hendershott, Follain, and Ling (1987), the negative effect of the TRA on overall real estate activity is not likely to be substantial because of the offsetting effect from the induced reduction in interest rates—taken to be 1 percentage point. They suggest that the adverse effect of the TRA on regular rental and commercial activity in real estate will be slight, whereas that on historic and old rehabilitation activity will be large. In contrast, they suggest that owner-occupied housing is favorably affected because the induced decline in interest rates will more than offset the withdrawal of tax benefits. As noted above, the interest rate decline of 1 percentage point assumed by Hendershott and his coauthors may be on the high side. If an induced interest rate reduction of between  $\frac{1}{2}$  and 1 percentage point is assumed instead, the effect of the TRA on overall real estate activity would be negative. The adverse impact would perhaps be small for owner-occupied housing, but it would be noticeable for investment in rental housing. Under any interest rate assumption, the new “passive” loss limitations are likely to lower significantly the value of recent loss-motivated real estate partnership deals.

### Full-Model Simulations of the Effects of Tax Reform

In the bulk of this paper, the focus is on the supply-side effects of tax reform, through labor supply, saving, and investment. In this section, by contrast, the results of three large-scale model simulations of the impact of the TRA on the U.S. economy are reviewed; such approaches integrate both the demand and supply effects of tax reform. The studies were performed using the macroeconomic models of the U.S. economy developed by Data Resources Incorporated (DRI), Wharton Econometrics (WEFA), and Washington University (WUMM).

The DRI analysis (Brinner and Abraham (1986)) outlines effects that are qualitatively similar to those discussed earlier in this paper. Labor supply would be likely to rise, and business fixed investment to fall, as a result of the TRA, whereas private saving could be reduced substantially below what it otherwise would have been because of the redistribution of private sector income away from businesses and toward households.<sup>17</sup> Before-tax nominal interest rates would be reduced, generating

<sup>17</sup>The comparisons discussed in this section are relative to a baseline that assumes no tax reform.

a reduction in the value of the U.S. dollar, whereas after-tax interest rates would be increased because of the diminished supply of private saving. By 1991, the DRI analysis envisages an increase in labor supply of almost 1 percent, whereas the stock of business capital would be reduced by  $2\frac{3}{4}$  percent, leading to a reduction in real GNP (relative to the no-reform baseline) of  $\frac{1}{4}$  percent by 1991.

The WEFA study (Behravesch (1986)) is based on the version of tax reform initially passed by the U.S. House of Representatives in 1986; this bill was broadly similar to the final legislation, although it differed in some details. In the WEFA simulations, which terminate in 1995, tax reform is likely to raise the labor force only negligibly, whereas business investment would be reduced by  $2\frac{3}{4}$  percent, close to the DRI estimate. Because the positive effect on labor supply is so small, the estimated decline in real GNP—relative to baseline—by the end of the simulation horizon is  $\frac{1}{2}$  percent, slightly more than the figure calculated by DRI.

Simulations with the Washington University macro model (Prakken (1986)) also indicate negative output effects of the TRA over the medium term.<sup>18</sup> By 1995, business fixed investment would be reduced by 13 percent relative to a no-reform baseline, whereas real GNP would be lower by  $2\frac{1}{2}$  percent. The extent of the effect on labor supply is not specifically indicated. In discussion of the WUMM results, Prakken has noted that a simulation period extending to 1995 does not capture long-run results fully when fundamental changes in tax policy are being considered. He also noted that the critical parameter for determining the long-run effects of tax reform on output is the responsiveness of labor supply to after-tax wages—a subject of considerable professional controversy—and suggested that the long-run effect of the TRA might well be to raise real GNP, notwithstanding the WUMM simulation results.

In sum, the three macroeconomic simulation studies reviewed here all indicate that the TRA might have a negative effect on real output in the United States over the medium term because the impact of the reduction in the capital stock induced by an increased cost of capital would more than offset the increase in aggregate labor supply that would be generated by increased after-tax wages. These results are only suggestive, however, because the shortness of the simulation horizons—to 1991 in one case, and to 1995 in the two others—may have precluded a full assessment of long-run effects. In addition, some of the channels of influence through which tax reform might work—such as the impact on

<sup>18</sup> As with the WEFA simulations, the WUMM results were based on a version of tax reform that, although qualitatively similar to the legislation finally enacted, was different in some details.

labor supply—may not be well captured in some of the models under review.

### III. An Empirical Analysis of the Tax Reform Act of 1986

This section presents the results of empirical work on the impact of the TRA on business fixed investment.<sup>19</sup> The equations are based on the neoclassical theory of capital accumulation, according to which the optimal combination of factor inputs used by firms depends on the relative factor prices.

The analysis assumes that the structure of the estimated equations is invariant to fundamental changes in government policy and, thus, is subject to the Lucas critique.<sup>20</sup> The impact of the Lucas critique on the investment equations is discussed at some length in Corker, Evans, and Kenward (1988, forthcoming), which concludes—in particular, by relying on standard Chow-Fisher tests of coefficient stability—that the empirical apparatus employed appears to be relatively robust because coefficient instability, which would be likely to be present were that critique a major problem, does not appear to be evident.

Summers (1981) has argued that the magnitude of economic responses to basic changes in the tax system could be substantially greater than indicated by empirically estimated elasticities, since such elasticities summarize economic agents' reactions to relatively small and often temporary movements, not to large enduring changes. There is no easy way to deal with this criticism. By contrast, the initial responses to tax reform may be subdued because—as a result of the frequency of tax changes in recent years—agents may be unsure whether the reform is permanent or temporary.

In the empirical work discussed below, business fixed investment is a function of output and the cost of capital,<sup>21</sup> which in turn is related to interest rates, expected inflation and tax variables.

<sup>19</sup>The empirical results are an extension of earlier, unpublished work by Corker and Kenward that soon will be made available in updated form in Corker, Evans, and Kenward (1988, forthcoming).

<sup>20</sup>Lucas (1976) criticized standard econometric techniques of policy evaluation, arguing that when government policy changed in a significant way private economic behavior would shift, making invalid the assumption of constant economic structure.

<sup>21</sup>The standard framework for the cost of capital used in assessing the impact of taxation on investment assumes that each asset is depreciated for tax purposes only once. To the extent that a secondary market exists for a given asset category, however, it becomes possible for an asset to be depreciated for tax pur-

The formula for the cost of capital is as follows:<sup>22</sup>

$$c = q[i + \delta - p(1 - \tau)](1 - k - uz)/(1 - u),$$

where

- $\tau$  = the maximum tax rate on capital gains
- $k$  = the investment tax credit per dollar of new investment
- $z$  = the present value of depreciation allowances
- $q$  = the price of capital assets relative to the GNP deflator
- $u$  = the maximum marginal corporate tax rate
- $i$  = the average cost of funds, after tax<sup>23</sup>
- $\delta$  = the rate of economic depreciation<sup>24</sup>
- $p$  = the expected rate of inflation.<sup>25</sup>

The equations specify investment as a function of output, the cost of capital, and the stock of capital goods.<sup>26</sup> Separate equations, presented below, were estimated for producers' durable equipment and non-residential structures by ordinary least squares, with a correction for first-order serial correlation, over the period from the first quarter of 1964 to the fourth quarter of 1985. In both cases, all variables were normalized

poses several times. In this way the tax benefits from accelerated depreciation schedules could be much higher than normally indicated, in the case of assets for which a secondary market is well established. This argument would imply that the possible impact of the TRA on investment in business structures may be higher than indicated by a cost of capital calculation because the tax benefits that were removed by the TRA might otherwise have been used several times.

<sup>22</sup>For a derivation and explanation of the formula, see Ott, Ott, and Yoo (1975). A useful guide—in particular, to the calculation of the present value of depreciation allowances—is provided in Hall and Jorgenson (1971).

<sup>23</sup>A weighted average of the interest rate on ten-year BAA-rated corporate bonds, the Standard and Poor's dividend-price ratio for common stocks, and the three-month U.S. Treasury bill rate, which is used as the proxy for the imputed cost of internally generated funds, was used. The weights are the respective proportions of total credit market debt owed by private business, an estimate of total business equity, and corporate cash flow in the sum of these items.

<sup>24</sup>A weighted-average service life was calculated for equipment and for structures, and economic depreciation was taken to be the inverse of the estimated service lives.

<sup>25</sup>From 1979, the ten-year-ahead survey of expected inflation conducted by Drexel Burnham Lambert was used; before 1979, a four-quarter moving average of the University of Michigan's survey of one-year-ahead consumer price expectations was used. Strictly speaking,  $p$  should represent the expected rate of increase of prices of investment goods; the implicit assumption is that this is adequately captured by expectations of general price-level movements.

<sup>26</sup>The specification follows the interpretation by Clark (1979) of Bischoff's (1971) formulation of the neoclassical theory of investment. A more detailed discussion of the specification is provided in Corker, Evans, and Kenward (1988, forthcoming).

with respect to middle expansion path GNP, to reduce heteroscedasticity in the error term. The estimation results are reported below. Investment in machinery and equipment is related to the cost of capital and changes in output with a fourteen-quarter distributed lag, the largest coefficient being in the fifth quarter. Investment in nonresidential structures is related to these variables with a twelve-quarter distributed lag, the largest coefficient being in the eighth quarter.

The equation for producers' durable equipment is

$$IE/Y^* = -10.31(1/Y^*) + \sum_{i=0}^{14} w_i \frac{(Y_{-i} - Y_{-i-1})}{Y_{-i}^* CE_{-i-1}} \quad (1.2)$$

$$+ 0.088KE_{-1}/Y^* - 0.003D \quad (2.2)$$

$$\rho = 0.82, \quad \bar{R}^2 = 0.967, \quad DW = 2.15, \quad (13.0)$$

where

$$w_0 = 0.0066 \quad (4.8)$$

$$w_1 = 0.0096 \quad (8.6)$$

$$w_2 = 0.0118 \quad (10.5)$$

$$w_3 = 0.0132 \quad (11.0)$$

$$w_4 = 0.0139 \quad (11.1)$$

$$w_5 = 0.0140 \quad (11.0)$$

$$w_6 = 0.0136 \quad (10.6)$$

$$w_7 = 0.0127 \quad (10.0)$$

$$w_8 = 0.0115 \quad (8.9)$$

$$w_9 = 0.0100 \quad (7.6)$$

$$w_{10} = 0.0083 \quad (6.3)$$

$$w_{11} = 0.0066 \quad (5.1)$$

$$w_{12} = 0.0047 \quad (4.0)$$

$$w_{13} = 0.0030 \quad (3.2)$$

$$w_{14} = 0.0014 \quad (2.4)$$

$$\Sigma w = 0.1410.$$

The equation for nonresidential structures is

$$IS/Y^* = 23.39(1/Y^*) + \sum_{i=0}^{12} v_i \frac{(Y_{-i} - Y_{-i-1})}{Y_{-i}^* CS_{-i-1}} + 0.0370KS_{-1}/Y^* \quad (4.7)$$

$$\rho = 0.90, \quad \bar{R}^2 = 0.934, \quad DW = 1.30, \quad (19.0)$$

where

$$v_0 = 0.00090 \quad (1.8)$$

$$v_1 = 0.00099 \quad (2.3)$$

$$v_2 = 0.00116 \quad (2.5)$$

$$v_3 = 0.00138 \quad (2.8)$$

$$v_4 = 0.00162 \quad (3.2)$$

$$v_5 = 0.00185 \quad (3.7)$$

$$v_6 = 0.00205 \quad (4.1)$$

$$v_7 = 0.00218 \quad (4.3)$$

$$v_8 = 0.00222 \quad (4.3)$$

$$v_9 = 0.00214 \quad (4.2)$$

$$v_{10} = 0.00190 \quad (4.0)$$

$$v_{11} = 0.00149 \quad (3.8)$$

$$v_{12} = 0.00086 \quad (3.6)$$

$$\Sigma v = 0.02074.$$



Symbols in the equations above are defined as follows:

- $IE$  = investment in producers' durables, in 1982 dollars
- $IS$  = investment in nonresidential structures, in 1982 dollars
- $Y$  = GNP, in 1982 dollars
- $Y^*$  = middle expansion path GNP, in 1982 dollars<sup>27</sup>
- $CE$  = the real cost of capital for producers' durables
- $CS$  = the real cost of capital for nonresidential structures
- $KE$  = the stock of producers' durable equipment, in 1982 dollars<sup>28</sup>
- $KS$  = the stock of nonresidential structures, in 1982 dollars (see footnote 28)
- $D$  = a zero/one dummy to allow for credit controls in the second quarter of 1980
- $w_i, v_i$  = coefficients estimated using third-degree Almon polynomials with a zero end-point constraint
- $\rho$  = the coefficient of serial correlation
- $\bar{R}^2$  = the adjusted coefficient of determination
- DW = the Durbin-Watson statistic.

In addition, the numbers shown in parentheses are  $t$ -statistics.

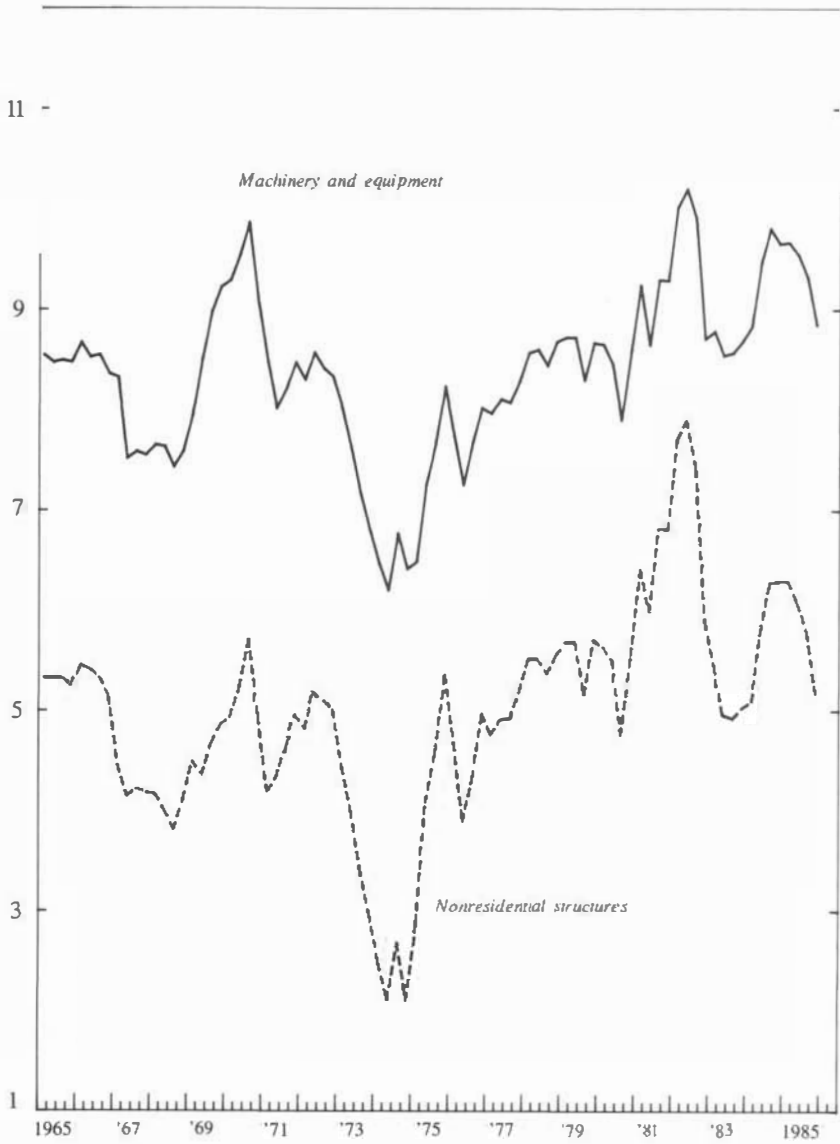
Under the TRA the average depreciation period for machinery and equipment is lengthened and the investment tax credit abolished, both of which would tend to raise the cost of capital and to reduce investment. At the same time, the use of 200 percent declining-balance depreciation—previously 150 percent—is permitted, which would work to lower the cost of capital. With regard to structures, the investment tax credit—relevant for some components of structures—also was abolished, and the tax life for depreciation is now stretched from 19.0 to 31.5 years; both measures would raise the cost of capital. Historical data for the cost of capital are illustrated in Figure 1.

The net effects of these tax changes on the present value of depreciation allowances and the cost of capital are illustrated in Table 4. For machinery and equipment investment, the abolition of the investment tax credit is the most important element, raising the cost of capital by  $\frac{1}{2}$  percentage point, other things being equal. The changes to depreciation formulas for machinery and equipment reduce the present value of depreciation allowances only slightly and correspondingly raise the cost of capital only a little. For nonresidential structures, the most important

<sup>27</sup>This variable was constructed by the Bureau of Economic Analysis, U.S. Commerce Department; see De Leeuw and Holloway (1983) and Holloway, Reeb, and Dunson (1986).

<sup>28</sup>Quarterly observations for the gross capital stocks were constructed by interpolating annual end of year stocks according to the patterns of gross investment throughout the year.

Figure 1. *Real Cost of Capital in the United States*  
(In percent)



Source: Authors' calculations.

Note: Real costs exclude relative price effects.

Table 4. *Effect of Tax Changes on the Cost of Capital in the United States*

Item	Investment Category	
	Machinery and equipment	Nonresidential structures
Base case (old tax law)		
Present value of depreciation	0.91	0.72
Real cost of capital	7.8	3.7
Effect of repeal of investment tax credit		
Present value of depreciation	—	—
Real cost of capital	1.1	0.1
Effect of revised depreciation schedules		
Present value of depreciation	-0.01	-0.17
Real cost of capital	0.1	0.5
New tax law (TRA)		
Present value of depreciation	0.89	0.50
Real cost of capital	9.9	5.3

Source: Authors' calculations.

Note: The depreciation figures represent the discounted present value of a single U.S. dollar of depreciation allowances. The percentage figures for cost of capital are in real terms, excluding the relative price term. The assumed rates of interest and expected rate of inflation are held constant across the various alternatives.

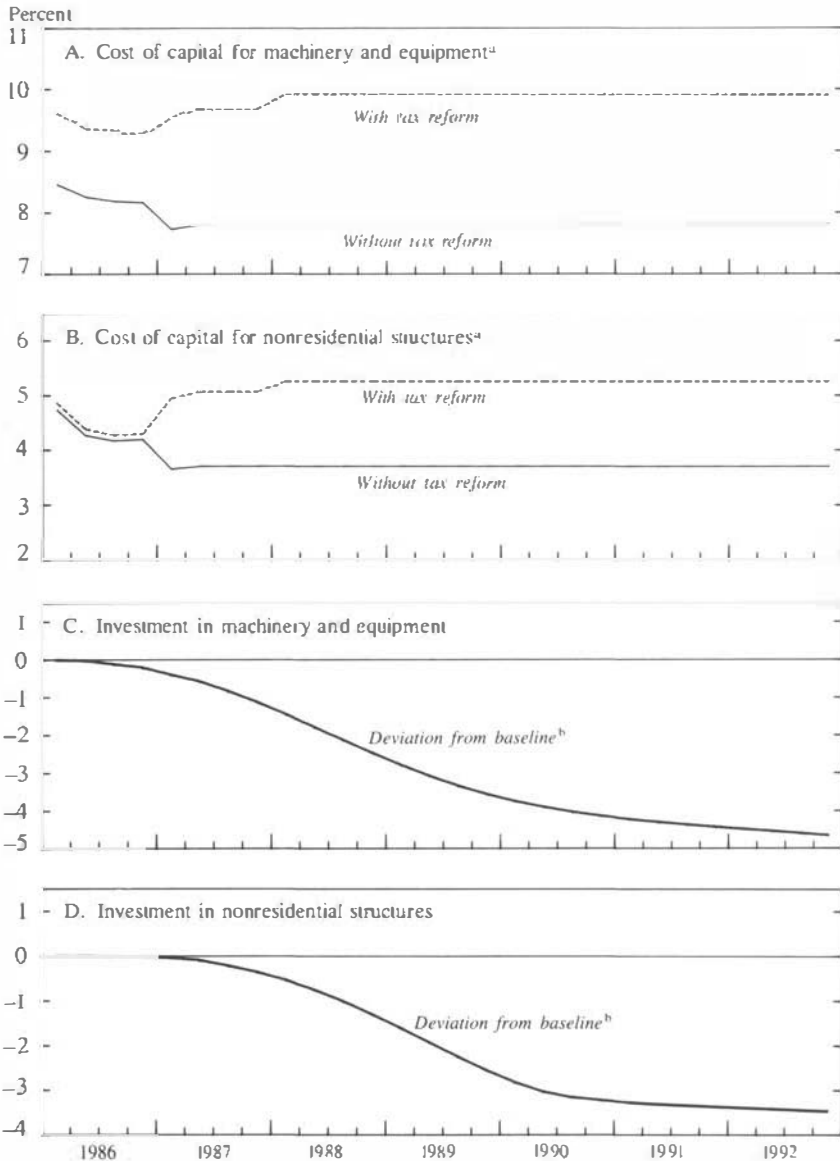
element of the TRA is the changed depreciation rules, which reduce the present value of a dollar of depreciation allowances by 17 cents, thereby raising the cost of capital significantly. Overall, tax reform is estimated to increase the cost of capital for equipment investment by 2 percentage points, or by 27 percent, whereas for nonresidential structures the cost of capital is raised by 1.6 percentage points, or 43 percent, under the assumption of unchanged before-tax interest rates (see panels A and B of Figure 2).<sup>29</sup>

To assess the impact of the TRA on investment and the capital stock, simple simulations were conducted over the period 1986–92<sup>30</sup> using ex-

<sup>29</sup>If tax reform is assumed to have induced a 1 percentage point decline in before-tax nominal interest rates, then the estimated rise in the cost of capital for equipment is reduced to 22 percent and that for structures to 29 percent.

<sup>30</sup>The starting point was set at 1986 because the retroactive repeal of the investment tax credit (to the start of 1986) was broadly anticipated. The terminal point of 1992 was chosen keeping in mind the long distributed lag terms in the investment equations.

Figure 2. Simulations of the Impact of Tax Reform in the United States



Source: Authors' calculations.

<sup>a</sup>In real terms, excluding relative price effects.

<sup>b</sup>The baseline is a simulation assuming no tax reform; the alternative assumes full implementation of tax reform. The model, of course, requires a variety of assumptions, and the results are thus necessarily subject to many uncertainties.

ogenous assumptions for real GNP, inflation, and interest rates that were in line with the medium-term baseline scenario of the Fund's *World Economic Outlook* forecasting exercise that was completed in September 1987 (International Monetary Fund (1987)). According to these simulations, the TRA would lower business investment in machinery and equipment by 4¾ percent by the end of 1992 under the assumption of no induced change in interest rates (panel C of Figure 2); the bulk of the adjustment would take place during 1987–89, when the growth of machinery and equipment investment would be below the baseline by approximately 1 percent annually. By the end of 1992, the TRA would reduce the stock of business machinery and equipment by 1½ percent. Similar simulations for nonresidential structures indicated that the TRA would lead to a 3½ percent reduction in gross investment in nonresidential structures by the end of 1992 (panel D of Figure 2), with the bulk of the adjustment coming in the years 1987–90. By 1992 the stock of nonresidential structures would be reduced by ½ percentage point.

To allow for the effect of a decline in interest rates induced by the TRA (discussed above), simulations were conducted under the assumption of a 0.5 percentage point reduction in interest rates. In this case, gross investment in machinery and equipment would be 4¾ percent lower relative to the baseline by 1992, whereas investment in nonresidential structures would be 2¾ percent below the baseline by 1992. When an induced interest rate reduction of 1 percentage point was allowed for, it was found that machinery and equipment investment would be 3¾ percent below baseline by the end of 1992, whereas investment in nonresidential structures would be 2¾ percent below baseline by that time.

Taken together, the results indicate that tax reform is likely to lower the business capital stock by 1 percent in the long run and to reduce the flow of gross fixed business investment by close to 4¾ percent, under the assumption of no induced reduction in before-tax interest rates—which would be equivalent to a reduction in GNP by roughly ½ percentage point. A 1 percent reduction in the business capital stock in turn would be accompanied by a reduction in long-run output of ¼ percent, under the assumptions of a Cobb-Douglas production function and a capital coefficient of 0.25.

The simulations conducted may provide a useful guide to the order of magnitude of the likely effects of the TRA on investment, but they have little to say on how rapidly these effects would actually manifest themselves, since the estimated lag structures are driven primarily by the accelerator term on real GNP and rather less by the cost of capital. In addition, it is quite likely that, because of announcement effects, tax

reform may have caused a shift in the timing of investment spending from early 1986 into late 1985, and from early 1987 into late 1986, as businesses advanced their plans to take advantage of expiring tax concessions.

#### IV. Conclusions

The Tax Reform Act of 1986 (TRA) lowered marginal tax rates for both the household and business sectors. At the same time, the TRA shifted the tax burden from the household to the business sector. Because the magnitude of the tax changes is relatively large, the assumption that historical response patterns—as summarized in estimated equations—can be extrapolated forward is more open to question than usual. Consequently, the assessment presented here is necessarily tentative.

By reducing the marginal tax rate for households, the TRA will likely encourage new entrants to the work force, probably through a further increase in the labor force participation rate of women. The magnitude of the effect will be dampened by the repeal of the deduction for married couples (both of whom are employed). Estimates vary widely, but a review of current studies suggests a long-run labor supply increase of 1.5 percent and a corresponding output effect of 1 percent. Several other studies, however, are less sanguine about the magnitude of the likely labor supply effect of the tax reform.

Through the abolition of the investment tax credit and the lengthening of depreciation schedules, the TRA will reduce the incentive to invest, both in nonresidential structures and in machinery and equipment. According to the estimates presented in the paper, tax reform would imply a reduction in machinery and equipment investment of  $4\frac{3}{4}$  percent and a decline in investment in nonresidential structures of  $3\frac{1}{2}$  percent by 1992, relative to what otherwise would have been, under the assumption that interest rates do not change. Correspondingly, the stock of machinery and equipment would be  $1\frac{1}{2}$  percent lower, and the stock of nonresidential structures  $\frac{1}{2}$  percentage point lower, by 1992 compared with a no-reform scenario. The overall impact on GNP from these changes in investment would be a decline of roughly half a percentage point. When an induced decline in interest rates of half a percentage point is allowed for, the overall effect of tax reform on investment is smaller. The empirical work did not attempt to assess the quantitative importance of the increased efficiency of investment resulting from “leveling the playing field,” but the President’s Council of Economic Advisers (United States (1987)) has suggested a gain through this channel of 0.1 percent of GNP.

Another effect not directly assessed in the empirical work was the size of the adverse effect on real estate investment—which, however, may be expected to be small in terms of GNP.

In sum, the principal effects of the 1986 U.S. tax reform are likely to be a change in factor proportions, with the labor supply increasing and the business capital stock declining relative to what otherwise would have occurred. According to the estimates presented in the paper, GNP on balance would probably rise a little—by around  $\frac{1}{2}$  percentage point.

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