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Volume Author/Editor: Mervyn A. King and Don Fullerton, eds.

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Chapter Author: Mervyn A. King, Don Fullerton

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7 Comparisons of Effective Tax Rates

One of the main purposes of our study is to examine the variations in effective tax rates among the four countries and to explain the main reasons for these differences. A summary of the major results for each country has been presented in the appropriate chapter. In section 7.1 we analyze the results more fully, placing particular emphasis on comparisons across countries. Such comparisons help to place the results for any one country in perspective and to shed light on some key relationships such as the effect of inflation on effective tax rates. As shown in section 7.2, this effect differs significantly from one country to another. In section 7.3 we also examine the extent to which differences in tax rates are attributable to differences in the tax systems or to differences in the importance of particular industries, assets, sources of finance, and owners.

In addition to these basic questions, we examine in section 7.4 the sensitivity of the estimated tax rates to the values of p (in the fixed-p case) and r (in the fixed-r case) at which they are evaluated. At different inflation rates, we evaluate the tax rates at constant average net of personal tax rates of return. The question of how sensitive our results are to this assumption is tackled in section 7.5. Finally, for each country we calculate the distribution of effective marginal tax rates.

7.1 Comparing Results under Standard Assumptions

Let us first summarize the results with the standard parameters for each country. Table 7.1 shows effective tax rates in the fixed-p case for the four countries. From the final row of table 7.1 we see that the highest overall effective marginal tax rate is the 48 percent rate in West Germany, followed by 37 percent in the United States, 36 percent in Sweden, and

Table 7.1 **Actual Effective Tax Rates for Each Country, Fixed-*p* Case**
(actual inflation, actual depreciation, actual weights)

	United Kingdom	Sweden	West Germany	United States
Asset				
Machinery	−36.8	0.2	44.5	17.6
Buildings	39.3	36.6	42.9	41.1
Inventories	39.5	68.8	59.0	47.0
Industry				
Manufacturing	−9.6	27.1	48.1	52.7
Other industry	−5.4	60.5	57.0	14.6
Commerce	36.2	39.2	44.4	38.2
Source of finance				
Debt	−100.8	5.0	−3.1	−16.3
New share issues	−4.2	90.4	62.6	91.2
Retained earnings	30.6	68.2	90.2	62.4
Owner				
Households	42.0	105.1	71.2	57.5
Tax-exempt institutions	−44.6	−51.8	6.3	−21.5
Insurance companies	−6.7	18.9	−3.8	23.4
Overall	3.7	35.6	48.1	37.2

only 4 percent in the United Kingdom. The overall rate for each country is an average of the effective marginal tax rates for the eighty-one combinations, weighted by the proportion of capital in each combination. These weights, together with all 1980 input parameters for each country, are shown in Appendix A, and the matrixes of tax rates for different combinations and inflation rates in the four countries are given in Appendix B.

Each row in table 7.1 shows a weighted average tax rate for a subset of combinations. For example, the first row shows the average tax rate over all combinations that include machinery. From this row we can see that immediate expensing of machinery is a major reason for the low overall rate in the United Kingdom. The effective tax rate on machinery is minus 37 percent, while other assets are taxed at over 39 percent. Britain has the lowest total tax on machinery and the highest share of machinery in its capital stock.[1] Sweden's exponential depreciation of machinery at a 30

1. The first matrix of weights in Appendix A shows the proportion of capital stock that is used in each combination of asset and industry. If we add across the three industries in each country, we find that machinery is 47 percent of total capital in Britain, 42 percent in West Germany, 32 percent in Sweden, and 22 percent in the United States. The high percentage in Britain can be explained by the tax advantages afforded machinery, and the low percentage in the United States can be explained by the fact that a larger proportion of utilities are private corporations in the United States than in Europe. Since there are more structure-intensive utilities in the "other industry" category, the United States has a lower relative total weight on machinery.

percent annual rate for tax purposes is considerably more than the 7 to 20 percent rates that we estimate for economic depreciation. This accelerated depreciation plus the 11 percent investment grant means that the total corporate and personal tax wedge on machinery in Sweden is zero. Accelerated depreciation plus a 10 percent grant in the United States implies that the total tax on machinery is 18 percent,[2] while tax lives of eleven years and only 2 percent credits in Germany result in a tax rate on machinery of 45 percent. The effective tax rate on investment in buildings is strikingly similar in all four countries, with rates ranging from 36 to 43 percent. The row for inventories demonstrates the importance of inflation accounting, since the lower tax rates are in the United Kingdom and United States, where FIFO accounting is not obligatory for tax purposes, while 59 and 69 percent tax rates are found in Germany and Sweden, where half of inventories and all of inventories, respectively, are on FIFO accounting.

Looking at the industry breakdown in the United Kingdom, the tax rate for manufacturing is lowest because of the high weight on machinery and because that industry receives extra grants for machinery. The "other industry" category, although qualifying for lower grants, has a higher relative weight on machinery. The more interesting aspect of the industry breakdown, however, is that in Germany and Sweden the tax rate in "other industry" is higher than the overall rate, and in the United Kingdom and the United States it is lower than the overall rate. The low United States rate reflects the availability of investment tax credits for both machinery and buildings in utilities. The higher tax rates in Germany and Sweden reflect larger weights on buildings and inventories, respectively. These assets receive less generous depreciation allowances and lower grants.

In the breakdown by source of finance, the United Kingdom again provides the most striking contrast. Debt-financed investments are heavily subsidized, since assets receive accelerated or immediate depreciation and corporate interest payments are fully deductible from taxable income. Investment financed by new share issues receives a small subsidy because of the tax credits for dividends afforded by the imputation system of corporation tax. Only investment projects financed by retained earnings are taxed at positive rates in Britain. In all four countries tax deductibility of interest payments keeps down the tax rate on debt finance. Because of the imputation system both in Germany and the

2. The overall rate on machinery is zero in Sweden and 18 percent in the United States, but we cannot infer that depreciation of machinery is more accelerated in Sweden. Indeed, as shown in table 7.5, the rate in Sweden exceeds the rate in the United States when we use a common set of weights. Instead, the zero rate for machinery in Sweden can be explained by the fact that Sweden has proportionately more of machinery in manufacturing and that this industry uses proportionately more debt than in the United States. All weights for each industry are shown in Appendix A.

United Kingdom, the tax rate on projects financed by new share issues is lower than that on projects financed by retained earnings. In Sweden and the United States, in contrast, the relative positions of the two sources of equity finance are reversed. The United States imposes both corporate and personal taxes on dividends, while Sweden's Annell deduction is not enough to offset a similar double tax.

Finally, table 7.1 shows effective tax rates by ownership category. These rates reflect the differences in personal rates on interest and dividends in each country that are shown in Appendix A. Households in Sweden and Germany have particularly high personal tax rates, and effective marginal tax rates on projects financed directly from households are 105 and 71 percent, respectively. In Germany, however, tax-exempt institutions do not receive refunds of dividend tax credits or withholding taxes, so that only in Germany is the tax wedge positive for projects financed by tax-exempt institutions.

In other countries tax-exempt institutions are subsidized because their receipts of income are tax free and the corporations in which they invest receive deductions for interest payments, accelerated depreciation, investment grants, and in certain cases credits for dividends paid. The position of insurance companies is rather different. Although they are, on average, subsidized in Britain and Germany, they are taxed at positive rates in Sweden and the United States. We discovered that in all four countries the taxation of insurance companies was an extremely complex matter. The effective tax rate depends critically on special provisions, such as the possibility of making tax-free allocations to reserves. These provisions imply that the tax may be quite different from the statutory corporate rate applying to insurance companies and can increase rapidly with inflation (see section 7.2).

The tax rates shown in table 7.1 refer to projects that are all assumed to earn a pretax rate of return of 10 percent per annum. These figures describe the incentives provided by the tax schedule but do not tell us what revenue we would expect to collect at the margin corresponding to a small increase in the capital stock as a whole. This is because we might expect investments to be pushed to the point at which all projects yield the same rate of return before deduction of personal taxes. This arbitrage equilibrium we call the fixed-r case. It gives greater weight to the more highly taxed combinations, because it is these combinations that require a higher pretax rate of return in order to generate funds to pay the given market rate of return. The results for the fixed-r case are shown in table 7.2. As mentioned above, the weighted-average tax rates in table 7.2 will generally be larger than those in table 7.1 for the fixed-p case.[3] The overall

3. If the tax system were linear, then the effective tax rate calculated for a particular combination would not depend on the choice of p or r in either the fixed-p or the fixed-r calculations. Since individual tax rates would then be the same in both cases, any weighted-

Table 7.2 Actual Effective Tax Rates for Each Country, Fixed-*r* Case
(actual inflation, actual depreciation, actual weights)

	United Kingdom	Sweden	West Germany	United States
Asset				
Machinery	−57.5	−0.7	63.4	26.4
Buildings	56.4	48.5	59.9	54.1
Inventories	45.9	72.5	70.4	54.5
Industry				
Manufacturing	10.7	45.1	65.0	61.2
Other industry	12.0	77.0	69.5	24.4
Commerce	55.0	53.7	61.3	48.8
Source of finance				
Debt	—	11.5	−17.9	−72.5
New share issues	−1.8	92.9	73.2	81.8
Retained earnings	48.2	89.6	85.4	66.5
Owner				
Households	104.6	141.0	82.4	73.4
Tax-exempt institutions	−34.5	−68.8	26.5	−21.3
Insurance companies	14.5	26.9	9.1	22.4
Overall	30.0	53.6	64.8	49.9

marginal tax rates in the fixed-*r* case are 30 percent in the United Kingdom, 50 percent in the United States, 54 percent in Sweden, and 65 percent in West Germany.

Although the absolute values of the tax rates shown in table 7.2 are higher than those in table 7.1, the patterns of variations of tax rates both among countries and across combinations remain the same. Investment in machinery is subsidized in the United Kingdom, pays virtually no tax in Sweden, and is taxed at higher positive rates in the United States and especially in West Germany. Tax rates on investments in inventories are highest in Sweden and Germany. Investment in the United Kingdom is taxed less heavily in manufacturing than in other industries, whereas in the United States manufacturing pays a higher tax rate than other sectors of the economy.

It is clear that investment financed by borrowing is much less heavily taxed than that financed by equity. In three of the four countries such

average in the fixed-*r* case must be greater than the corresponding weighted-average in the fixed-*p* case. The tax system is not linear, however, so the individual tax rates depend on the chosen *p* of 10 percent in table 7.1, and on the chosen *r* of 5 percent in table 7.2. Since the tax rates for individual combinations are not identical in the two cases, averages over tax rates in the fixed-*r* case do not necessarily exceed those in the fixed-*p* case. Indeed, when we average over all combinations involving a particular asset, industry, source, or owner, the fixed-*r* tax rate in table 7.2 is sometimes less than the corresponding fixed-*p* rate of table 7.1.

projects are subsidized, and in the exception, Sweden, they receive a tax rate of only 11.5 percent. In Britain the subsidy is sufficiently large that the required pretax rate of return, necessary to generate a 5 percent rate of return before personal taxes to savers, is actually negative. Thus the factor income net of depreciation that would be produced in arbitrage equilibrium is negative, and the use of this factor income as the denominator of an estimated tax rate would produce figures with a sign opposite from that corresponding to our intuition. The tax wedge on debt finance in the United Kingdom is negative, and in table 7.2 the implied tax rate would be positive because of the negative pretax rate of return. Hence this figure is omitted. One advantage of reporting the results in the form of the implied tax wedge ($p - s$) is that the sign of the wedge always corresponds to the effect of the tax system on the incentive to save and invest.

Finally, there are substantial differences in the effective tax rates levied according to the identity of the provider of the funds for the project. Tax-exempt institutions receive a net subsidy in all countries except Germany, whereas in all four countries projects financed directly by households pay extremely high tax rates.

7.2 Effects of Inflation on Marginal Tax Rates

Section 4 of each country chapter provides estimates of tax rates for inflation rates of zero, 10 percent per annum, and the estimated actual inflation rate during the period 1970–79. In this section we investigate more systematically the effect of inflation on marginal tax rates. Figure 7.1 shows the overall effective marginal tax rates in the fixed-p case for inflation rates varying from zero to 15 percent. The figure illustrates some major differences among the four countries. In particular, overall marginal tax rates in Germany and the United States are rather insensitive to the rate of inflation, whereas in Sweden and Britain the tax rate is much more dependent on the inflation rate. But the influence of inflation is in opposite directions for the latter two countries. At zero inflation both countries have an overall marginal tax rate of about 13 percent, but as inflation increases the tax rate rises in Sweden and falls in the United Kingdom.

To discuss figure 7.1 and the different net effects of inflation in each country, it is useful first to summarize four separate effects of inflation that might operate in any one country.[4] First, a marginal investment in 1980 typically has future depreciation allowances that are based on

4. We concentrate here on four effects of inflation because they serve to explain figure 7.1. Inflation might also (a) raise taxes on capital gains if the tax base is not indexed, (b) push taxpayers into higher brackets if the tax schedule is not indexed, and (c) reduce the real tax burden if payments are delayed relative to the time that liabilities are incurred.

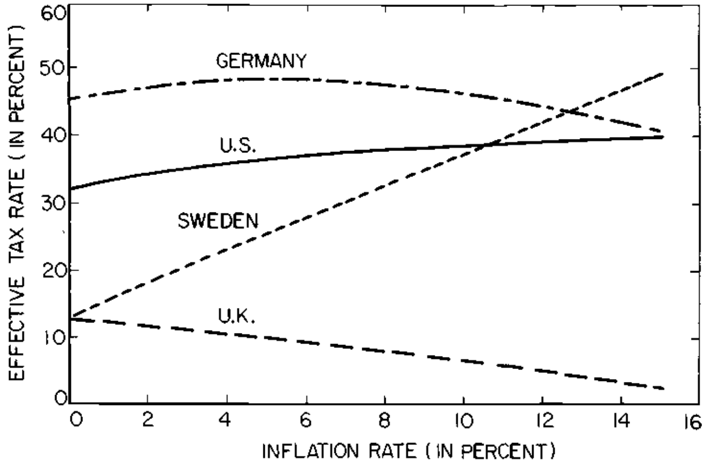

Fig. 7.1 Overall effective tax rate as inflation varies in each country.

historical cost (the 1980 purchase price for the asset). Since inflation reduces the real value of these fixed nominal deductions, it tends to increase effective tax rates. As inflation increases further, however, the real value of depreciation allowances falls at a reduced rate: only at an infinite rate of inflation does the real value of these deductions approach zero. For this reason the effect of historical cost depreciation becomes less important with successive increases in the rate of inflation. It is also less important in Britain, where machinery receives immediate expensing and hence inflation has no effect on the vector of such allowances.

Second, inflation increases the nominal interest rate. Where nominal interest payments are deductible from the corporate income tax, inflation tends to increase these deductions and decrease the overall tax rate. At the same time, where nominal interest receipts are included in the personal income tax base, inflation tends to increase these receipts and increase the overall tax. In combination, since the corporate rate is greater than the personal rate averaged over investors in all of our countries, inflation tends to decrease overall taxes.

Third, inflation increases the nominal value of inventories. Under FIFO inventory accounting, taxable profits are measured by the difference between nominal sales price and nominal costs. Thus, for given real magnitudes, inflation tends to increase taxable nominal profits and increase the effective tax rate. This effect depends on the proportion of assets held as inventories.

Fourth, tax rules for insurance companies can exacerbate the effects of inflation. In the United States and Sweden, insurance companies are allowed deductions for reserves that are based on fixed nominal interest rate assumptions. As inflation increases nominal interest receipts, it reduces the real value of deductions for reserves. The entire addition to the nominal return is taxed, even if it is needed to meet reserve obligations. As a result, inflation tends to increase the effective tax rate proportionately.

These four effects of inflation operate in different directions and with different magnitudes in each country, but the total effects are shown in figure 7.1. In Germany, for example, the tax rate starts at 45 percent with no inflation. It tends to increase because of historical cost depreciation and inventory accounting, but it tends to decrease because of nominal interest deductions at a corporate rate that exceeds the personal rate. The net effect is positive at first, but the effect of historical cost depreciation diminishes with further inflation. Nominal interest deductions become relatively more important at a 5 percent rate of inflation, and further inflation reduces the total tax.

The same general story applies to the United States, except that the effect of FIFO inventory accounting is replaced by the effect of nominal reserve allowances for insurance companies. Taxes increase with inflation, but at a diminishing rate as the effect of historical cost depreciation diminishes. The curve becomes almost flat at high rates of inflation, where the tax-increasing effects of insurance rules are almost exactly offset by the tax-reducing effects of nominal interest deductions at a corporate rate that exceeds the personal rate.

Most effects operate in the same direction for Sweden. First, depreciation is allowed on a historical cost basis. Second, Sweden requires FIFO inventory accounting. Third, insurance companies are allowed only a fixed nominal return for reserves. Finally, nominal interest is taxed at a weighted-average marginal rate that is almost as high as the corporate rate. (Sections 4.2.5 and 4.4.3 find that the effective corporate rate in Sweden was 35 percent in 1980.) The combination of these four effects for Sweden itself is dramatic, but the contrast with Britain in figure 7.1 is tremendous. Nominal interest in Britain is deducted at the 52 percent corporate rate, and it is received by households with an average 28 percent rate, tax-exempt institutions, or insurance companies with a 17 percent rate. This effect swamps that of historical cost depreciation. Although some buildings in Britain receive delayed depreciation at historical cost, other assets are expensed. Inflation does not operate to increase taxes through investment in inventories or saving through insurance companies. As a result, overall taxes start at about 13 percent of the pretax return, fall with inflation, and keep falling as inflation increases.

Figure 7.1 does not show differential effects of inflation among combinations in each country. To investigate differences among assets, industries, financial sources, or owners, we start with tax rates for zero inflation in table 7.3. These tax rates for each country are taken from the zero-inflation column of the first table of results in each country chapter. The

Table 7.3 **Actual Effective Tax Rates for Each Country with Zero Inflation, Fixed-*p* Case**
(actual depreciation, actual weights)

	United Kingdom	Sweden	West Germany	United States
Asset				
Machinery	−24.2	−18.1	38.1	3.9
Buildings	41.5	28.9	42.7	35.4
Inventories	50.5	26.5	57.7	50.9
Industry				
Manufacturing	−1.7	8.1	44.7	44.2
Other industry	4.6	29.6	50.8	10.0
Commerce	46.8	12.1	44.6	37.9
Source of finance				
Debt	−29.6	−12.9	12.1	−2.0
New share issues	7.6	44.2	56.1	61.0
Retained earnings	23.5	40.9	72.0	48.4
Owner				
Households	26.6	57.1	59.7	44.1
Tax-exempt institutions	−5.1	−39.2	17.6	4.0
Insurance companies	8.7	−16.0	14.6	4.0
Overall	12.6	12.9	45.1	32.0

columns for the United Kingdom and Sweden demonstrate that these two countries not only start at the same overall 13 percent effective tax rate with no inflation, but also start with very similar tax rates on particular combinations. Machinery is subsidized in both countries, because of accelerated or immediate depreciation, and other assets are taxed. Debt is subsidized in both countries, because of interest deductions at the corporate level, and other sources of finance are taxed. Tax-exempt institutions are subsidized, and households are taxed.

There, however, the similarity ends. Table 7.4 shows, for each combination in each country, the differential effect of inflation. Each entry shows the addition (or subtraction) to the tax rate in that combination for an increase of inflation from 6 percent to 7 percent. Almost all the entries for the United Kingdom are negative, and almost all the entries for Sweden are positive. One percentage point of inflation reduces British taxes by one percentage point for machinery, by five points for debt, and by three points for tax-exempt institutions. The one point of inflation *raises* Swedish taxes by four points for inventories, by four points for insurance companies, and by five full points for households. It even increases the tax rate on debt by two percentage points.

Finally, we might also be interested in the variance of the effects of inflation within each categorization. Among owners in the United States,

Table 7.4 **Change in Effective Tax Rates for a Change in the Inflation Rate from 6 Percent to 7 Percent, Fixed-*p* Case**
(actual depreciation, actual weights)

	United Kingdom	Sweden	West Germany	United States
Asset				
Machinery	−1.0	2.0	0.5	1.8
Buildings	−0.2	0.9	−1.9	0.4
Inventories	−0.8	4.1	0.3	−0.5
Industry				
Manufacturing	−0.6	1.9	−0.1	0.8
Other industry	−0.7	3.3	0.2	0.4
Commerce	−0.8	2.7	−1.3	−0.2
Source of finance				
Debt	−5.2	2.0	−5.1	−2.0
New share issues	−0.9	4.8	0.7	4.3
Retained earnings	0.5	2.6	3.7	1.5
Owner				
Households	1.1	5.0	2.0	1.6
Tax-exempt institutions	−3.0	−1.6	−4.1	−4.5
Insurance companies	−1.1	4.2	−5.9	5.0
Overall	−0.6	2.4	−0.2	0.4

for example, an extra point of inflation adds five points to the tax rate on insurance companies and subtracts 4.5 points from the tax rate on tax-exempt institutions. This difference of 9.5 points is larger than the difference among owners in any other country. Britain has the smallest difference among owners. Among sources of finance, Germany has the largest differences (−5.1 for debt and +3.7 for retained earnings, for a difference of 8.8), and Sweden has the smallest. Among industries, Germany has the largest differences, and Britain has the smallest. Finally, among assets in each country, Sweden has the largest differences, and Britain the smallest. Thus, we conclude that, although inflation reduces overall taxes in Britain, it does so on a comparatively uniform basis.

7.3 Differences among the Four Countries

While the United States, United Kingdom, Sweden, and Germany show obvious differences in the tax treatments of different assets, they also differ in the relative stocks of each asset. The weighted-average tax rates differ for both these reasons. Second, while we have found clear differences in the way inflation affects tax rates in each country, there are also differences in actual rates of inflation. Tax rates differ for both these reasons as well. Finally, while new investments receive different grants and allowances in each country, they also have different actual rates of depreciation. They thus have differences in the rates at which reinvestment qualifies for new grants and allowances. This section investigates how much of the overall tax rate differences is attributable to tax law and how much is due, instead, to differences in the measured weights, inflation rates, or actual depreciation rates.

To perform this decomposition, we first recalculate tax rates for each country, using its own parameter values everywhere except for a common set of weights. We recalculate tax rates again with own parameters everywhere except for a common inflation rate, and then with own parameters except for a common set of actual depreciation rates. Finally, we recalculate tax rates for each country using its own tax parameters, but using common weights, inflation rates, and actual depreciation rates.

The choices for the common weights, inflation rate, or depreciation rates are essentially arbitrary. We might select the weights or rates from any one of the four countries, or we might apply to each country an average set of weights or rates. We do not wish to introduce a fifth set of weights, however, even if it is an average of the four countries, because such parameters would not reflect any actual experiences. Instead, we select United States weights and rates for the standard of comparison.

Table 7.5 reflects results of the first simulation, which attempts to answer two questions. First, What would be the effective marginal tax rates in each country if they all had the United States mix of assets, industries, sources of finance, and owners? Second, or conversely, How much of existing tax rate differences are attributable to different weights on each category? If all countries provided the same relative tax treatments to different assets, industries, sources, or owners, then we would not expect taxes to cause differences in the distribution of capital among those components. If relative tax treatments differ, however, then we might expect substitution among production processes to allow relatively more use of a particularly tax-favored asset, more output of a tax-favored industry, more finance through a tax-favored source, or more savings channeled through a pension fund, insurance company, or other particularly tax-favored ownership category. Since there are these differences among countries, we might expect the switch to a common set of weights in each case to put less weight on particular tax-favored investments and thus to raise the overall average tax rate.[5]

The fourth column of table 7.5, for the United States, is identical to that of table 7.1. Since weights for the United States have not changed, the overall rate is still 37 percent in the fixed-*p* case. The overall rate for

5. Tax rates for Britain. Sweden. and Germany rise as expected in table 7.5 when those countries are given weights from the United States. In other experiments, however, this result does not hold. When other countries are assigned the debt-intensive weights from Sweden. for example, some effective tax rates fall.

Table 7.5 **Effective Tax Rates for Each Country, with United States Weights, Fixed-*p* Case**
(actual inflation, actual depreciation)

	United Kingdom	Sweden	West Germany	United States
Asset				
Machinery	−45.5	25.7	54.6	17.6
Buildings	24.8	58.4	52.5	41.1
Inventories	35.8	87.6	71.5	47.0
Industry				
Manufacturing	22.0	66.6	69.2	52.7
Other industry	−13.6	44.4	43.6	14.6
Commerce	24.8	59.8	54.3	38.2
Source of finance				
Debt	−84.1	29.4	2.1	−16.3
New share issues	46.9	109.6	63.2	91.2
Retained earnings	61.5	69.6	87.5	62.4
Owner				
Households	48.3	103.0	73.3	57.5
Tax-exempt institutions	−82.6	−65.2	31.6	−21.5
Insurance companies	−46.5	7.7	−9.1	23.4
Overall	11.6	58.0	57.5	37.2

Britain, however, has increased from 3.7 to 11.6 percent. This overall change results primarily from the fact that the United States has a much lower weight for machinery than does the United Kingdom, where machinery is subsidized. It is somewhat offset by the fact that the United States has more weight on debt, which Britain also subsidizes.

The overall tax rate in Sweden increases from 36 to 58 percent when United States weights are employed. Zero-taxed machinery is given less weight, low-taxed debt is given much less weight, and the highly taxed households are given relatively more weight. Moreover, because United States statistics include more privately owned utilities in the other industry category, this highly taxed sector is also assigned more weight with the United States proportions. In West Germany, the overall tax rises from 48 to 58 percent when United States weights are employed. Again, the "other industrial" sector plays a major role, because it is the most highly taxed sector in Germany, and its weights are the largest in the United States. Also, debt changes from a net subsidy to a tax, because relatively more of it is held by households in the United States. Individual components can be further investigated by considering the individual country weights as shown in Appendix A.

Thus, as expected, overall tax rates of all countries increase when common weights are employed. The differences, however, remain intact.

The spread actually increases from forty-four percentage points (the difference between 48.1 for Germany and 3.7 for the United Kingdom) to forty-six percentage points (the difference between 57.5 and 11.6 for the same two countries). According to these experiments, then, differences in weights by themselves do not account for any of the overall tax rate differences.

Next we turn to inflation. How much of the actual tax rate differences would remain if all countries had the same rate of inflation? This question can be answered by looking at the zero inflation column of each country's 1980 results table (brought together in table 7.3) or by looking at the 10 percent column of each 1980 results table. For consistency, in table 7.6, we look at the tax rates that would exist in each country with 6.77 percent inflation, the actual United States rate of inflation.

Again tax rates in the United States are the same as they were before. Tax rates in other countries rise or fall, as can be seen from figure 7.1. Since taxes in Britain fall with inflation, and since the United States inflation rate is less than the United Kingdom rate, the 3.7 percent tax rate for Britain in table 7.1 rises to 8.9 in table 7.6. This overall change reflects smaller subsidies on machinery, debt, and tax-exempt institutions, as well as higher positive taxes on other categories. Since taxes in Sweden rise with inflation, and since the United States inflation rate is

Table 7.6 Effective Tax Rates for Each Country with 6.77 Percent Inflation, Fixed-*p* Case
(actual depreciation, actual weights)

	United Kingdom	Sweden	West Germany	United States
Asset				
Machinery	−30.2	−5.2	46.3	17.6
Buildings	42.0	33.9	38.9	41.1
Inventories	45.5	58.6	59.8	47.0
Industry				
Manufacturing	−4.8	22.1	48.2	52.7
Other industry	0.2	51.7	58.3	14.6
Commerce	42.2	32.2	41.8	38.2
Source of finance				
Debt	−64.6	−0.6	−15.4	−16.3
New share issues	2.1	77.8	64.6	91.2
Retained earnings	27.9	61.8	100.1	62.4
Owner				
Households	34.8	92.1	76.5	57.5
Tax-exempt institutions	−23.8	−47.7	−3.4	−21.5
Insurance companies	1.9	6.6	−18.2	23.4
Overall	8.9	29.5	47.9	37.2

less than the Swedish rate, the 35.6 percent tax rate in table 7.1 falls to 29.5 in table 7.6. Finally, note that the figure 7.1 tax rate curve for Germany reaches its highest point at a 5 percent rate of inflation and then starts to decline. Since the German inflation rate is 4.2 percent and the comparison here is at a rate of 6.77 percent, the overall tax rate is hardly affected. The flatness of that curve incorporates offsetting effects, however, so there is a higher tax on inventories and a lower tax on debt.

According to these experiments, then, some of the actual tax rate differences can be attributed to inflation-rate differences. The forty-four point spread in table 7.1 falls to a thirty-nine point spread in table 7.6 (47.9 for Germany minus 8.9 for the United Kingdom). This conclusion is not robust, however, as can be seen from figure 7.1. For any two countries in that diagram, tax rates may become more similar at one common inflation rate and less similar at a different common inflation rate.

Finally, we ask, How much of the differences in tax rates may be attributed to differences in actual depreciation rates? We have two reasons for addressing this question. First, we want to isolate differences attributable solely to tax law. Of course, the tax law can induce producers to alter the maintenance or type of particular assets employed. Second, each of our country chapters uses its own procedures to derive estimates of actual depreciation. These methodological differences might contribute to apparent effective tax rate differences.

Table 7.7 shows calculations for all countries when we use only United States depreciation rates. As shown in Appendix A, these rates for buildings are greater than those for Britain and Sweden but less than those for Germany. The United States rates for machinery are approximately in the middle of those for other countries but depend on industrial location. Substitution of these parameters serves to reduce the overall tax rates in Britain and Germany and slightly increase that in Sweden. The spread between the low rate of Britain and the high rate of Germany is essentially unchanged.

While these factors sometimes greatly affect individual combinations, we conclude that none has a major impact on the differences in overall tax rates among countries. In table 7.8, however, we take all these factors together and calculate effective tax rates when all countries have the same weights, inflation rates, *and* depreciation rates. Because these factors are not independent, they have more of an effect together than they do separately. Taken together, these factors increase the tax in Britain for two reasons: we use less weight on Britain's subsidized machinery, and we use a lower rate of inflation. The overall rate in the United Kingdom increases from 3.7 to 18.9 percent, while that in Germany increases only from 48.1 to 52.6 percent. The spread thus falls from 44.4 to 33.7 percent. These remaining differences can be attributed solely to tax law.

All the calculations above referred to the fixed-p case. In table 7.9 we show comparable calculations for the fixed-r case. When all countries have all their own parameters, fixed-r tax rates vary between the 30 percent rate for Britain and the 65 percent rate for Germany (as shown in table 7.2). When all countries have their own tax parameters but United States weights, depreciation, and inflation, fixed-r tax rates vary between 42 percent for Britain and almost 70 percent for Sweden (as shown in table 7.9). The spread thus falls from thirty-five points to twenty-eight points. Changes in the individual components of any country can be explained by arguments similar to those for the fixed-p case above.

7.4 Sensitivity to Assumed Rates of Return

In general, the measured effective tax rate depends on the assumed value for p or r in the fixed-p or fixed-r calculations. Are our estimates relatively robust to these choices, or do they depend greatly on the assumed rate of return? This section discusses the possible reasons for this dependence and then calculates different effective tax rates for different rates of return.

In a linear system, the tax is a constant fraction of the pretax return.

Table 7.7 Effective Tax Rates for Each Country, with United States Depreciation Rates, Fixed-p Case
(actual inflation, actual weights)

	United Kingdom	Sweden	West Germany	United States
Asset				
Machinery	−42.2	−0.8	40.3	17.6
Buildings	39.7	38.3	35.4	41.1
Inventories	39.5	68.8	59.0	47.0
Industry				
Manufacturing	−13.5	27.2	44.5	52.7
Other industry	−5.1	61.2	51.3	14.6
Commerce	36.1	39.7	39.2	38.2
Source of finance				
Debt	−104.2	5.4	−8.9	−16.3
New share issues	−6.6	90.6	59.0	91.2
Retained earnings	28.5	68.3	87.8	62.4
Owner				
Households	40.0	105.3	68.1	57.5
Tax-exempt institutions	−47.5	−51.4	0.9	−21.5
Insurance companies	−9.2	19.2	−9.9	23.4
Overall	1.3	35.9	44.2	37.2

Thus the tax *rate* is independent of the pretax or posttax rate of return. In general, however, tax systems are not linear. The tax rate depends on the present value of depreciation allowances, which depends nonlinearly on the rate of return used for discounting. The importance of this point justifies some algebraic elaboration. In chapter 2, equation (2.23) provides a complicated expression for the pretax return (p) as a function of the corporate tax rate (τ), the firm's discount rate (ρ), the depreciation rate (δ), the present value of allowances (A), and other parameters. In order to focus on the main issue and to avoid unnecessary complications, we consider the case with LIFO accounting ($v = 0$), no corporate wealth taxes ($w_c = 0$), and no inflation ($\pi = 0$ or, equivalently, complete indexation for inflation). In this simple case, (2.23) reduces to

$$(7.1) \qquad p = \frac{(1-A)}{(1-\tau)}(\rho + \delta) - \delta.$$

Also in chapter 2, equations (2.24) to (2.27) provide expressions for the firm's discount rates when finance is obtained by debt, new share issues (NSI), and retained earnings (RE). If we take a classical corporate tax system ($\theta = 1$) and ignore capital gains taxes ($z = 0$), then these equations reduce to

Table 7.8 Effective Tax Rates for Each Country, with 6.77 Percent Inflation, United States Depreciation, and United States Weights, Fixed-*p* Case

	United Kingdom	Sweden	West Germany	United States
Asset				
Machinery	−37.3	19.0	53.8	17.6
Buildings	31.7	56.0	42.0	41.1
Inventories	43.3	76.7	75.4	47.0
Industry				
Manufacturing	21.0	60.9	69.3	52.7
Other industry	1.1	40.2	32.5	14.6
Commerce	37.4	53.5	48.2	38.2
Source of finance				
Debt	−45.0	22.0	−20.3	−16.3
New share issues	40.4	96.4	59.2	91.2
Retained earnings	52.4	65.9	92.2	62.4
Owner				
Households	43.3	92.5	73.3	57.5
Tax-exempt institutions	−43.6	−52.4	19.3	−21.5
Insurance companies	−19.8	−3.6	−37.2	23.4
Overall	18.9	52.6	52.6	37.2

Table 7.9 **Effective Tax Rates for Each Country, with 6.77 Percent Inflation, United States Depreciation, and United States Weights, Fixed-*r* Case**

	United Kingdom	Sweden	West Germany	United States
Asset				
Machinery	−61.5	30.1	69.2	26.4
Buildings	51.7	69.5	59.2	54.1
Inventories	51.1	81.5	79.3	54.5
Industry				
Manufacturing	43.3	78.7	77.8	61.2
Other industry	25.0	55.9	51.4	24.4
Commerce	54.7	68.3	64.9	48.8
Source of finance				
Debt	−114.5	27.4	−125.5	−72.5
New share issues	55.0	93.5	71.4	81.8
Retained earnings	64.5	88.2	86.6	66.5
Owner				
Households	63.9	120.7	84.8	73.4
Tax-exempt institutions	−33.5	−65.2	39.7	−21.3
Insurance companies	−14.0	−6.0	−45.3	22.4
Overall	42.3	69.8	68.4	49.9

(7.2)
$$\begin{aligned} \rho_{DEBT} &= r(1-\tau) \\ \rho_{NSI} &= r \\ \rho_{RE} &= r(1-m), \end{aligned}$$

where m is the personal tax rate. The real interest rate r is equal to the nominal rate i, since inflation is assumed to be zero here. Finally, the saver's posttax real rate of return in equation (2.6) reduces to

(7.3) $$s = r(1-m).$$

With these formulas, for any source of finance we can calculate the effective tax rate $t = (p - s)/p$. Starting with r, for example, we have s and ρ directly as linear functions. In general, however, the present value term A is not a linear function of ρ, so the tax is not linear in r. Similarly, if we start with a value for p, we can generally find a value for ρ that is consistent with equation (7.1). However, it also will depend nonlinearly on the initial p chosen. The tax rate remains a nonlinear function of p.

Suppose, however, that there are no cash grants or immediate expensing ($f_2 = f_3 = 0$), and that depreciation allowances are equal to economic depreciation at replacement cost. In this case, the present value of allowances is

(7.4) $$A = A_d = \tau \int_0^{\infty} \delta e^{-(\delta+\rho)u} du = \frac{\tau\delta}{\delta+\rho},$$

and equation (7.1) reduces simply to

(7.5) $$p = \frac{\rho}{1-\tau}.$$

Now the three effective tax rates reduce to

(7.6) $$\begin{aligned} t_{DEBT} &= m \\ t_{NSI} &= \tau + m(1-\tau) \\ t_{RE} &= \tau . \end{aligned}$$

That is, interest is deductible at the corporate level, so the return to debt is taxed only at the personal rate m. The return to equity is taxed only at the corporate rate τ if it is retained, but the after-tax profits are taxed again at the personal rate if the earnings are distributed.

Equations (7.6) make clear that these effective tax rates do not depend on p or r. The system is linear in that the tax is a constant fraction of any pretax return. Our effective tax rate formulas provide global estimates of the tax rate, in either the fixed-p case or the fixed-r case, for any initial p or r.

In our example above, linearity depends upon the assumption of economic depreciation at replacement cost.[6] Actual tax systems conform neither to an income tax on properly measured income nor to a consumption tax. In particular, depreciation allowances are often accelerated relative to economic depreciation. Because these tax advantages are delayed, the effective tax rate depends on their present value and thus nonlinearly on the rate of discount. For these reasons, there is no such number as *the* effective tax rate. Different estimates are obtained for different values of p and r. It is very important, therefore, to investigate the sensitivity of results to the initial p or r. For reasons of space, we limit this investigation to the standard 1980 parameters in each country. We also limit the investigation to one example, machinery in the manufacturing sector. Our sensitivity analysis should consider the most sensitive case, and machinery has differentially accelerated depreciation allowances. It is therefore expected to exhibit some of the greatest nonlineari-

6. Auerbach and Jorgenson (1980) suggest a "first-year recovery" system where the investor receives only an immediate deduction, equal to the present value of actual depreciation on the asset. All internally financed investments are then subject to a uniform tax rate τ, from equation (7.6). This is not the only linear tax system, however. At the other extreme, immediate expensing in our simple case provides a uniform rate of zero on all internally financed assets. Brown (1981) suggests that any uniform rate between zero and τ can be obtained by providing a common rate of grant that is proportional not to the purchase price of the asset, but to the purchase price minus the first-year deduction.

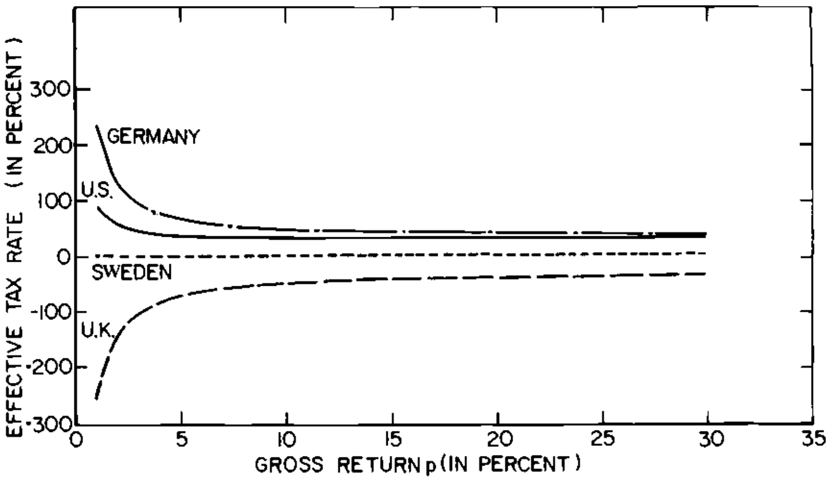

Fig. 7.2 Effective tax rate on machinery as p varies in each country.

ties. We weight over owners and sources of finance to calculate the total tax wedge or tax rate on the "average" investment in manufacturing machinery in each country.

Figure 7.2 plots, for each country, the effective tax rate on machinery as the pretax return varies from 1 to 30 percent. These calculations are for the fixed-p case, and the firm's discount rate is linked by our formulas to this pretax return. For machinery in the United Kingdom, immediate expensing means that the discount rate does not affect the present value of depreciation allowances, but additional grants ensure that the asset receives a subsidy at *any* pretax return. When this subsidy is expressed as a fraction of a 1 percent pretax return or less, the rate of subsidy becomes arbitrarily large. Because the rate of tax or subsidy is misleading in such cases, we also show the tax wedge in figure 7.3. As the pretax return becomes small, the negative wedge in Britain is reduced in absolute size, although it becomes a larger fraction of p.

In Sweden, as we see in table 7.1, the total tax on the average new investment in machinery is approximately zero. The wedge $(p - s)$ is zero, so the wedge as a fraction of p is also zero. As a result, the curves for Sweden in figures 7.2 and 7.3 are rather flat at a zero value for the tax rate.

To interpret the curves for Germany and the United States, consider first a hypothetical case with no inflation but with accelerated depreciation and investment grants. When the pretax return is relatively low, the discount rate is also relatively low, and the delayed depreciation allowances are more important. A subsidy may result in such a case, and it may be an arbitrarily high fraction of p. As p (or the discount rate) increases,

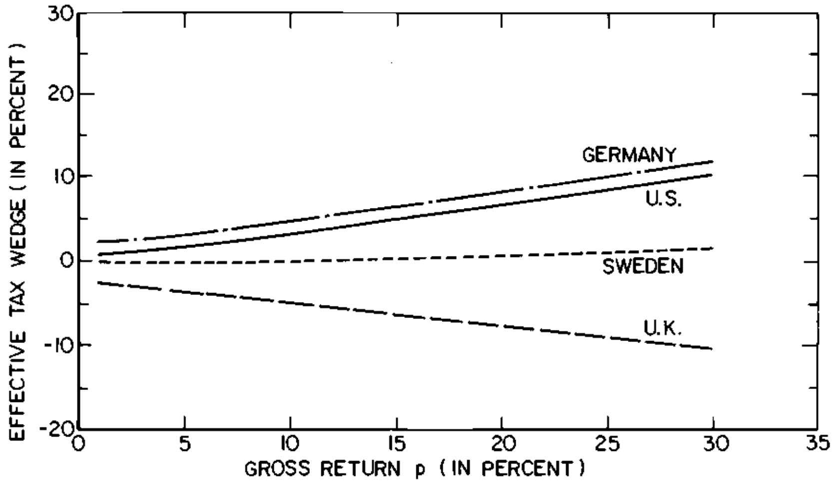

Fig. 7.3 Effective tax wedge ($p - s$) on machinery as p varies in each country.

depreciation allowances become less important, and the tax may rise to zero or above. In such a case, the curve would look like that of the United Kingdom.

With significant inflation, as in the United States, or with long asset lifetimes, as in Germany, depreciation allowances on historical cost may be less than economic depreciation at replacement cost. In such cases the tax wedge may be positive, and it may be an arbitrarily high fraction of a very small p. Moreover, as p (or the discount rate) increases, the disadvantageous depreciation allowances become less important, and the effective tax rate falls. Figure 7.3 shows that the tax wedges in the United States and Germany are small at low p, even if they are a high fraction of p as shown in figure 7.2.

An important aspect of figures 7.2 and 7.3 is that the curves do not cross. At actual inflation rates and standard 1980 parameters, the choice of p does not affect the conclusion that the highest tax rates are in Germany, followed by the United States, Sweden, and the United Kingdom. Moreover, while the amount of tax naturally increases with the earnings from the asset, as shown in figure 7.3, the tax rate curves of figure 7.2 have large segments that are fairly flat. Beyond some critical value of p, the tax rate is not much affected by further changes in p. Our standard calculations use a p of 10 percent, clearly beyond this critical point.

Similar analyses are performed for the fixed-r methodology in figures 7.4 and 7.5. Curves for Germany and the United States are very similar to those for the fixed-p case above. In Sweden, the fixed-r calculation

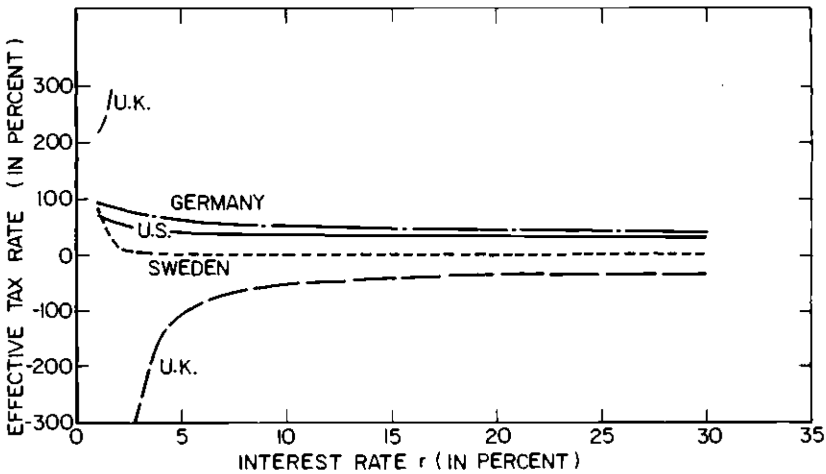

Fig. 7.4 Effective tax rate on machinery as r varies in each country.

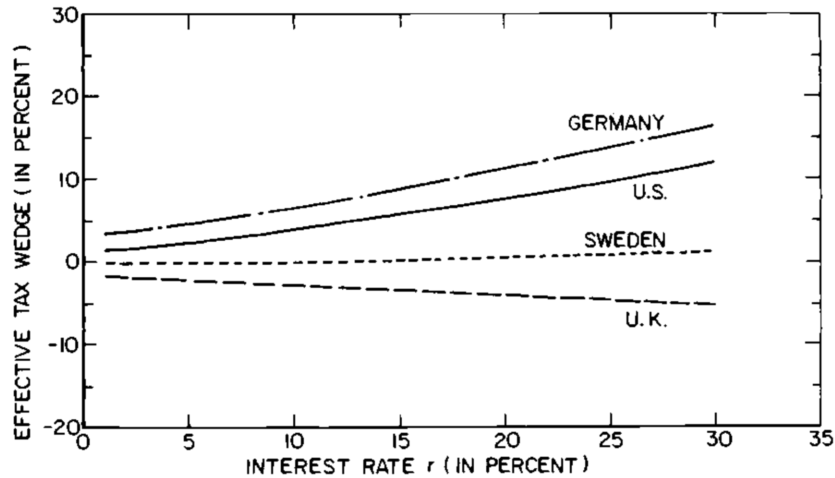

Fig. 7.5 Effective tax wedge $(p - s)$ on machinery as r varies in each country.

implies a small positive wedge for machinery in manufacturing.[7] When r is 1 percent in this case, the value of p is only 0.1 percent. A small denominator makes the tax rate misleadingly high.

For the United Kingdom, figure 7.5 demonstrates that machinery is clearly subsidized at any value for r. As r is reduced to about 2 percent, however, the subsidy $(p - s)$ becomes equal to the whole return to the

7. Table 7.2 shows a small subsidy for machinery in Sweden when r is fixed at 5 percent, but that calculation considers an average over all industries, sources, and owners. Here, when we look at machinery only in manufacturing, we have a small positive tax at any value for r.

saver (s). Since the government provides the saver's entire return, the asset need earn nothing. The pretax return p is zero, and the subsidy rate $(p - s)/p$ is not defined. At even lower values for r, the subsidy is even larger than the saver's return, and the asset can make a loss. A negative wedge $(p - s)$ divided by a negative p implies a positive rate in spite of the subsidy.

We need a common standard for comparing taxes on different assets or in different countries. The tax-inclusive effective rate $(p - s)/p$ is a logical candidate, because it corresponds to our general conception of a tax rate and because it reduces to the statutory rate in special cases. Because p can be zero or negative, however, this rate is sometimes not useful for drawing comparisons. The tax-exclusive rate $(p - s)/s$ is a logical alternative, but the next section describes cases where s can be zero or negative as well. Both rates are subject to misleadingly wide variations when their denominators are close to zero. The remaining alternative is to report the tax wedge $(p - s)$; in this case we do not have a denominator. This effective tax measure always has the "correct" sign, and it can be interpreted as a wealth tax rate, the percentage of the asset value paid in tax each year. As the earnings of the asset increase in figures 7.3 and 7.5, so does the amount of tax or subsidy. The tax wedge thus appears to be sensitive to higher rates of return, but this is a consequence of the fact that the tax *rates* level off in figures 7.2 and 7.4.

These diagrams demonstrate clearly the nonlinear aspects of our effective tax formulas. The tax rates in figures 7.2 and 7.4 are particularly nonlinear because p appears in the denominator. Even the tax wedges in figures 7.3 and 7.5 are nonlinear, however, because p is a nonlinear function of r. Both wedges and rates are sensitive to the choice of p or r, so care must be taken in their interpretation.

One other interesting result can be explained with the use of the equations given above. It turns out that the effective tax rate is related *inversely* to the personal tax rate m in some instances. In the United States, for example, the effective tax rates in some categories are raised by the use of "low tax" parameters or reduced by the use of "high tax" parameters. In particular, the effective tax rate on retained earnings is 67 percent with the low value for m, 62 percent with the standard value for m, and only 58 percent with the high value for m (see tables 6.20 and 6.23).

This result derives from the arbitrage assumption of chapter 2. In equilibrium, savers are assumed to require the same net-of-tax real return on any investment, in any asset or industry. Thus s is always given by the real net-of-tax interest rate, whatever source of finance is actually used. Consider an increase in the personal tax rate m on interest income. The value of s falls for a given r. Since equity does not actually pay the tax on interest income, however, the firm can earn a lower gross return on the asset and still provide a net return equal to that on interest income. In other words, the cost of capital for retained earnings falls. Whether the gross return p falls by more or less than the net return s depends on depreciation deductions. If depreciation allowances are not immediate, and the higher m implies a lower discount rate for the firm, then the present value of allowances rises. In this case the required return p falls by more than s, and the tax wedge is reduced. In effect, the increase in m raises the relative advantage of internal finance if capital gains are taxed at concessionary rates, and in some cases this can reduce the tax wedge on an investment project.

Consider, for example, the simple case with no inflation, no wealth taxes, no capital gains taxes, and no investment grants. Discount rates for this case are shown in equation (7.2), and the saver's return is shown in equation (7.3). With economic depreciation at replacement cost, the pretax return reduces to $\rho/(1 - \tau)$, as shown in equation (7.5). The total tax rate on debt is m, on new share issues is $\tau + m(1 - \tau)$, and on retained earnings is τ, as shown in equations (7.6). An increase in m thus raises effective tax rates for debt and new share issues but leaves unchanged the rate for retained earnings. With other than economic depreciation, however, the expression for the pretax return does not reduce to equation (7.5). To reduce the expression for p in a different way, suppose actual depreciation (δ) is zero. Then $A > 0$ represents "accelerated" depreciation, and a higher discount rate reduces the present value of depreciation allowances. With this alteration, the expression for the gross return p changes from (7.1) to

$$(7.7) \qquad p = \frac{\rho(1 - A)}{1 - \tau},$$

and the effective tax rate on retained earnings changes from τ to

$$(7.8) \qquad t = 1 - \frac{1 - \tau}{1 - A}.$$

Now a change in the personal tax rate m affects t for projects financed from retained earnings according to

$$(7.9) \qquad \frac{\partial t}{\partial m} = \frac{-(1 - \tau)}{[1 - A]^2} \cdot \frac{\partial A}{\partial \rho} \cdot \frac{\partial \rho}{\partial m}.$$

With $\rho = r(1 - m)$, the discount rate for retained earnings falls as m rises ($\partial\rho/\partial m \leqslant 0$). Since $\partial A/\partial\rho$ is negative, and τ is less than one, the effective tax rate also falls as m rises.

The effect on any single asset or industry depends on the share of retained earnings as a source of finance. In the countries studied here, other sources of finance are large enough that the overall effective tax rate does in fact increase with the personal tax rate.[8]

8. In an alternative methodology, Bradford and Fullerton (1981) assume that firms arbitrage between debt and real capital such that the net-of-tax return to the corporation is equalized. Since $r(1 - \tau)$ would be saved by retiring a unit of debt, the same must be earned

7.5 Sensitivity to Assumed Relation between Inflation and Interest Rates

In the fixed-r calculations above, we assume that arbitrage eliminates differences in net-of-tax interest rates, except for differences in personal tax rates among owners. In this case the same real interest rate r is earned on any investment. Because of tax differences, then, the pretax returns p must differ among investments. While we hold r constant across investments at any inflation rate, this assumption provides no guide to correct comparisons among inflation rates. There is no arbitrage story to be told here, and we are concerned simply with the choice of r at which to evaluate the tax rate. With a linear tax system the choice would not matter, but in practice nonlinearities necessitate an assumption to enable us to make comparisons for ceteris paribus changes in the rate of inflation. For this purpose we typically hold constant the average real rate of return to savers. (We could hold $i - \pi$ constant instead, but this real interest rate is relevant to only one saver, tax-exempt institutions.) This assumption implies a particular relation between the inflation rate and the nominal interest rate, and the purpose of this section is to investigate alternative assumptions about this relation.

In the fixed-r case, we may interpret r_F as the interest rate that would exist if there were no inflation. In such a case, the average posttax return to savers would be $\bar{s} = r_F(1 - \bar{m})$, where $\bar{m}$ is the weighted average of different owners' personal marginal tax rates. If inflation increased to the rate π, and the nominal interest rate rose to a value i, then in real terms the average saver would receive $\bar{s} = i(1 - \bar{m}) - \pi$. If the average real return to savers is to be constant across inflation rates, by assumption, then we must set these two expressions equal to each other and solve for the nominal interest rate as:

$$(7.10) \qquad i = r_F + \frac{\pi}{1 - \bar{m}}.$$

Because nominal interest is subject to tax, inflation must add more than point-for-point to the nominal interest rate for the real after-tax return to be constant. In our calculations above, we do not mean to claim that inflation does add more than point-for-point to nominal interest. Rather, equation (7.10) is a natural consequence of the standard we use for comparing across inflation rates.

Other standards might be employed, of course, and we now investigate their implications for our results. We stress, however, that the choice of

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by a new investment in any asset using any source of finance. This net rate is always the firm's discount rate, so m cannot affect the gross return p. However, when the income from the asset is retained, distributed, or paid out in interest, different personal tax treatments imply that the net returns s must differ. Thus, when risk is ignored, one can assume either that individuals arbitrage away differences in s, or that firms arbitrage away differences in source of finance, but not both.

standard has nothing whatever to do with an empirical relationship between inflation and nominal interest rates. It merely determines the fixed value of r at which we evaluate effective tax rates. One alternative standard is to follow Fraumeni and Jorgenson (1980), who find a roughly constant real after-tax rate of return in the corporate sector. If corporations successfully arbitrage between bonds and real capital, then the real after-tax return they earn on an investment must be the same as the real net interest saved by retiring a bond, namely, $r_F(1 - \tau)$ with no inflation or $i(1 - \tau) - \pi$ with inflation at rate π. Assuming equality of these expressions across inflation rates implies

$$i = r_F + \frac{\pi}{1 - \tau}. \tag{7.11}$$

Feldstein and Summers (1978), on the other hand, have estimated that inflation adds approximately point-for-point to nominal interest rates. This is described as the result of two countervailing forces within the tax system. Taxation of nominal interest tends to raise i by more than π to keep the real net return constant, while historical cost depreciation and taxation of nominal capital gains tend to reduce the real net return that can be earned. Summers (1981) makes a stronger statement, that nominal interest rates rise by at most the inflation rate, if at all. This empirical finding can be summarized as

$$i = r_F + \pi. \tag{7.12}$$

In the absence of taxes, (7.12) would keep borrowing and lending opportunities independent of the rate of inflation. Since Irving Fisher originally considered the case without taxes, (7.12) has been referred to as "strict Fisher's law" (Bradford and Fullerton 1981). In a tax system where all nominal interest receipts are taxed at the rate τ and all nominal interest payments are tax deductible, (7.11) would keep real borrowing and lending opportunities independent of inflation. This relationship has been referred to as "modified Fisher's law." In the other relationship used above, equation (7.10), we account for varying tax rates on nominal interest income by keeping the average saver's opportunities independent of inflation. It can, of course, be thought of as a different modification to Fisher's law.

When inflation is zero, all versions of Fisher's law imply the same result. When inflation is positive, however, the choice among these standards has an effect on tax rate estimates. Table 7.10 shows overall tax rates for each country, using actual inflation and standard 1980 parameters (only the fixed-r case is presented). In the middle rows of table 7.10, where the standard assumption of equation (7.10) holds, the effective tax rates match those from table 7.2 above. In the bottom set of rows, where (7.11) holds, the effective tax rates in all countries are reduced. Because (7.11) holds constant the real return after corporate taxes, additional

Table 7.10 Overall Tax Rates for Alternative Assumptions about the Effect of Inflation on Nominal Interest, Fixed-*r* Case
(actual inflation, 1980 parameters, %)

		United Kingdom	Sweden	West Germany	United States
$i = r + \pi$	p	1.5	2.3	5.7	3.5
Equation (7.12)	s	0.7	−0.2	1.5	1.3
	$p - s$	0.8	2.6	4.2	2.2
	$(p - s)/p$	51.5	110.2	74.4	62.6
$i = r + \dfrac{\pi}{1 - \bar{m}}$	p	5.5	6.0	8.2	6.8
	s	3.9	2.8	2.9	3.4
Equation (7.10)	$p - s$	1.7	3.2	5.3	3.4
	$(p - s)/p$	30.0	53.6	64.8	49.9
$i = r + \dfrac{\pi}{1 - \tau}$	p	16.1	6.5	13.8	10.4
	s	12.1	3.2	6.0	5.8
Equation (7.11)	$p - s$	4.0	3.3	7.9	4.9
	$(p - s)/p$	24.9	50.8	56.9	45.7

inflation serves to *increase* the real return after personal taxes. To meet the higher required net return, assets must earn more before tax as well. The result is similar to consideration of figures 7.2 to 7.5, where higher rates of return imply lower tax rates.

In the top rows of table 7.10, where strict Fisher's law applies, effective tax rate estimates in each country are increased. Because inflation adds only point-for-point to nominal interest, and because nominal interest is fully taxable in these countries' tax systems, inflation reduces the real after-tax returns s (except for tax-exempt institutions). The assets need only earn a lower pretax return p. While the tax wedges $(p - s)$ are all smaller, as shown in the table, division by small values of p implies higher tax as a proportion of gross returns. In fact, individual pretax returns are often negative under strict Fisher's law, so the use of effective tax rates presents more of a problem generally. We provide p and s separately in the table for this reason.[9]

With strict Fisher's law, the ordering of country tax rates is altered. Germany takes second place, and Sweden acquires the highest tax rate estimate. The inflation rate in Germany is low, however, so the taxation of nominal interest does not reduce s or p as much in that country as it does in Sweden. The high rate in Sweden reflects a low denominator, since the wedge is still higher in Germany.

To give an idea of how these assumptions might affect the breakdown of effective tax rates within a country, table 7.11 presents detailed results for the United States. For any individual combination, p is always lower

9. The choice among equations (7.10) to (7.12) also affects the relation between inflation and effective tax rates. While curves in figure 7.1 correspond to equation (7.10), similar curves could be plotted for each country under each alternative assumption.

Table 7.11 **Effective Tax Rates in the United States for Alternative Assumptions about the Effect of Inflation on Nominal Interest, Fixed-*r* Case**
(actual inflation, 1980 parameters, %)

	$i = r + \pi$ Equation (7.12)			$i = r + \frac{\pi}{1 - \bar{m}}$ Equation (7.10)			$i = r + \frac{\pi}{1 - \tau}$ Equation (7.11)		
	p	*s*	*t*	*p*	*s*	*t*	*p*	*s*	*t*
Asset									
Machinery	2.0	1.3	32.9	4.7	3.5	26.4	7.9	5.9	25.6
Buildings	4.2	1.3	68.7	7.5	3.4	54.1	11.4	5.9	48.6
Inventories	3.2	1.2	62.1	7.3	3.3	54.5	12.0	5.7	52.1
Industry									
Manufacturing	4.4	1.1	75.3	8.2	3.2	61.2	12.5	5.5	55.9
Other industry	2.2	1.5	31.8	4.9	3.7	24.4	8.0	6.2	23.5
Commerce	3.3	1.4	58.6	6.9	3.5	48.8	11.0	6.0	45.7
Source of finance									
Debt	0.3	2.2	−769.9	2.7	4.6	−72.5	5.5	7.3	−32.7
New share issues	10.0	0.8	91.9	15.5	2.8	81.8	21.8	5.1	76.7
Retained earnings	4.7	0.8	82.7	8.4	2.8	66.5	12.7	5.1	60.1
Owner									
Households	3.6	0.1	98.0	7.1	1.9	73.4	11.1	3.9	64.5
Tax-exempt institutions	3.3	5.0	−49.8	6.7	8.1	−21.3	10.6	11.6	−10.1
Insurance companies	1.9	1.5	19.3	4.8	3.8	22.4	8.2	6.2	24.2
Overall	3.5	1.3	62.6	6.8	3.4	49.9	10.7	5.8	45.7

under strict Fisher's law (in the first column) than it is under either modified version of Fisher's law. The tax wedges $(p - s)$ are also lower, but dividing by p provides tax rates that are higher. The subsidy for debt is so large that p is very close to zero, and the subsidy rate is misleadingly large. In fact, since further inflation reduces real net return still more under strict Fisher's law, calculations for 10 percent inflation imply that p is negative for the average debt-financed United States investment. The net return s is small but positive, so this subsidized investment would show a large positive tax "rate."

These sections have demonstrated that effective tax rates $(p - s)/p$ may not be useful indicators of the total tax or subsidy on a given marginal investment. They are not very stable at low values of the pretax return, and they may even have the wrong sign. We recommend great care in their use and interpretation, and, in addition to the tax rate, we suggest using the tax wedge $(p - s)$, which is more stable and always has the right sign.

7.6 Summary

We have tried in this chapter to present effective marginal tax rate calculations in a number of ways for each country. While these results depend fundamentally upon the basic methodology chosen for our study, they depend also on a number of additional assumptions. In particular, the results reflect our decision to look at the statutory provisions that determine the tax liability on a marginal investment in each combination of asset, industry, source of finance, and owner. The precise values of the estimated tax rates depend upon our choice of a given value for the pretax rate of return on all projects in the fixed-p case, and upon our choice for the interest rate earned on all projects in the fixed-r case.

Table 7.12 summarizes the major findings for each country. In the first row the tax rates refer to the fixed-p case, with a pretax annual return of 10 percent on all assets. In the second row they are based on a fixed real interest rate of 5 percent per annum for all assets. These fixed-r results are higher than the corresponding tax rates for the fixed-p case, but the ranking of the countries is the same. We find the highest overall effective tax rates in Germany, followed by Sweden, the United States, and the United Kingdom. As shown above, this ranking is unaffected by the values of p and r at which the tax rates are evaluated. As discussed in chapter 2, it is the fixed-p results that are more relevant for an analysis of the incentive to save and invest.

A major issue in all countries is the effect of inflation on effective tax rates. The overall effective tax rates for inflation rates between zero and 15 percent are plotted for each country in figure 7.1. The surprising result is that taxes in Sweden and the United Kingdom start out at a common 13

Table 7.12 Summary of Overall Effective Tax Rates in Each Case

Table Number	Case	United Kingdom	Sweden	West Germany	United States
7.1	Actual, fixed-p	3.7	35.6	48.1	37.2
7.2	Actual, fixed-r	30.0	53.6	64.8	49.9
7.3	Zero inflation, fixed-p	12.6	12.9	45.1	32.0
7.4	Change in t for change in π, fixed-p	−0.6	2.4	−0.2	0.4
7.5	With U.S. weights, fixed-p	11.6	58.0	57.5	37.2
7.6	With U.S. inflation, fixed-p	8.9	29.5	47.9	37.2
7.7	With U.S. depreciation rates, fixed-p	1.3	35.9	44.2	37.2
7.8	With U.S. depreciation, weights, and inflation, fixed-p	18.9	52.6	52.6	37.2
7.9	With U.S. depreciation, weights, and inflation, fixed-r	42.3	69.8	68.4	49.9

percent mean rate at zero inflation, but they diverge dramatically as inflation increases. Tax rates in Sweden rise with inflation, while those in Britain fall with inflation. In Germany, overall taxes rise initially because of historical cost depreciation, but they eventually fall as nominal interest deductions become more important at higher rates of inflation. The curve for the United States is similarly shaped, but tax rates level off only at a 15 percent inflation rate. At lower inflation rates, the effective marginal tax rates rise with inflation. The fourth row of table 7.12 shows the changes in taxes when inflation increases from 6 to 7 percent in each country.

We tried also to decompose tax rate differences into those attributable to differences in rates of inflation, the allocation of investment, and actual depreciation rates, as opposed to differences in tax parameters themselves. Table 7.12 summarizes these results, indicating that none of these differences taken by itself had a major influence on the spread of tax rates, but that in total they do have some influence. Effective tax rates are somewhat more equal among countries when only tax parameter differences remain.

A very important aspect of our study is not captured by any of these overall effective tax rate calculations. That is, the overall tax rates conceal a wide distribution of individual effective tax rates within each country. To summarize these differences in each country, figures 7.6 to 7.9 provide histograms for the actual inflation rate with 1980 parameters. For the height of each bar in the histogram, we add together the capital stock weights for any individual combinations that are taxed at effective rates falling in each 10 percent interval between −320 percent and +200 percent.

These bounds are chosen because at least one combination in the United Kingdom is taxed at a −312 percent rate. Appendix B shows the individual fixed-p tax rates for each combination, at each inflation rate, in each country. For actual inflation rates, the lowest tax rate anywhere is the -312 percent rate in Britain, for debt-financed machinery in the manufacturing sector, where the debt is held by tax-exempt institutions. At an annual inflation rate of 13.6 percent in the United Kingdom, a considerable inflation premium in the nominal interest rate is tax deductible at the corporate level, but for this combination it is not taxed at the personal level. Machinery receives immediate expensing and in addition qualifies for a cash grant. At the other extreme, Appendix B shows a $+130$ percent rate on an internally financed investment in other industrial buildings in the United Kingdom, where the equity is held by households. Buildings receive only straight-line depreciation, and other industry receives smaller grants than manufacturing. Because of disparate tax treatments of different assets, industries, sources, and owners, figure 7.6 shows a relatively flat distribution of tax rates in Britain. They extend from -312 to $+130$ percent, with no more than 12 percent of the capital stock taxed within a single ten-point interval. This implies a very high variance of marginal tax rates.

A similarly flat distribution is shown for Sweden in figure 7.7. Again, no more than 12 percent of the capital stock is taxed at rates falling within any ten-point interval. In this case, however, the rates range from -116 to $+144$ percent. The investment with the lowest tax rate is a machine in "other industry" financed by bonds sold to tax-exempt institutions. Although the 11.4 percent grant and 30 percent exponential depreciation allowances are the same for machinery in all sectors, machinery in other industry was found to have the highest true rate of economic deprecia-

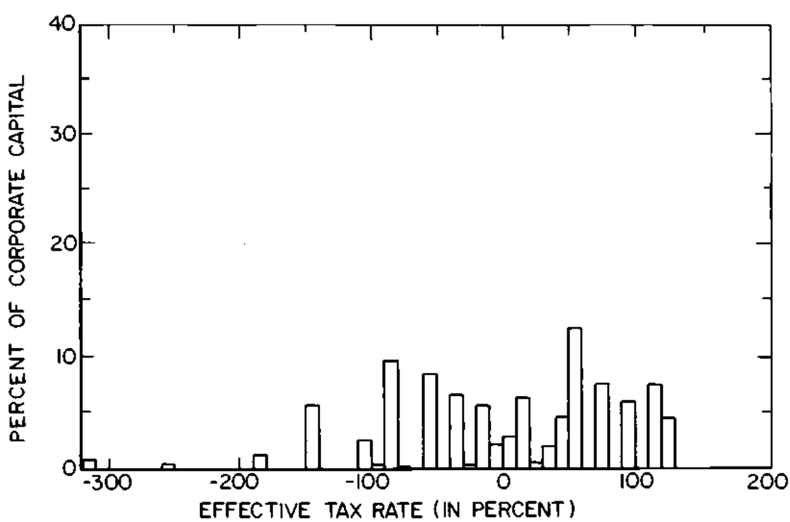

Fig. 7.6 Proportion of investment taxed at each rate in the fixed-p case for the United Kingdom.

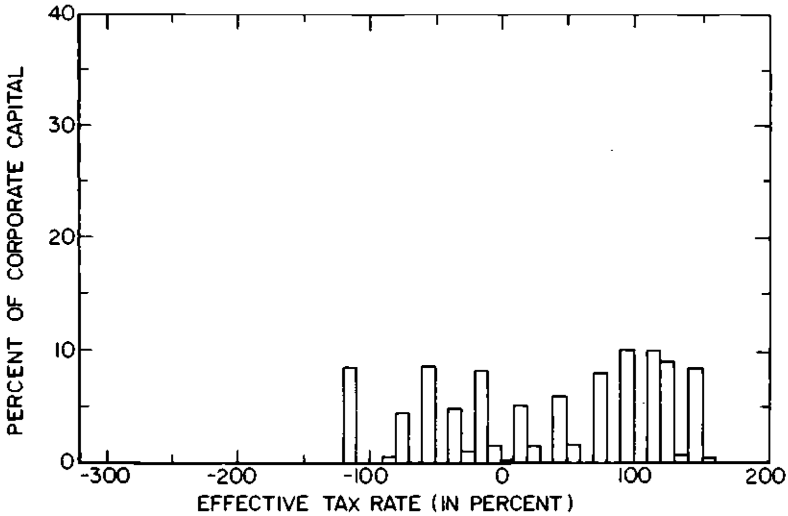

Fig. 7.7 Proportion of investment taxed at each rate in the fixed-p case for Sweden.

tion. Reinvestment qualifies for grants at a faster rate, so this asset has the lowest total tax rate. Other combinations with tax rates less than -110 percent bring the total weight for that interval up to almost 10 percent of total capital in Sweden. The investment with the highest total tax is a building in other industry financed by issuing new shares to households. The Annell deduction in Sweden did not fully mitigate double taxation of dividends in 1980, so earnings on such an investment are taxed by both the corporate and the personal tax systems.

West German investments are taxed at a much narrower spread of rates, as shown in figure 7.8. The lowest tax rate is only -59 percent, on a building in manufacturing financed by debt issued to tax-exempt institutions. Machinery in Germany receives relatively long eleven-year tax lifetimes, as well as a wealth tax rate that is higher than that on buildings. Interest deductions make the lower building tax rates negative. At the other end, the highest rate is "only" 102 percent, on inventories financed internally through equity held by households. (This rate is identical for all industries.) Inventories receive the highest tax rate because of unfavorable inflation accounting practices required for tax purposes, and internal finance receives the highest tax rate because of taxation at both corporate and personal levels. Dividends, on the other hand, receive imputation credit at the personal level for corporate tax already paid.

Unlike the United Kingdom and Sweden, Germany and the United States have most of their capital stock taxed at rates between zero and 100 percent. Figure 7.9 shows that nearly 30 percent of United States capital is taxed at rates between 80 and 90 percent. Because another 30 percent

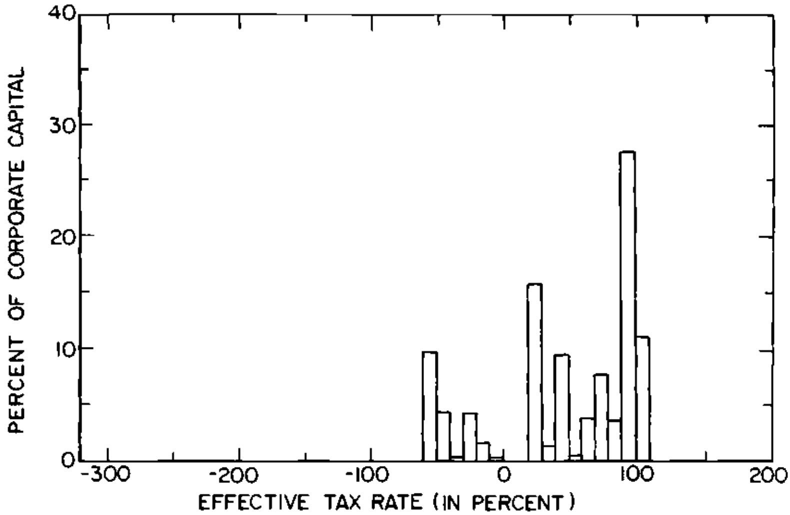

Fig. 7.8 Proportion of investment taxed at each rate in the fixed-*p* case for West Germany.

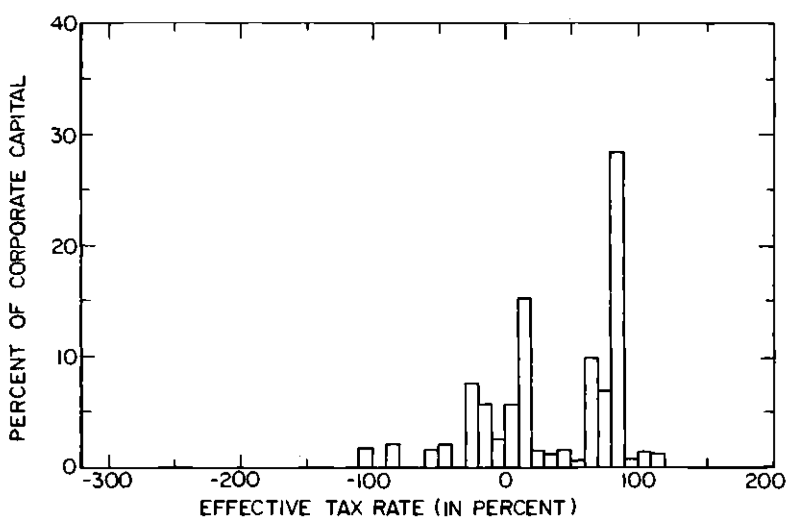

Fig. 7.9 Proportion of investment taxed at each rate in the fixed-*p* case for the United States.

of United States capital is taxed at rates between −30 and +20 percent, and because rates extend down to −105 percent, the weighted-average marginal tax rate is found to be 37 percent in this fixed-*p* case. As in all other countries, the least-taxed investment in the United States is financed by debt sold to tax-exempt institutions, but in this case the asset is machinery used in the commercial sector. This asset receives lower grants in commerce and the same depreciation allowances in all sectors, but the faster actual depreciation rate in commerce means that reinvestment qualifies for those tax advantages more often. The highest tax rate in the United States is + 111 percent, on buildings financed by new shares sold to households, in either manufacturing or commerce. Buildings receive less-accelerated depreciation allowances, while dividends are fully taxed at both corporate and personal levels.

In general, we find that the histograms in figures 7.6 to 7.9 provide much more useful information than individual overall tax rates in each of the four countries studied.

These disparate tax treatments in each country would be eliminated under a comprehensive income tax—that is, with full integration of corporate and personal tax systems, economic depreciation at replacement cost, no special grants or incentives, no wealth taxes, full indexing, and the full taxation of accrued real capital gains. In such a case, all investments would be taxed at the weighted-average personal tax rate. For comparison purposes, in table 7.13, we calculate this marginal personal tax rate in each country, taking weighted averages over household rates on debt and on equity. In order to capture a comprehensive tax concept, we do not include tax-exempt institutions or insurance companies, nor do we reduce personal rates to account for returns earned in the form of tax-free banking services. The United States, the United Kingdom, and West Germany are very close together, at 43–44 percent tax rates, and Sweden is at a 57 percent rate. Histograms under such a hypothetical comprehensive income tax would collapse to a vertical line at the country's single tax rate, applied to 100 percent of the capital stock. Under a comprehensive consumption or expenditure tax, the histograms would collapse to a vertical line at a tax rate of zero.

We do not mean to imply that countries could easily switch to a comprehensive income tax, or that to do so would be desirable. Rather, these calculations demonstrate another striking contrast: the overall effective rate in Britain is a full forty percentage points below the average marginal personal rate, the overall effective rate in Sweden is twenty-one points below the average personal rate, the effective rate in the United

Table 7.13 **Comparison with a Comprehensive Income Tax** (%)

	United Kingdom	Sweden	West Germany	United States
Weighted-average personal rate on debt and equity (m)	44.0	57.3	44.4	43.1
Overall effective rate (t)	3.7	35.6	48.1	37.2
Difference ($m - t$)	40.3	21.7	−3.7	5.9

Source: Own calculations as described in the text.

States is six points below the personal rate, and the effective rate in West Germany is several points *above* the personal rate. Our four countries are quite different in this respect.

Finally, we might naturally ask about the implications of these effective tax rates for economic growth in each country. Clearly, this is not a study about comparative capital formation, income growth, or living standards in the four countries. We have attempted to measure effective marginal tax rates in each country in a number of ways, but we have not tried to use these estimates to measure effects on growth, excess burdens, or income distribution. Nevertheless, it is interesting to look at some summary growth statistics in light of our tax rate findings. To this end, the bottom row of table 7.14 reproduces our standard 1980 fixed-p overall effective tax rates, and the top rows show two average annual growth rates in constant dollars from 1960 to 1980 in each country. The first growth rate is for GDP, and the second is for the nonfinancial corporate capital stock, excluding inventories.

The results are surprising to say the least. If we rank the four countries by their average annual growth in GDP, we obtain exactly the same order as when we rank by 1980 effective tax rates. West Germany has the highest overall effective tax on income from capital *and* the highest growth rate. The United States is second in both categories, and Sweden is third. The United Kingdom has the lowest overall effective tax on income from capital *and* the lowest growth rate. If we look at growth of nonfinancial corporate capital, results are substantially the same. The United States and Sweden are reversed, but Germany is still the highest and Britain is the lowest.

Table 7.14 **Comparison with Alternative Growth Rates**
(%)

	United Kingdom	Sweden	West Germany	United States
Average annual growth of GDP in constant prices (1960–80)	2.3	3.2	3.7	3.5
Average annual growth of nonfinancial corporate capital in constant prices (1960–80)	2.6	4.7	5.1	3.7
Weighted standard deviation of 1980 tax rates	86.2	82.9	53.5	52.5
Coefficient of variation	2314.9	232.7	111.2	140.9
Overall effective tax rate				
1960	53.8	33.9	52.5	48.4
1970	33.6	41.6	49.1	47.2
1980	3.7	35.6	48.1	37.2

Source: United Kingdom: Blue Book. Sweden: National accounts. Germany: Bundesbank and Statistical Office. United States: *Survey of Current Business.*

Nothing here should be construed to imply causation in either direction. It is certainly possible that the slower-growing countries have reacted to their slow growth by providing more investment incentives that reduce overall effective taxes. As can be seen in the bottom three rows of the table, tax rates have changed over time, in some cases markedly. For example, tax rates in the United Kingdom were very high in 1960 but have fallen dramatically since then. This reduction in rates may lead to higher investment in the future than would otherwise have taken place. It is also possible that high growth is associated with high taxes on capital if these taxes are somehow less distorting than alternative taxes on labor income.[10]

Table 7.14 also shows the weighted standard deviation of 1980 effective tax rates in each country. This is a measure of the dispersion of rates that can be seen in each of the histograms discussed above. If this standard deviation is divided by the mean of the distribution (the overall effective tax rate) and expressed as a percentage, we have the coefficient of variation in the next row of the table.

Another startling result is the ordering of countries according to these coefficients of variation. Britain has the highest variation of tax rates on different combinations *and* the lowest growth from 1960 to 1980. Sweden is second for both parameters, and the United States is third. Germany has the lowest coefficient of variation and the highest overall growth.[11]

These correlations do not, of course, prove that diverse effective tax rates inhibit growth. Rather, the correlations in table 7.14 are interesting in themselves. They suggest many possible interpretations and hypotheses, some of which will, we hope, be investigated further and tested using the estimates of tax rates and data on individual countries that we have produced in the course of this study.

10. See Fullerton and Gordon (1983) for some elaboration and testing of the idea that replacement of capital taxes with a labor tax of equal yield can provide a welfare gain.

11. Harberger (1966), of course, suggests that varying effective tax rates cause capital misallocations and inefficient production. These could reduce overall growth. For this purpose, however, the standard deviations are more meaningful than the coefficients of variation.