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Luxembourg Income Study Working Paper Series

Working Paper No. 102

**Combining Consistency with Simplicity When Estimating
Tax Incidence: Alternative Assumptions and
Findings for Three Countries**

Clive Bell and Christoph Rosenberg

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COMBINING CONSISTENCY WITH SIMPLICITY WHEN ESTIMATING
TAX INCIDENCE: ALTERNATIVE ASSUMPTIONS AND FINDINGS FOR
THREE COUNTRIES

by

Clive Bell and Christoph B. Rosenberg*

September, 1993

Abstract

This paper identifies and examines three forms of potential inconsistency that can arise in the Pechman-Musgrave method of estimating the distribution of the total tax burden using microdata sets. It develops proposals to remedy these failings, while preserving the simplicity of the method. Several variants of shifting assumptions are formulated for analysis, in which the indexation of transfer incomes and the international mobility of capital play a central role. These variants are applied to data from the Luxembourg Income Study for Germany, Sweden and the U.S. The resulting patterns of effective tax rates are quite sensitive not only to whether transfers are indexed, but also, in the case of the U.S., to whether capital is so mobile as to escape the burden of all taxes.

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1. INTRODUCTION

The late Joseph Pechman's empirical studies of the distribution of the tax burden in the United States (Pechman and Okner, 1974; Pechman, 1985) are undoubtedly classics in the field. Along with the contemporary study of Browning and Johnson (1979), they represent the culmination of a line of work that goes back to Musgrave et al. (1951) and earlier. The hallmark and strength of this approach is its combination of simplicity and detail, the unit of analysis being the individual household and the information being drawn from large-scale surveys. A salient weakness is that the framework is not theoretically tightly specified in all respects, so that its implementation is prone to internal inconsistency. Thus, the approach stands in marked contrast to that based on applied general equilibrium models, in which some disaggregation over commodities and factors is necessarily combined with rather crude groupings of households, but internal consistency is almost certainly ensured.¹

This paper has two aims: first, to set out the framework in a consistent form, while preserving both its simplicity and some flexibility in the choice of assumptions. In doing so, we shall focus on three sorts of inconsistency that can arise and on two key issues, namely, the indexation of transfer incomes and the incidence of taxes on capital. The second aim is to apply the framework empirically, using several sets of shifting assumptions on data from the "Luxembourg Income Study" (LIS). For this purpose, we have chosen the Federal Republic of Germany, Sweden and the U.S., which have quite different social and fiscal policies. The findings are not only interesting in themselves, but they also yield insights into the robustness of estimates of the distribution of individual tax burdens both to the removal of inconsistencies and to changes in assumptions concerning these key assumptions.

The first inconsistency arises in connection with the calculation of the income base, which is the level of income a household would receive in the hypothetical absence of all taxation. Whenever a factor tax is shifted, the owners of the factor in question should not bear any part of the burden that is shifted; for otherwise the actual economic incidence of the tax will depart from the stated assumption concerning its incidence. Yet Pechman allocates the shifted portion of taxes on particular factors to total income from all factors and transfers. When, for example, a part of the corporate or payroll tax is assumed to be shifted to consumption, he treats the said amount as an indirect tax, which is then distributed across households in proportion to their total incomes (Pechman and Okner, 1974, p.91). Such a procedure leads to the anomalous result that if the corporate tax were wholly shifted and a household derived all of its income from dividends, then the household would not escape the tax at all. Instead, the shifted portion of any factor tax should be allocated only to that portion of income in each category which is assumed not to escape the burden of the tax in question.

Second, there is an inconsistency in his method of computing effective tax rates when a tax is assumed to be shifted forward onto consumers. In the case of a general sales tax, for example, the tax is allocated according to the uses of income when calculating individual tax burdens, but it is allocated according to the sources of income when calculating the levels of the corresponding income base. We shall argue that the individual burdens of all indirect

taxes should be allocated instead according to incomes by source, depending on the precise shifting assumptions employed.

The third inconsistency arises when a factor is assumed to escape the burden of some taxes but not others. To give an example, Pechman (1985, p. 35) assumes both that capital cannot escape any part of the income tax, which implies that the supply of capital is completely inelastic, and that the sales tax is wholly shifted forwards onto consumers, which implies that the supply of capital is perfectly elastic. A similar problem afflicts the "Alternative" analysed by Browning and Johnson (1979, p. 36). This form of inconsistency in the treatment of incidence where a particular factor is concerned was first pointed out by Prest (1955) in a critique of Musgrave et al. (1951). Avoiding it will impose tight limits on the admissible menu of shifting assumptions, as will become clearer in Section 4.

There are, of course, other shortcomings in Pechman's approach. The omission of excess burden is fundamental and surely at odds with reality. To deal with this shortcoming, some form of general equilibrium analysis would be needed; but this would also wholly defeat any attempt to preserve simplicity and individual detail.² Other shortcomings, such as the definition of capital income, stem from the practical details of implementing the approach³.

In any application of the method, the empirical plausibility of certain key assumptions must also be discussed. Whereas Browning and Johnson argue that transfers in the U.S. were effectively wholly indexed (1979, p. 19), Pechman assumes that they were not indexed at all. Since transfers account for a large proportion of total income among poorer households, it is no great surprise that this difference in assumption should result in their arriving at fundamentally different findings concerning the progressivity of the tax system. Legislation and practice may not, however, yield full indexation in other countries. At the time of the survey, pensions and unemployment compensation in Germany were linked to the level of the average wage in the preceding three-year period (Bäcker et al., 1989). Thus, at most one half of all transfer incomes were indexed to the cost of the relevant bundle of commodities. Given these variations across countries, and given the fact that how these policies functioned in practice is open to debate, we shall analyse the data for each country under both of the extreme assumptions that can be made.

The second key assumption concerns the incidence of taxes on capital. If the supply of capital is fixed and markets are competitive, the burden of these taxes will fall wholly on the owners of capital. This is largely the position adopted by both Pechman and Browning and Johnson, though, as noted above, neither is fully consistent. In a world in which capital has become highly mobile and international capital markets have become extensively integrated⁴, it is surely hazardous to assume that the burden of taxes on capital is indeed so distributed, especially if the ensuing results are interpreted as pertaining to the long run. We have therefore analysed two variants in which, by virtue of such mobility, capital is assumed to escape the burden of all taxes.

The plan of the paper is as follows. Section 2 deals with the determination of the income base. Various assumptions concerning the mobility of capital and the indexation of transfers are examined within a competitive framework in which a single good is produced by means of capital and labor. Four cases are analyzed, of which one is closely related to a variant in Pechman (1985), a second corresponds to the main variant in Browning and Johnson (1979), and the remaining two involve the assumption that capital bears none of the burden of taxation. The potential problems that arise in the estimation of effective rates of taxation when there are indirect taxes are taken up in Section 3, and those of assembling a set of internally consistent assumptions about shifting in Section 4. In section 5, we comment on the quality of the data and give an account of the changes which we felt compelled to make therein. The empirical estimates of the distribution of the tax burdens for each country and each of three variants of shifting assumptions are presented and discussed in Section 6, and the main conclusions follow in Section 7.

2. THE DETERMINATION OF THE INCOME BASE

In order to calculate the real burden of taxes, it is essential to have the correct income "base", which is defined to be the level of income that would rule in the absence of all taxation. There is a consensus in the literature that simply adding up all factor and transfer incomes will not, in general, yield such a base⁵. For the base refers to a hypothetical world, whose configuration depends on the nature of the shifting assumptions that define it in relation to the world that is actually observed. As we will now demonstrate, the associated pitfalls are especially severe if one assembles these assumptions in an ad hoc fashion.

Consider the simple competitive model in which a single good is produced under constant returns to scale and let output be the numeraire. If factors are supplied completely inelastically, then all taxes on them will be borne wholly by their owners, while relative factor costs to firms, and hence the levels of employment of factors, will be unaffected by the imposition of such taxes. This is the case where factor taxes are not shifted: in the absence of taxation, factor incomes would be equal to their respective before-tax levels in the presence of taxation.

Now suppose, instead, that capital is fully mobile across international borders, and that it commands a net rental (measured in terms of the numeraire) whose level is given independently of domestic taxes. All taxes on capital will be shifted, the cost of capital to domestic firms will rise by the full amount of those taxes, and firms will substitute away from capital. . As other factors are supplied completely inelastically, their real rentals will fall. The upshot will be a higher level of its employment abroad, the domestic endowment of capital being given.

With this benchmark in mind, we turn to Pechman's procedure when part or all of a tax on a factor is shifted forward. First, he treats the tax in question as an indirect tax. Then, in order to arrive at the income base, or "adjusted family income", as he calls it, he adds this

amount to the value of total family income (Pechman, 1985, p. 18). In the aggregate, this is quite correct. In order to arrive at the individual levels of adjusted family income, however, he allocates the aggregate among households in the same proportions as their shares in total family income (*ibid.*, p. 18; Pechman and Okner, 1974, p. 91)⁶. There are two major problems with this procedure. First, although it is assumed that shifting occurs, the calculation actually implies that the owners of that factor bear part of the burden associated with the amount so shifted, even if they have no other sort of income. The procedure will, therefore, generate a computed pattern of tax incidence among households which is likely to be far removed from what the statement of the assumed pattern of incidence among factors would suggest in relation to households' ownership of factors. Second, even if this inconsistency is remedied, the allocation of the burden among households will not be correct if transfer incomes are at all indexed.

In order to deal with the first problem, it is necessary to perform the calculations in a way that is consistent with the assumptions about shifting. The method will now be laid out formally, in the course of which the question of indexation will also be taken up. Four sets of shifting assumptions are formulated, three of which will form the bases for the variants used in the empirical analysis in Section 6.

Let K_h , E_h , R_h and S_h denote the income of household h from capital, employment (wages and salaries), transfers and self-employment, respectively, all before tax and measured in terms of the numeraire. Then the household's levels of total income before and after tax are, respectively,

$$(1) \quad Y_h = K_h + E_h + R_h + S_h$$

and

$$(2) \quad Y'_h = Y_h - T_h,$$

where T_h denotes its payments of direct taxes. Pechman calls Y_h "family income" (1985, p.12). Summing over all households, we have aggregate income before tax:

$$(3) \quad Y = \sum_h Y_h.$$

The aggregates K , E , R , S and T are analogously defined. We shall also need the household's shares in various aggregates. Let the shares of household h in aggregate income and aggregate factor income be denoted by

$$(4) \quad \omega_h = Y_h/Y$$

and

$$(5) \quad \phi_h = (K_h + E_h + S_h)/(K + E + S),$$

respectively.

Following Pechman (1985) and Browning and Johnson (1979), we ignore all deadweight losses of taxation. They also make the specific assumption that each category of factor income will bear its statutory burden under the income tax, the theoretical basis for which is set out above. Then Y^*_h , the household's income in the absence of taxes on factors, would be equal to its gross income before tax:

$$(6) \quad Y^*_h = Y_h.$$

As noted in the Introduction, a plausible alternative assumption is that all taxes on capital are shifted. If this burden is borne by households in proportion to their total non-capital incomes (that is, if transfers are not indexed), then

$$Y^*_h = (K_h - T_{hk}) + (E_h + R_h + S_h) + \theta_h T_k,$$

where T_{hk} is the statutory tax burden of household h arising from its ownership of capital, T_k is the corresponding aggregate, and

$$\theta_h = (Y_h - K_h)/(Y - K)$$

is the household's share of aggregate, non-capital income. Using (1), we have

$$(7) \quad Y^*_h = Y_h + [\theta_h - T_{hk}/T_k] T_k.$$

Comparing (6) and (7), it is seen that the effect of this change in assumption depends on the difference between θ_h and the household's share of the aggregate statutory burden, scaled by the size of that aggregate. Summing (7) over all h and noting that $\sum_h \theta_h = 1$, we obtain $Y^* = Y$, as required.

The next step is to incorporate indirect taxes, T_c , into the accounting. Again, we ignore any deadweight losses, so that aggregate income in the absence of all taxation would be

$$(8) \quad Y^* = Y^* + T_c.$$

Pechman allocates the burden of these taxes in proportion to family incomes (1985, p. 18). Thus, what he calls "adjusted family income" is

$$(9) \quad Y^*_h = (1 + t_c) Y^*_h,$$

where $t_c = T_c/Y^*$ is the ratio of aggregate indirect taxes to aggregate (unadjusted) "family income", and Y^*_h is given by eq.(6). Adjusted family income is Pechman's income base for the calculation of effective tax rates.

Browning and Johnson (1979, pp. 27-28), arguing that transfers are indexed and the lifetime propensity to consume is the same for all households, allocate the burden in proportion to factor incomes. Thus, Browning and Johnson's income base is

$$Y^*_h = Y^*_h + \phi_h T_c,$$

where Y^*_h is also given by eq.(6). Recalling the definitions of ω and t_c , this income may be written as

$$(10) \quad Y^*_h = [1 + (\phi_h/\omega_h)t_c] Y^*_h.$$

Comparing (9) and (10), we see that in the latter, t_c is weighted by the ratio of the household's share of aggregate factor income to its share of total income. If a household depends heavily on transfers, this ratio will be close to zero.

Under the alternative assumption that capital escapes the burden of taxes entirely, there remains the question of whether transfers are indexed. If they are not, then the clearest case is that where they are tied to the after-tax wage measured in units of output, as in eq. (7). In that case, the burden of indirect taxes should be distributed in proportion to households' non-capital incomes, so that the income base is

$$(11) \quad Y^*_h = [1 + (\theta_h/\omega_h)t_c] Y^*_h.$$

This differs from (10) not only in the substitution of θ_h for ϕ_h , but also in that Y_h^* is now given by eq. (7) rather than eq. (6).

At the opposite extreme, where transfers are fully indexed, the burden of all taxes must be borne by employees and the self-employed. This requires a change in eq. (7), as follows. Let the share of household h in aggregate labour income be denoted by

$$\lambda_h = (E_h + S_h)/(E + S).$$

Then λ_h replaces θ_h , first in (7), yielding

$$(12) \quad Y_h^* = Y_h + [\lambda_h - T_{hk}/T_k] T_k,$$

and then in eq. (11), yielding

$$(13) \quad Y_h^* = [1 + (\lambda_h/\omega_h)t_c]Y_h.$$

To sum up, we have four measures of the income base for the calculation of effective rates of taxation, which correspond to the possible combinations of two assumptions each about the economic incidence of factor taxes and about the extent to which transfers are indexed:

Case 1 (Pechman). Owners of factors bear their statutory tax burdens; transfers are not indexed. The income base, Y_h^* , is defined by eq. (9), where factor income in the absence of factor taxation, Y_h^* , is given by eq. (6).

Case 2 (Browning and Johnson). Owners of factor incomes bear their statutory tax burdens; transfers are fully indexed. The income base is defined by eq. (10), where Y_h^* is given by eq. (6).

Case 3. Capital bears no real burden; transfers are not indexed. The income base is defined by eq. (11), where Y_h^* is given by eq. (7).

Case 4. Capital bears no real burden; transfers are fully indexed. The income base is defined by eq. (13), where Y_h^* is given by eq. (12).

3. EFFECTIVE RATES OF TAXATION

The real tax burden of a household, B_h , is the difference between the income it would receive in the absence of all taxation and its actual after-tax income:

$$(14) \quad B_h = Y_h^* - Y_h',$$

so that the corresponding effective (average) rate of taxation is

$$(15) \quad \tau_h = B_h/Y_h^*.$$

When dealing with indirect taxes, or any tax that is shifted forward onto consumers, Pechman employs "adjusted family income" as defined in eq. (9) as the denominator in eq. (15) [Pechman and Okner (1974, pp. 18-20, 91), Pechman (1985, p. 18)]. Thus, the said taxes are allocated according to the sources of income. When calculating the $\{B_h\}$, however, he allocates these taxes in proportion to households' total expenditures (1985, pp. 28, 34), and hence to the uses of income. It follows that Pechman's procedure involves one definition of the income base in the denominator of eq. (15) and another in the numerator. As these

definitions are equivalent only if all households have the same propensity to consume, the procedure almost certainly will be inconsistent in practice.

In order to remedy this inconsistency, we propose instead that such taxes be allocated to the sources of income at all stages of the estimation of real tax burdens. In itself, this proposal is not new. Browning and Johnson (1979), for example, also allocate all taxes to the sources side; but their grounds for doing so are specific to their assumption that transfer incomes are effectively indexed, so that the burden of taxes must fall on other types of income (1979, p. 3). It is clear from Section 2, however, that while it is necessary to make a well-defined assumption concerning the indexation of transfer incomes in order to arrive at a consistent income base, it is certainly not necessary to assume full indexation. Thus, as legislation concerning indexation varies across countries (as, indeed, does some opinion concerning its practical workings in a given country), this proposal must be more generally grounded.

The source of the problem is the existence of life-cycle effects. It is well known that income, savings and the propensity to consume all vary over an individual's lifetime, regardless of whether bequests are made. A snapshot picture of income and consumption at any point in time will contain individuals at different stages of the life-cycle, and will therefore overstate the true degree of heterogeneity in the population. Since current consumption is heavily influenced by lifetime income, and the intertemporal pattern of consumption is smoother than that of income, it could be argued that allocating taxes according to expenditures, as Pechman does, will get closer to the true pattern of lifetime incidence than will allocating them according to current incomes. The difficulty with this argument is that the estimates of the denominator in eq. (15) must be based on current incomes, which is all the snapshot captures. Of those households with a high current propensity to consume, many have current incomes that are below their 'normal' levels, due to unemployment or ill-health, and those in retirement will typically have lower incomes than they did in their prime, and may be drawing down the assets they accumulated during that period. Hence, allocating the burden of taxes according to current consumption and using current income to arrive at the income base will result in an underestimate of the progressivity of the pattern of effective rates of taxation. Allocating all taxes instead according to the sources of income partially corrects for this overstatement of the real tax burdens on those with a high current propensity to consume.

There is, however, no such simple solution to the problem that incomes also vary over the life-cycle and that lifetime resources vary across individuals. This is a difficulty common to all the procedures considered here, and in ignoring it, all tend to obscure the true degree of progressivity in the pattern of tax burdens.

Once one accepts the proposition that it is the lifetime incidence of taxes that really matters, which is implicit in the above discussion, then the use of snapshot data becomes inherently problematic. Panel data, if collected fairly frequently, would provide a general solution in principle, but the practical problems are enormous⁷.

4. ON THE CONSISTENCY OF SHIFTING ASSUMPTIONS

A third form of inconsistency can arise when a set of variants for analysis is assembled from a range of various assumptions. A clear requirement is that each of the resulting variants should be internally consistent, in the sense that the assumed pattern of incidence with respect to one tax should not contradict that with respect to another. Although this is a general point, the sort of difficulties that can arise are best illustrated through examples.

Pechman considers eight variants in all, each corresponding to a particular set of shifting assumptions (1985, p. 35). In his Variants 2b and 3b, he assumes that one half of the employer's statutory payment of the payroll tax is borne by employees and the other by consumers. Now, given the assumption common to all variants that taxes on labor income are borne wholly by suppliers of labor, it is certainly consistent to assume that the whole of the payroll tax is borne by employees, as in Variant 1b. To assume, however, that one half is shifted forward onto consumers is implicitly to assume that a common economic process of wage determination should produce one sort of outcome when a tax on labor has the label "Income Tax" and a qualitatively different outcome when the label is changed to "Payroll Tax". Since a second common assumption is that all sales taxes are borne by consumers, it follows that all of Pechman's variants fail to meet this test of internal consistency.

It should be noted also that whereas Browning and Johnson's "Competitive Variant" (1979, p. 26) is quite free of such inconsistency, their "Alternative", which appeals to empirical studies with a perspective of imperfect competition, is certainly not so. Thus, allocating the burden of taxes according to the sources of income, as proposed in Section 3, does not suffice to avoid this potential error.

We consider next the salient assumption of Cases 3 and 4 that capital escapes the entire burden of taxation. This would come about if capital were completely mobile and there existed an untaxed (or untaxable) activity yielding a fixed return measured in units of the numeraire. A potential inconsistency arises, therefore, if assets differ in their degree of mobility and no allowance is made for these differences. In the long run, this difficulty is not so troubling where reproducible capital is concerned; for physical depreciation 'releases' the capital embodied even in very durable structures such as plant and buildings. This argument is much harder to sustain in the case of land. It is valid if land and reproducible capital are very good substitutes in production, and some reproducible capital is employed in taxed activities. Taxes on capital will then affect the allocation of reproducible capital among activities, but not the after-tax return on all assets. Otherwise, it seems desirable to treat land separately from other assets. In any event, Cases 3 and 4 should be construed as pertaining to a longer run than either of Cases 1 and 2.

The conclusion to be drawn from this discussion is that it is dangerous to assemble the findings of independent and methodologically diverse studies of various taxes, and then to

choose combinations of assumptions based on the plausibility of each when considered separately.

5. THE DATA

The principal data pertain to representative subsamples⁸ of households in the "Luxembourg Income Study" (LIS), the information in which covers more than fifty income and tax variables, and is closely comparable across countries.

The definition of income was kept as close as possible to that of Haig-Simon. Thus, employers' non-mandatory contributions, which are presumably fringe benefits of various kinds, were included in employment income. The reported amounts are quite substantial in the cases of both Sweden and the U.S. LIS also contains information on the values of an extensive assortment of transfers. Understandably, the households' claims on the retained earnings of corporations are absent. Since dividend income is not reported as a separate category, the aggregate retained earnings reported in OECD (1989) were suitably scaled and then allocated among individual households in proportion to their property incomes⁹.

In a number of respects, however, we had to depart from this ideal definition quite substantially. Where factor income is concerned, there are no estimates of the imputed rentals of owner-occupied dwellings; and although the values of such dwellings are reported, close examination revealed them to be unuseable for such an imputation. Turning to transfer incomes, LIS omits certain in-kind benefits in the form of private goods, such as the public provision of individual medical services and schooling. The omission of the benefits of public goods, such as defense and public health, the estimation of which involves well-known difficulties, requires no particular commentary.

A general difficulty arises in connection with the property tax. Many households paid property taxes, but reported no property income, an anomaly stemming from the absence of estimates of the imputed rentals of owner-occupied dwellings. This problem is especially marked in the U.S., and there, among lower-income households. In Germany and Sweden, the proportion of households reporting the payment of property taxes is small, but the anomalous cases are also relatively numerous. In the absence of the said imputed rentals, there is no satisfactory solution to this problem. The choice lies between omitting the corresponding taxes, with an unclear effect on the pattern of effective tax rates, and retaining them. A clear theoretical argument in favor of the former arises when property taxes finance local public goods and there is Tieboutian competition among jurisdictions. In this case, the taxes measure the corresponding benefits received; so that a household bears no net burden in connection with this tax. On balance, then, this choice seems the better of the two.

An examination of the data on payroll taxes revealed that the quality of those for the U.S. leaves something to be desired. In 1979, the statutory combined rate stood at 13 per cent. Yet almost half of the sample reported a higher rate, with numerous cases exceeding 16 per cent. Again, the problem is more marked among lower-income households. In those cases

where the reported combined rate exceeded 13 per cent, we decided to accept the reported amounts of wages, salaries and self-employment income as valid, and then applied the combined statutory rate to them. As can be seen from the statements of shifting assumptions in Section 6, combining the various portions of the payroll tax in this way poses no difficulty for any of the Cases analysed there. The data for Germany and Sweden are internally consistent, in that the implicit rates are fairly uniform, especially for Sweden. Thus, no modifications to the LIS data were made in these cases¹⁰.

Finally, there were a very few obvious instances of severe reporting or transcription errors, in which a household's income taxes exceeded the sum of its factor and transfer incomes. All were discarded. Such examples suggest that a good deal of noise may remain in the data; but we resisted the temptation to massage them further.

6. THE RESULTS

We estimated the effective rates of taxation for each of the three countries, using three different alternatives. The alternatives are as follows, the exact shifting assumptions under each being set out in Table 1.

Case 1. We selected Pechman's Variant 1b, first, because it conforms most closely to Case 1 in section 2, the theoretical underpinnings of which are clear¹¹. Second, under Pechman's calculations, this variant yields one of the most progressive patterns of tax incidence among his set of eight. Since one of our alternatives assumes full indexation of transfers, which will impart a strong measure of progressivity to the pattern of incidence, it seems desirable to control for progressivity at the outset if comparisons thereof across alternatives are not to be confounded. Third, inspection of all eight variants suggests that Variant 1b is less heavily contaminated by internal inconsistency than the others. This choice therefore reduces the force of another possible confounding factor in the comparisons that follow.

It must be emphasized, however, that all calculations were performed in the manner described by Pechman. Thus, no attempt was made to purge them of the inconsistencies identified in Sections 2-4. In consequence, there are important departures from what is labelled "Case 1" in Section 2, which is consistently specified.

Cases 3 and 4. Two comments should be made. First, the corporation income tax is treated, in effect, as a partial factor tax. Second, for the reasons given in Section 5, taxes on property are omitted from the analysis entirely. Thus, the potential inconsistency in the treatment of different assets that was discussed in Section 4 does not arise in this particular empirical application.

The composition of income by source (K, E, R, S) and decile for each country is depicted in Figures 1a-1c. In all three countries, the proportion of family income derived from labor (E + S) generally increases with family income, whereas that from transfers (including pensions) decreases, although neither does so monotonically. When transfers are

indexed, as in Case 3, the former proportion plays a key role in determining the pattern of economic incidence. When they are not, as in Cases 1 and 4, it is the sum of the two proportions that has a central influence. In all countries, this sum is close to unity for virtually all deciles: indeed, for many deciles, the share of capital income is almost negligible. There are, however, some differences. In Germany, the combined proportion is unity except at the extreme tails and in the exact middle of the distribution. In Sweden, by contrast, all deciles report some capital income, the corresponding share having a sharp peak at the third decile and then falling off rapidly, with a minimum at the top decile. The pattern for the U.S. is similar to the Swedish one. The share of capital income increases sharply at first, also reaching a peak of almost one-third of family income in decile 3, and then fluctuates between three and twelve per cent¹².

We are now in a position to examine the patterns of incidence, which are depicted in the form of effective tax rates in Figures 2a-2c. For each country, one can say that one pattern is more progressive than another if the graph of the former intersects that of the latter just once from below. If the graphs intersect an odd number of times, one pattern will be more progressive with respect to the end-points, and in that sense, it may be called 'broadly' more progressive. The ranking will, however, be reversed somewhere in the distribution, so that there is an ambiguous pattern of (relative) progressivity overall.

Taking each country in turn, in Germany, the difference between Cases 1 and 4, in which transfers are not indexed, is rather small. Both are broadly and moderately progressive, but neither is monotonically so. In Case 1, there is a slight fall in the effective rate between the first two deciles, which is a consequence of how indirect taxes are allocated, as discussed in Sections 3 and 4. In Case 4, the fall in the rate between the fourth and fifth deciles is attributable to the sudden appearance of significant income from capital in the fifth decile, capital bearing no burden in this variant. Turning to Case 3, in which transfers are indexed, the overall pattern is strongly and monotonically progressive, as one would expect from Figure 1a in the face of a progressive income tax schedule. While the pattern is not unambiguously more progressive than those for Cases 1 and 4, it is almost so, as can be seen from the narrow differences between their graphs between the sixth and eighth deciles.

The picture for Sweden is generally similar, despite certain differences in the composition of income across deciles. The graphs for Cases 1 and 4 follow each other very closely, there being five intersections in all. Both are broadly and moderately progressive, and that for Case 1 is monotonic over the lower half of the distribution. Given their associated assumptions, the behavior of the share of labor income across deciles and a flat payroll tax of 33 per cent, these findings are not very surprising. The fact that both graphs tend to level off from the sixth decile onwards suggests that the income tax schedule adds little effective progressivity to the system at the higher end of the range. What does make a radical difference, especially to the lower half of the distribution, is the assumption that transfers are fully indexed. Since the share of income from labor rises steadily from a small base up to the fifth decile and then jumps sharply, the corresponding graph is steep over that range and then

flattens off. The pattern is unambiguously more progressive than that of Case 1; but there is a slight ambiguity where the comparison with Case 4 is concerned. The two graphs run close together, but intersect thrice between the fifth and eighth deciles, which appears to be the result of the sudden jump in the importance of transfers in the seventh decile.

In the case of the U.S., in contrast, the difference between Cases 1 and 4 is quite marked, especially over the lowest three deciles. Whereas the overall pattern for Case 1 has the general U-shape that is characteristic of Pechman's variants, the pattern for Case 4 is broadly progressive and almost monotonic. The "disturbances" to both graphs at the third decile, which run in opposite directions, are attributable to the sudden and large change in the importance of capital as a source of income both before and after this decile. Their graphs cut twice, the second intersection lying between the top two deciles. The difference in the effective tax rates on the top decile is so small, however, that it is not too much to claim that the pattern under Case 4 dominates that under Case 1 for all practical purposes.

Since the assumptions of Case 4 are not only internally consistent, but also empirically at least as plausible as those of Case 1, an important conclusion follows where the differences in the findings of Pechman and Okner (1974) and Browning and Johnson (1979) are concerned. Pechman (1985) asserts that the assumption that transfers are indexed would yield a much more progressive pattern of effective tax rates than any of his variants. A comparison of Cases 1 and 4 reveals that it is unnecessary to appeal to full indexation of transfers in order to make a serious case that the pattern of tax incidence in the U.S. in 1979 was not only broadly progressive, but also unambiguously more progressive than one of Pechman's most progressive variants.

When such indexation is assumed, these conclusions about progressivity are greatly strengthened, as one would expect from a glance at Figure 1c. Apart from the "disturbance" at the third decile, which is now magnified by the fact that the corresponding share of labor income is relatively small, the graph of Case 3 is strongly progressive and monotonic. It intersects the graph of Case 1 only once from below, and though it intersects that of Case 3 thrice between the fifth and eighth deciles, its broad pattern is clearly more progressive than the latter's. In view of the strong arguments that transfers were almost fully indexed in the U.S., these conclusions cast considerable doubt on Pechman's principal finding concerning the distribution of the tax burden.

Although certain comparisons across countries are complicated by the fact that their overall tax burdens differ, this does not apply where changes in assumptions about the incidence of taxes on capital and the extent to which transfers are indexed are concerned. It is clear that full indexation makes the pattern of incidence strongly progressive in all three countries, particularly over the lower half of the distribution. Thus, any assessment of the actual degree of progressivity of the tax system must hinge on whether transfers are, in fact, heavily indexed. Browning and Johnson (1979) argue persuasively that this was indeed the case for the U.S. at the time of the surveys on which the LIS is based. For Germany and

Sweden, indexation was probably less extensive, which arguably puts the U.S.'s tax system in a better comparative light than it is sometimes seen.

Whether capital escapes the burden of all taxes is a more debatable issue than is the extent to which transfer incomes are indexed. In the cases of Germany and Sweden, our findings on incidence are substantially independent of the position one takes on the former question. In the case of the U.S., however, it does matter whether capital bears a burden in accordance with Case 1, which is roughly its statutory burden, or no burden at all, as in Case 4. Resolving this matter in the light of the evidence then becomes of considerable importance in assessing how the real burden of taxation was in fact distributed.

Where other comparisons across countries are concerned, allowance must be made for the fact that their overall effective tax rates varied, Sweden's being the highest, and the U.S.'s the lowest of the three. Under the assumption of full indexation, the graph for Sweden has the greatest range and that for the U.S. the smallest; but whereas the former flattens off after the fifth decile, the latter is mostly convex over that interval. Thus, ranking them in terms of progressivity is problematic. In the absence of indexation, the ranges and shapes of the graphs for Case 4 are somewhat similar. Under the assumptions of Case 1, the marked U-shaped pattern for the U.S. is distinctively different from all others. While it provides a basis for the claim that the tax burden was less progressively distributed in the U.S. than in Germany or Sweden, it should now be clear that the assumptions that underpin that basis, and hence the claim itself, are open to serious question.

7. CONCLUSIONS

We have emphasized that Pechman's general approach to estimating the distribution of the tax burden can be given a rigorous basis in the form of a simple competitive model. In this form, it allows a number of consistent variants of shifting assumptions, although the demands of consistency severely limit the menu of admissible options in comparison with those typically found in the related literature, which are drawn up without any such constraint. The resulting framework retains the great advantage of accomodating the detailed information on individual households which is available in large-scale surveys, and being computationally tractable. What also remains, however, is the salient weakness that excess burden is wholly ignored. As noted in the Introduction, applied general equilibrium models remedy this weakness, but at the cost of a fairly severe aggregation of households. Faced with this choice, our particular formulation of Pechman's approach may appeal to those who view the detail on individual households as central to empirical studies of the distribution of the tax burden, but who also desire a strong measure of analytical consistency.

Whatever be the choice of aggregation, however, assumptions must still be made about two important matters, namely, the international mobility of capital and the extent to which transfer incomes are indexed. These are fundamental issues, and changes in the corresponding assumptions may produce very different findings. In our view, they have not

been given the attention in the literature on applied general equilibrium models that their importance warrants, at least where the incidence of taxation is concerned.

That these issues are, in fact, empirically important is strongly borne out by our results using the LIS data for West Germany, Sweden and the U.S. Our findings concerning the sensitivity of the estimated patterns of effective tax rates in all three countries to the assumption concerning indexation are quite striking. If transfer incomes are indeed heavily indexed, as was (and is) the case in the U.S., then these patterns must be judged as quite strongly progressive, especially over the lower half of the distribution. If, on the other hand, transfers are not indexed, then the patterns of incidence are only moderately progressive in an overall sense, and the effective average tax rate decreases with income over certain intervals. Turning to the question of whether capital escapes the burden of all taxes, the answer matters a good deal for our findings for the U.S., but not much for Germany or Sweden. One case of such sensitivity is, however, sufficient to place the assumption on the agenda of important issues to resolved before analysis begins and conclusions are drawn.

Footnotes

- 1 For a general survey of applied general equilibrium models, see Shoven and Whalley (1992). For a specific comparison of this approach with that of Pechman, see Devarajan, Fullerton and Musgrave (1980).
- 2 The excess burden of taxation is, of course, readily calculated within the framework of an applied general equilibrium model. In a well known study of the U.S. tax system, for example, Ballard et al. (1985, p. 136) estimate the marginal excess burden to be 17-56 per cent of the marginal revenue collected, depending on the tax in question.
- 3 See, for example, Feldstein (1988).
- 4 The assumption that capital is immobile across national frontiers is very common in the literature on tax incidence. Where applied general equilibrium models are concerned, Piggott (1989) concedes that "[t]his is an important assumption, not wholly realistic, which has powerful implications for the results" (pp.284-5). A recent exception is Fehr et al. (1993), who assume that capital is fully mobile internationally.
- 5 This point was argued at length by Bishop (1966, pp. 379-81). Meerman (1974) shows the consequences for national income accounting.
- 6 One can certainly read footnote 23 on p. 19 of Pechman (1985) to imply that the allocation is in accordance with factor incomes, but we have decided to stay with the interpretation in the texts of both studies.
- 7 One solution to this impasse is to use a simulation model of life-cycle savings and bequests. Whalley (1984, p.676) reports that when applied to a representative sample of Canadian households, such a model yielded a "mildly progressive" pattern of incidence.
- 8 The base comprises 2,800 households for Germany, 9,600 for Sweden and 65,000 for the U.S. The German and Swedish data relate to 1981, and those for the U.S. to 1979. The representative sub-samples used in this study numbered 218, 188 and 176 households, respectively.
- 9 For Germany, there is a potential problem of compatibility between the aggregate data from official sources and the microdata from the LIS: German conventions in national accounting do not distinguish between K and S. This may result in a uniform over- or underestimate of the shares $\{\theta_h\}$ and hence bias the pattern of effective average tax rates.
- 10 Another indicator of the quality of the data is the discrepancy between the sample estimates of certain income aggregates and their counterparts in the national accounts. This is discussed in Slottjie and Smeeding (1992).
- 11 An extensive analysis of others of Pechman's variants using LIS data may be found in Rosenberg (1992).
- 12 A more thorough analysis of the composition of incomes can be found in O'Higgins et al. (1989).

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Table 1. Shifting Assumptions

	Case 1 Pechman (Variant 1b)	Case 3 full capital mobility, full indexation of transfers	Case 4 full capital mobility, no indexation of transfers
income tax	E,S,R,K	E,S	E,S,R
commodity tax	consumption	E,S	E,S,R
corporate income tax	K	E,S	E,S,R
payroll tax (employee part)	E	E,S	E,S,R
payroll tax (employer part)	E	E,S	E,S,R

Fig. 1a: Composition of Gross Income in Germany (1981)

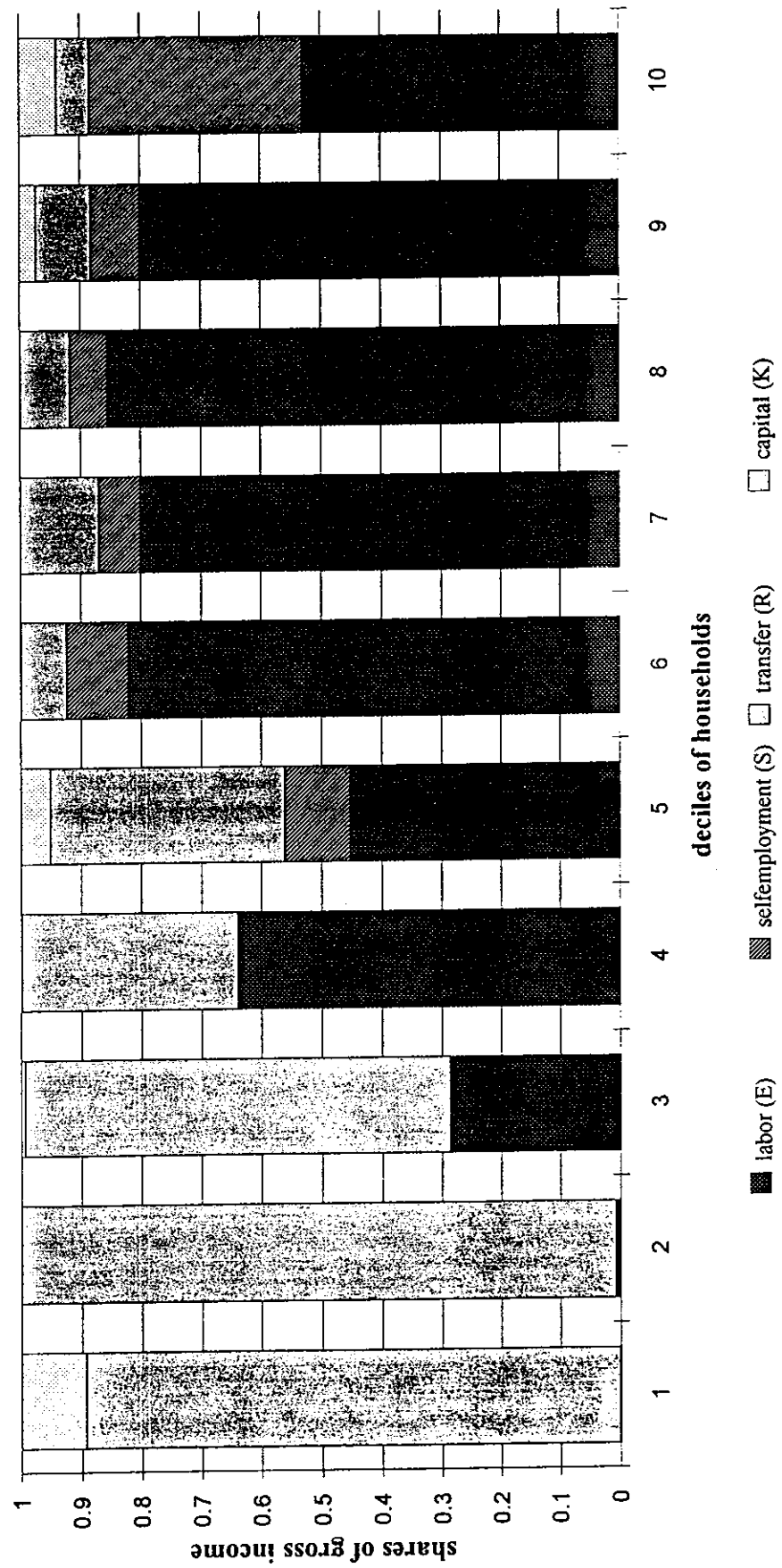


Fig. 1b: Composition of Gross Income in Sweden (1981)

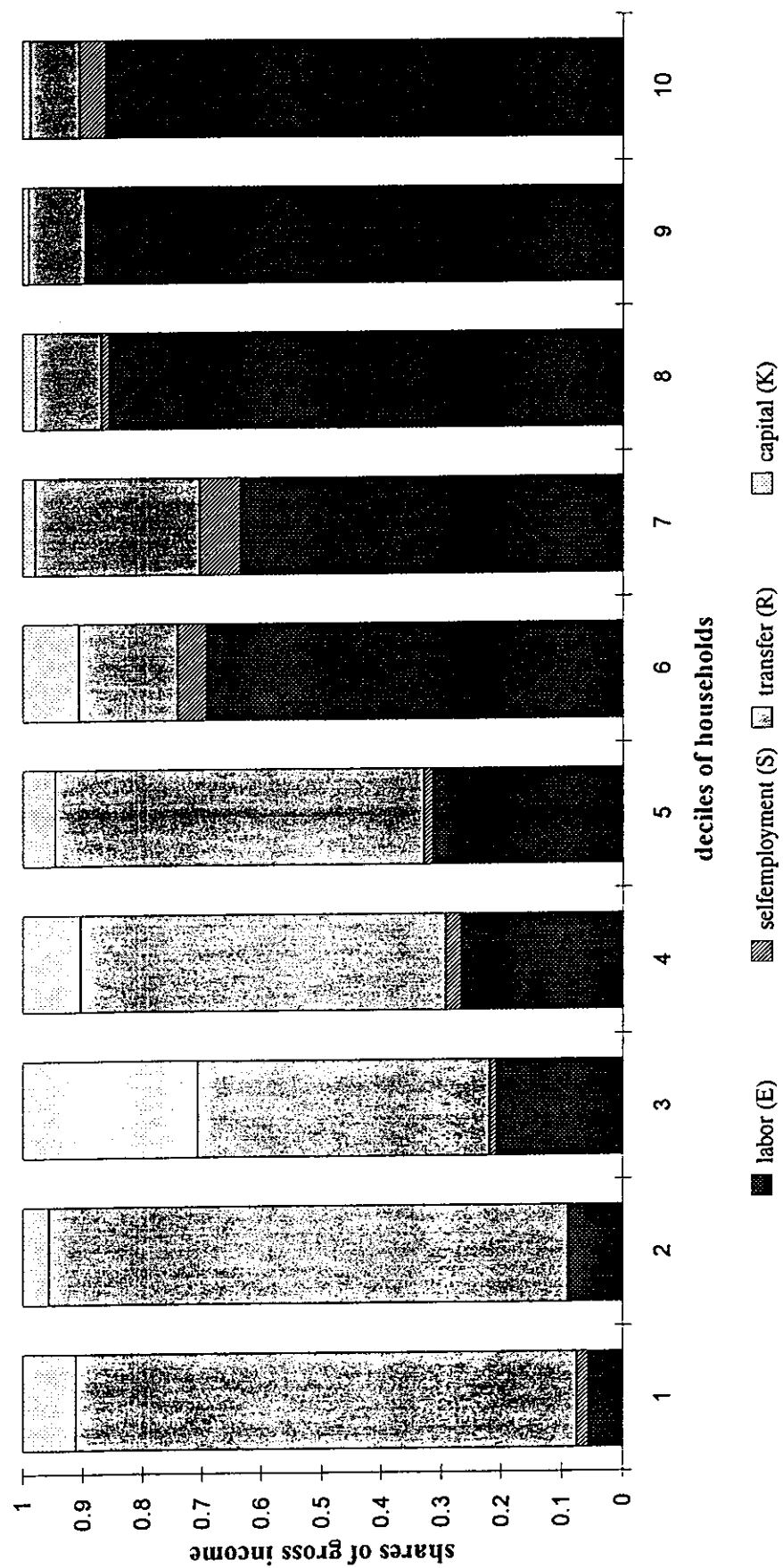


Fig. 1c: Composition of Gross Income in the USA (1979)

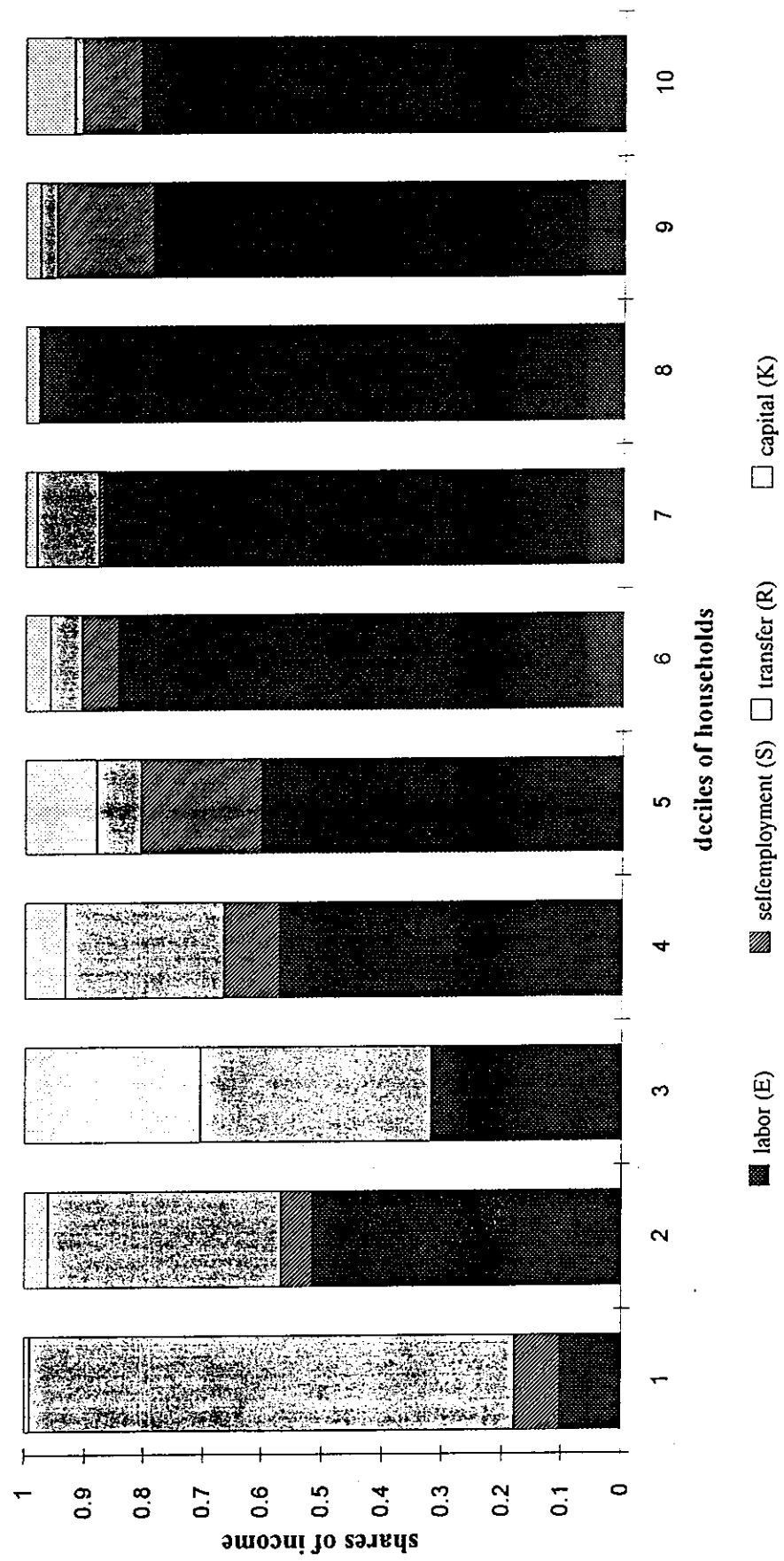


Fig. 2a: Effective Average Tax Rates in Germany (1981)

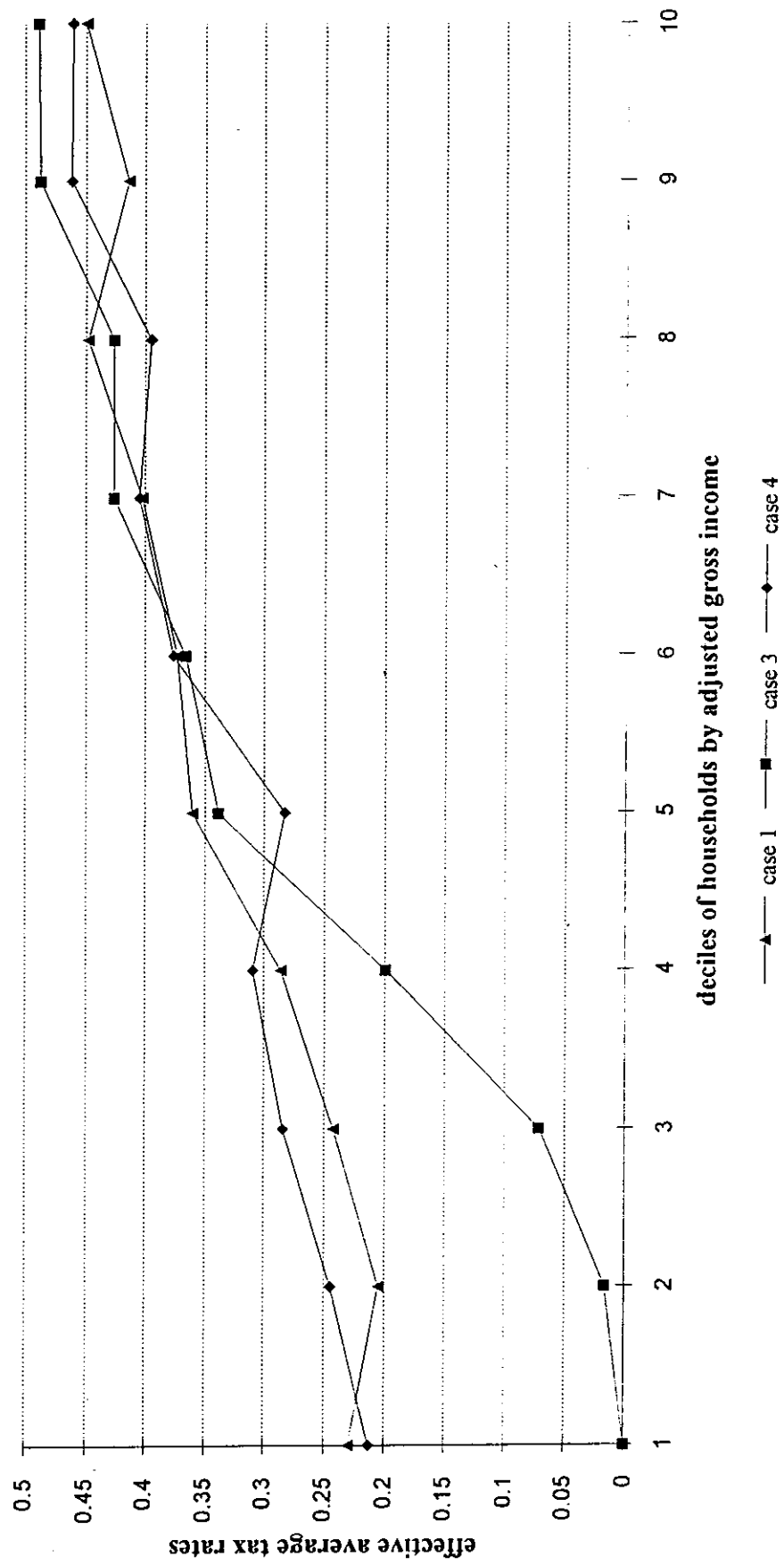


Fig. 2b: Effective Average Tax Rates in Sweden (1981)

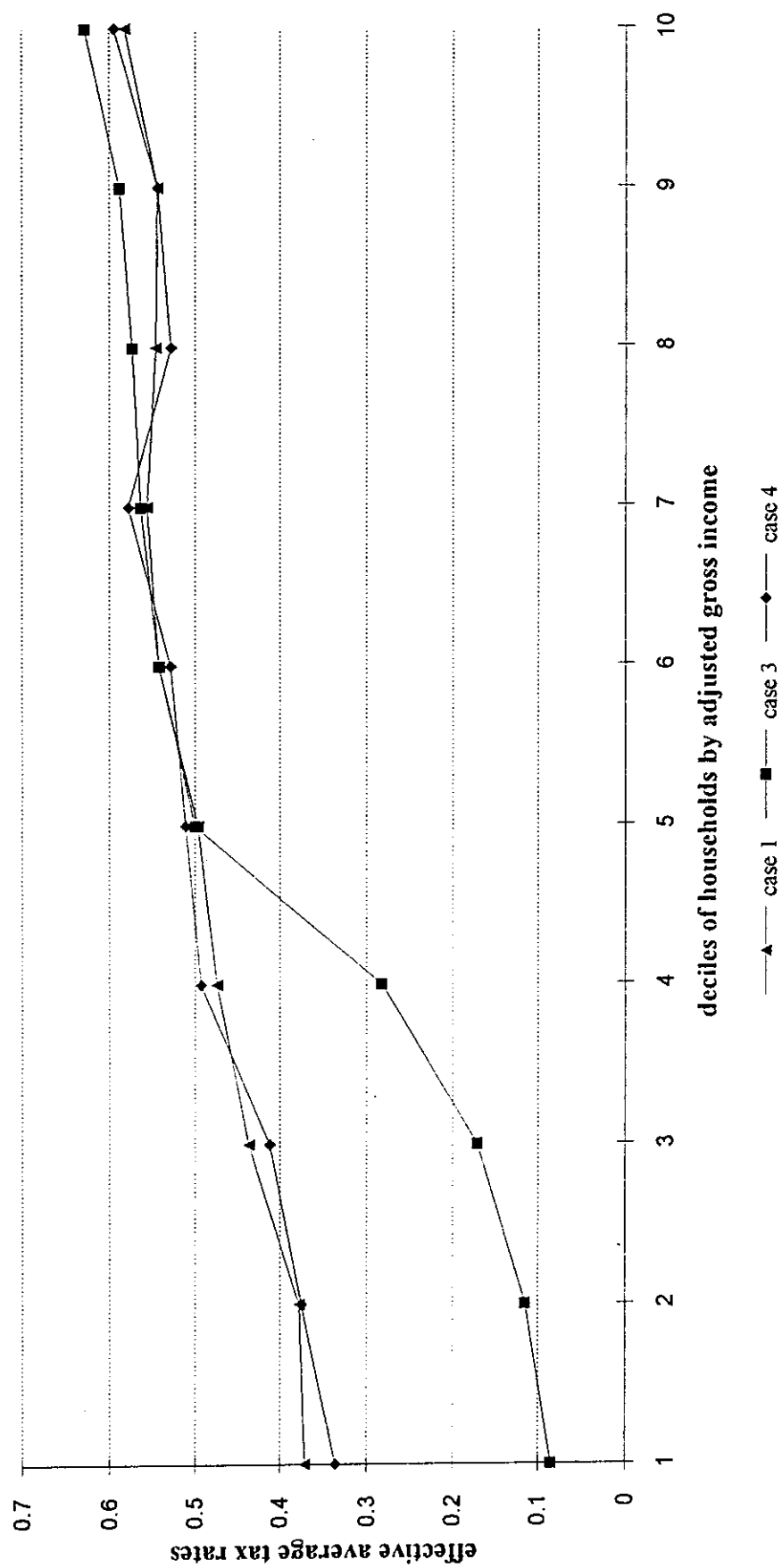


Fig. 2c: Effective Average Tax Rates in the USA (1979)

