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Personal Taxes and the Scope for Market Activity*

by

Steven J. Davis[1] and Magnus Henrekson[2]

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[1]The University of Chicago
Graduate School of Business
1101 East 58th Street
Chicago, IL 60637
USA
Phone: +1-773-702-7312
Fax: +1-773-702-0458
e-mail: sjd@gsbsjd.uchicago.edu

[2]Department of Economics
Stockholm School of Economics
P. O. Box 6501
S-113 83 Stockholm
SWEDEN
Phone: +46-8-736 92 02
Fax: +46-8-31 32 07
e-mail: Magnus.Henrekson@hhs.se

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Abstract

We develop a model of how income, payroll and consumption taxes displace market production in favor of substitutable, and untaxed, forms of household production. The model exhibits a tax-distorted law of comparative advantage that governs the allocation of time and production across households and between home and market activities. Calculations for the mid 1990s show that the threshold level of comparative advantage that leaves a household indifferent between market provision and home production is twice as high in Sweden as in the United States. Swedish tax data for the 1970s and 1980s imply that home production is privately preferred on the margin to market provision even when its social cost is up to six (ten) times greater for an average white-collar worker (executive).

A crude and preliminary investigation suggests that several empirical relationships predicted by the theory find modest support in the data. First, there is a negative relationship among OECD economies between personal tax rates and hours worked in the market sector. Second, the U.S-Swedish comparison shows a negative relationship between personal tax rates and the share of employment accounted for by services that are highly substitutable with home production. Third, a U.S.-German comparison shows a positive relationship between personal tax rates and time spent working at home in activities that substitute closely for market production.

We plan to assess the efficiency consequences of the Danish Home Service Scheme, a program designed to undo the tax penalty on market-mediated production for certain types of housework. We estimate that the deadweight gain from the shift to greater market production amounts to X% of program expenditures.

1 Introduction

Consumer expenditures financed by labor earnings are subject to income, payroll and consumption taxes – collectively, personal taxes. These taxes induce a shift away from market-mediated production and consumption in favor of substitutable, and untaxed, forms of household production. In the process, personal taxes distort the allocation of time, the choice between home and market production, and the consumption of goods and services.

To appreciate the scope for tax-induced distortions in time use, consider the possibilities for substitution between market and household production. Many firms supply services that are highly substitutable with home-produced services. Examples include cleaning services, restaurants and child care. Other firms supply services that economize on time spent in market transactions. Examples include real estate brokers, delivery services and convenience stores. Internet firms like Amazon.com and E-bay economize on the time needed to locate and buy hard-to-find books, music CDs, collectibles and other highly differentiated products. Many goods embody time-saving services as well. Thus meals prepared from "scratch" require more time than meals prepared from highly processed, more expensive, ingredients. Each of these types of services, goods and business models present households with a trade off between time and money and, hence, time spent working in the labor market.

We begin our analysis of these issues by developing a simple model of time allocation over production activities. The model's equilibrium exhibits a tax-distorted law of comparative advantage that governs the allocation of time and production across households and between home and market activities. The size of the tax-induced departure from the law of comparative advantage is a simple, easily measured, function of personal tax rates.

Next, we calculate the size of tax-induced departures from comparative advantage for Sweden, a high-tax economy, and the United States, a relatively low-tax economy. The calculations show that the personal tax system creates a much larger deterrent to market-mediated production and consumption in Sweden than in the United States. As of the mid-1990s, the threshold level of comparative advantage that leaves a household indifferent between market provision and home production is roughly twice as high in Sweden. At their peaks in the late 1970s, Swedish taxes implied that home production was privately preferred on the margin even when its social cost was up to four times greater than market provision for an average blue-collar worker, up to six times greater for an average white-collar worker and up to ten times greater for an average executive.

These results suggest that higher rates of personal taxation drive the much lower levels of market work activity observed among Swedish adults than among U.S. adults. Data for twenty OECD economies also show a clear negative relationship between personal tax rates and hours worked in the market sector.

The negative cross-country relationship between taxes and hours worked can be explained by standard labor supply models that abstract from home production. Hence, we are led to consider tax effects that relate more closely to the presence of home production and its substitutability with market production. In this regard, our theoretical model implies that personal taxes disproportionately reduce market employment in sectors for which output is readily substitutable with home production. To investigate this implication, we consider how the industry mix of market employment differs between Sweden and United States. Compared to the United States, Swedish employment shares are low in industries with high potential for substitution between home and market production.

Lastly, we apply our model to a particular normative issue. Personal taxes reduce efficiency by causing departures from the law of comparative advantage in the allocation of time and production. Tax-induced distortions in the mode of production also distort consumption allocations, as we explain. In principle, these efficiency losses can be mitigated by policies that shift production activity back to the market sector. Partly motivated by this goal, Denmark introduced a "Home Service Scheme" (HSS) in 1994 that greatly reduced tax penalties on the market-mediated provision of cleaning services and other household work. Simple calculations suggest that the deadweight gain from the HSS-induced shift toward market production amounts to X% of program expenditures.[1]

Our study is related, more or less closely, to several strands of research. Home production and time use are major topics in economics, but relatively few studies focus on tax-induced substitution toward non-market production activities.[2] In a noteworthy exception, Sandmo (1990) provides a well-known theoretical treatment. More recently, Sørensen (1997), Piggott and Whalley (1998) and Kleven *et al.* (2000) show that the scope for tax-induced

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[1] The Danish HSS is partly motivated by the sort of tax effects highlighted by our theoretical model. Other countries that subsidize market activity in selected services include Belgium, Finland, France, Germany, the Netherlands, Spain, Sweden and the United Kingdom. See European Commission (1996).

[2] See Gronau (1986) for a review of the microeconomics literature on home production, Juster and Stafford (1991) for an empirically oriented review of time use studies and Greenwood *et al.* (1995) on the role of home production in macroeconomic models. Taxes receive little attention in these literatures. Household production also plays a modest role in the public finance literature on tax distortions and economic efficiency, as evidenced by the recent review by Auerbach and Hines (2001). There is, of course, an enormous literature on labor supply behavior, and much of it explicitly treats tax effects. However, the empirical designs adopted in most research on labor supply behavior do not capture the effect of personal taxes working through labor demand.

substitution into non-market production activity can profoundly influence the optimal structure of commodity taxation.[3] The basic message is that optimal tax rates are lower, possibly much lower, for goods with easy substitution between home and market production.[4]

On the empirical front, Nickell and Layard (1999, Table 16) find that higher personal tax rates are associated with lower rates of employment and market work hours in OECD countries. Karoleff *et al.* (1994) and Spiro (1993) find a sizable increase in underground activity following Canada's 1990 switch from a 13.25 percent sales tax on manufactured goods, which offer limited scope for non-market production, to a broad-based consumption tax at a 7 percent rate. Piggott and Whalley report that the percentage of food dollars spent on restaurant meals fell from 42 percent prior to the Canadian tax reform to 35 percent afterwards. Walsh and Jones (1988), among others, find that local retail sales are highly sensitive to tax rate differences across geographic borders, which indicates that consumers exploit cross-border tax rate differences by trading off extra travel time.

Freeman and Schettkat (2002) investigate the large gap in employment rates between U.S. and German women. They find that German women actually work as many hours as U.S. women once one accounts for household work. Housework activities like cleaning and cooking account for a major part of the extra time worked at home by German women. Similarly, expenditure shares on restaurant meals and personal services are much lower for German than for U.S. households. As Freeman and Schettkat note, personal tax rates are much higher in Germany than the United States.[5] These U.S.-German comparisons suggest an important role for personal taxes, and they are consistent with our Proposition 1 below.

The paper proceeds as follows. Section 2 describes our theoretical model and develops the comparative advantage result and other implications. We explain how tax-induced departures from comparative advantage distort production and consumption, and how the

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[3] Another recent line of research focuses on tax-induced distortions of time allocation among members of multi-person households. This issue has implications for the choice between individual and joint (household-level) income taxation. See Piggott and Whalley (1996), Apps and Rees (1999) and the commentaries on Piggott and Whalley (1996) in the April 1999 *Journal of Political Economy.* This literature also emphasizes the possibilities for substitution between market and non-market production, but it addresses a different tax distortion than the one that occupies our attention.

[4] Kleven *et al.* consider an optimal tax problem with untaxed leisure and two consumption goods, one that can be produced only in the market sector and another that can be produced at home or in the market. They show that easy substitution between home and market production yields a revision in two classical results in the theory of optimal taxation. First, the Corlett-Hague rule is modified in that it can be efficient to levy a relatively low tax rate on complements to leisure. Second, preferences that yield uniform commodity taxation in the absence of home production, as in Sandmo (1974) and Sadka (1977), call for a relatively low rate of taxation on goods and services that are substitutable with home production.

[5] Based on OECD data for the early 1990s, personal tax rates on the margin for an average production worker were nearly identical in Germany and Sweden but much higher than in the United States. See column 3 of Table 5 in Nickell and Layard (1999).

distortions are magnified by imperfectly competitive product markets and labor market institutions that compress wage differentials. Section 3 calculates the size of the tax-induced departure from comparative advantage for working households in Sweden, the United States and other countries. Section 4 presents evidence that OECD countries with higher personal tax rates have (a) fewer hours worked in the market sector, (b) smaller employment and valued-added shares in highly substitutable service industries and (c) greater household work time devoted to the production of close market substitutes. Section 5 considers the efficiency consequences of tax relief for services that are highly substitutable between home and market production, with an application to the Danish Home Service Scheme. Section 6 offers concluding remarks and identifies directions for future research.

2 Personal Taxes in a Model of Comparative Advantage

This section develops a model of how taxes affect time allocation and the choice between market and home production of consumption goods. Becker (1965) and Gronau (1977) consider fairly general frameworks for analyzing household activity and time allocation, but they do not focus on tax consequences. Boskin (1975) provides an early analysis of the distortions caused by the taxation of inputs into market production in a model with untaxed household production. Sandmo's (1990) treatment of tax distortions allows for time and other inputs into household production. Like Piggott and Whalley (1998) and Kleven *et al.* (2000), we assume that time is the only input to household production. The structure of our model differs from theirs in several respects, most importantly in that home production technologies are linear in our setup.

2.1 The Household Problem

A household has strictly concave preferences, $U[C,l]$, where l denotes leisure and C is a vector or continuum of consumption goods indexed by i. Marginal utilities are positive for leisure and all consumption goods. We specify other preference restrictions below.

The household can acquire good i in the market at gross price $P(i)[1+m(i)]$ per unit, where $m(i)$ is the value-added or sales tax rate and $P(i)$ is the pre-tax market price. Alternatively, the household can produce a unit of good i by allocating $1/H(i)$ units of time

to task i, where there is a one-to-one correspondence between tasks and goods. H approaches zero for goods that can only be acquired through the market (e.g., open-heart surgery).

The household can also supply labor to the market and use the resulting earnings to buy market-produced goods. If the household supplies L units of time to market work, its net earnings are $[W(1-t)/(1+s)]L$, where s denotes the payroll tax rate levied on the employer, t is the tax rate on the employee's labor income and W is the wage cost per unit time for the employer (inclusive of payroll taxes). Let T denote the household's total time endowment.

A household allocates its available time across leisure, market work and home production to satisfy a time constraint,

$$l + L + \int \frac{C^H(i)}{H(i)} di = T, \tag{2.1}$$

where C^H is consumption of home-produced goods. A household also allocates income across market-produced goods C^M to satisfy a financial constraint,

$$A + [W(1-t)/(1+s)]L = \int P(i)[1+m(i)]C^M(i)di, \tag{2.2}$$

where A is non-labor income. The household chooses non-negative l, L and C to maximize $U[C,l]$ subject to the constraints (2.1) and (2.2).

We assume that the household optimum involves positive amounts of leisure, home production activity and labor supplied to the market. We also assume that all goods and leisure are normal. Households can differ with respect to preferences, market wages, tax rates, and productivity levels in home production activities. When essential for clarity, we index households by h or k.

Several aspects of this formulation merit comment. First, both the market and home production technologies for acquiring consumption goods involve a linear transformation of household time. The transformation reflects after-tax wages and prices for market goods and the parameter H for home-produced goods. As we show below, this structure implies that a household typically buys a particular good in the market or produces it at home, but not both.

Second, our formulation presumes specialization in market work activity but not in home production. That is, the household faces a single market wage, but it may engage in many household activities (in addition to leisure). This pattern in the allocation of work time can be derived from a more primitive model, but the underlying economics is clear enough. Given that labor income can be used to buy a diversified bundle of market-produced goods, the household maximizes the value of time spent working in the market by specializing in the

activity that offers the highest price for its time. This logic does not hold for work at home, because home-produced goods are less easily transferable across households. As a related point, the household's ability to prepare meals to its own satisfaction, lavish attention on its own children, landscape its own yard, and so on does not mean that it can efficiently supply the same services to the market or other households.

Third, the constraints (2.1) and (2.2) combine into a single budget constraint:

$$A+\tilde{W}T=\left\{l+\int\frac{C^H(i)}{H(i)}di\right\}\tilde{W}+\int P(i)\left[1+m(i)\right]C^M(i)di, \tag{2.3}$$

where $\tilde{W}=W(1-t)/(1+s)$ is the wage rate net of labor income taxes, and the left side is full income in the terminology of Becker (1965). This equation says that full income is allocated among leisure, home-produced goods and the acquisition of goods produced in the market. In line with our earlier remark, it is apparent from (2.3) that each consumption good has two linear prices, $\tilde{W}/H(i)$ for home production and $P(i)[1+m(i)]\equiv\tilde{P}(i)$ for market provision.

2.2 Household Behavior

Let U_l and U_i denote marginal utility with respect to leisure and good i, respectively. Since the leisure choice is interior, and the household faces two modes for acquiring each good, we have the following optimality conditions for each good i:

$$U_l\geq H(i)U_i \tag{2.4}$$

$$U_l\geq\frac{W(1-t)U_i}{P(i)\left[1+m(i)\right](1+s)}=\frac{\tilde{W}U_i}{\tilde{P}(i)} \tag{2.5}$$

The first condition holds with equality for a home-produced good, and the second holds with equality under market provision. If both inequalities are strict, the household does not consume the good.

For goods with positive consumption, these optimality conditions imply a simple cutoff rule for the choice between home production and market provision. In particular, the household produces at home when the net market price exceeds the net cost of self supply:

$$P(i)[1+m(i)]\geq\frac{W(1-t)}{H(i)(1+s)},\ \text{ or }\ \tilde{P}(i)\geq\frac{\tilde{W}}{H(i)}. \tag{2.6}$$

The inequality is strict except in the knife-edge case where the household is indifferent between market provision and home production. For convenience, we henceforth assume that the household relies on home production when (2.6) holds as an equality.

Figure 1. The Choice between Market Provision and Home Production

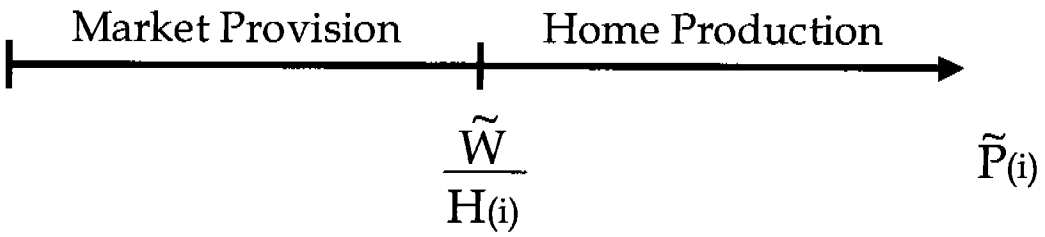

Figure 1 illustrates the partition between market-provided and home-produced goods implied by (2.6). The set of goods acquired in the market shrinks as the net market price rises or the net market wage falls. Note that the choice between market provision and home production revolves entirely around substitution effects. Income effects operate only through the decision of which goods to consume and how much.

It follows that the income-compensated wage elasticity of hours in the labor market is positive. However, as in standard labor supply models that abstract from home production, the corresponding uncompensated elasticity cannot be signed without further restrictions.[6] Some of our results require that the market labor supply schedule slopes upward.

Assumption A: For given commodity prices, hours worked in the market sector rise with the net market wage, $\tilde{W}$.

This assumption implies that personal taxes induce a substitution away from market activity and towards home production at given pre-tax prices and wages.

Proposition 1 (Personal Taxes and Market Activity):
Assume A. Given pre-tax market prices and the pre-tax household wage, an increase in labor income tax rates (t or s) or a uniform percentage increase in consumption tax rates (m) has the following effects:

a. Time supplied to the labor market declines.
b. The consumption of market-provided goods declines.
c. Time worked in home production activity rises.

[6] To see this point, consider a household with highly income-inelastic demands for market-acquired goods at an initial optimum. Faced with a reduction in its net wage, $\tilde{W}$, the extra hours that the household supplies to the labor market to satisfy its demand for market consumption goods can more than offset the reduced market work hours implied by the cutoff rule (2.6).

d. The consumption of home-produced goods rises.

Proof: Consider an increase in t; parallel arguments hold for an increase in s or a uniform increase in m. Part (a) is equivalent to Assumption A, and part (b) then follows immediately from the financial constraint (2.2). Given (a), the time constraint (2.1) implies that total time allocated to the home sector rises. By (2.4), the marginal rate of substitution between leisure and home production is unaffected by a change in t. Given normal demands, the negative impact of higher t on full income implies a reduction in leisure. Less time allocated to leisure and less time supplied to the market imply more time devoted to home production, which proves (c). Part (d) follows immediately from (c), because the transformation between time and home production is unaffected by t. □

The model also delivers sensible implications regarding cross-sectional variation in labor supply, given suitable restrictions on preferences and the home productivity parameters. The main assumption in this regard says that the market wage is more sensitive to ability than is productivity in home work activities.

Assumption B: $\tilde{W} / H(i)$ rises with $\tilde{W}$ in the cross section for each good i.

Proposition 2 (Market Wage and Hours Worked in the Cross Section):
Assume A and B. Consider a cross section of households with identical preferences and facing the same prices for market-provided goods. Conditional on non-labor income,

a. Hours worked in the market sector rise with the net market wage rate;
b. Hours worked in the home sector decline with the net market wage rate.

Proof: Given Assumptions B, identical preferences and the same level of non-wage income, equation (2.6) implies that a comparison of low-wage and high-wage households in the cross section is isomorphic to the analysis of a wage increase for a single household. Hence, parts (a) and (b) of Proposition 2 follow immediately from Proposition 1. □

Proposition 2 rests on strong restrictions on cross-sectional variation in preferences and household production parameters. These restrictions can be relaxed – while preserving the essential empirical content of the proposition – by introducing random variation in preferences and the productivity parameters, and by placing suitable restrictions on the random terms. Because this paper does not test Proposition 2 on household-level data, we leave the formulation of a detailed statistical model for another occasion.

2.3 Market Equilibrium and Comparative Advantage in Time Allocation

Market technologies use one or more capital and labor inputs to produce each good. We assume that market technologies are convex and differentiable with positive marginal

products. We also assume that firms maximize profits, and that capital and labor are freely mobile.

In competitive equilibrium, the real product wage equals the worker's marginal product for any worker k engaged in the production of good i in the market sector:

$$\frac{W^k}{P(i)} = F_k(i), \tag{2.7}$$

where $F_k(i)$ is the marginal product of worker k in the market production of good i. Combining this equilibrium condition with the cutoff rule (2.6), we obtain our central theoretical result:

Proposition 3 (Personal Taxes and Comparative Advantage):

a. In a no-tax economy, the competitive equilibrium allocation of time across households and production activities satisfies the law of comparative advantage. That is, for any household h that consumes good i and any worker k that engages in the market production of good i, the allocation satisfies the following rule:

$$\text{If } \frac{H^h(i)}{W^h} < \frac{F_k(i)}{W^k}, \text{ then } h \text{ acquires } i \text{ in the market and } k \text{ engages in the market production of } i\text{; otherwise, } h \text{ produces } i \text{ at home.} \tag{2.8}$$

b. More generally, the allocation of time in a competitive equilibrium satisfies a tax-distorted law of comparative advantage:

$$\text{If } \frac{[1+m(i)](1+s)}{1-t^h} < \frac{F_k(i)}{H^h(i)}\frac{W^h}{W^k}, \text{ then } h \text{ acquires } i \text{ in the market and } k \text{ engages in the market production of } i\text{; otherwise, } h \text{ produces } i \text{ at home.} \tag{2.9}$$

Proof: Part (b) follows directly by using the equilibrium condition (2.7) to substitute for $P(i)$ in the cut-off rule (2.6). Part (a) then follows by setting all tax rates to zero. □

Proposition 3 characterizes the allocation of time and production along two dimensions.[7] First, it governs the allocation between the home and market sectors within each household. Second, it characterizes how the market allocates the production of goods, and the time devoted to their production, among households. In a no-tax economy, household h acquires

[7] The comparative advantage result in Proposition 3 and the cut-off rule illustrated by Figure 1 recall the Dornbusch-Fischer-Samuelson (1977) analysis of international trade in a continuum of goods. It is perhaps worth noting how our setup and analysis differ from theirs. First, they consider two countries and Ricardian production technologies, while we consider many households and allow for a much broader class of technologies in the market sector. Second, the analogy between countries in DFS and households in our setup is imperfect. Tariffs (and transport costs) discourage the consumption of goods produced with foreign labor in DFS, but personal taxes discourage consumption of *all* market-produced goods in our model, even those that rely intensively on a household's own labor. In addition, countries supply labor to produce a range of traded goods in DFS, but they supply labor to the production of a single traded good in our model. Third, our analysis delivers cross-sectional implications that have no counterpart in DFS, as illustrated by Proposition 2. Finally, DFS exploit the two-

good i through the market, and worker k engages in the production of good i, if worker k has comparative advantage in producing i. This task assignment is also socially optimal, because it minimizes the value of scarce time resources applied to the task.

The determination of comparative advantage in a no-tax economy involves three elements: the professional's physical marginal product in the market sector $\left(F_k(i)\right)$, the consumer's physical marginal product in home production $\left(H^h(i)\right)$ of the same good, and the relative market wage of the professional and the consumer $\left(W^k / W^h\right)$. Personal taxes introduce an additional element that distorts the allocation of time and production along both dimensions – within the household and among households.

2.4 The Nature of the Inefficiencies Induced by Personal Taxes

Proposition 3 shows that personal taxes drive a wedge between privately and socially optimal task assignments by raising the threshold level of comparative advantage required for the market solution to obtain. As a consequence, personal taxes distort both production decisions and consumption allocations.

A simplified example illustrates how personal taxes erode the operation of comparative advantage and undermine efficiency. Suppose that a household wants its home exterior to be painted. For simplicity, assume that the market technology involves only one type of worker and no capital. Normalize the time unit so that "do-it-yourself" takes one unit of household time, and let $1/F$ be the time required by the professional.[8]

When the home owner and professional have the same market wage rate and there are no taxes, then by (2.8) the household prefers to hire the professional painter so long as the professional is "faster" at the job; i.e., so long as $F > 1$. This outcome minimizes total time devoted to house painting over two persons with the same opportunity cost of time. When wages are unequal, it is privately and socially optimal to hire the professional provided that the product of the household's relative wage and the professional's relative productivity in

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country assumption, Ricardian technologies and specific assumptions about preferences in order to characterize equilibrium outcomes much more fully than do we.

[8] When $F > 1$, the professional is "faster" at painting and has an absolute advantage in that activity. It is certainly possible, even likely in many cases, for the household to have an absolute advantage. Households can have an absolute advantage in certain activities for at least three reasons. First, the household may simply be highly able in many tasks, not just its market specialty. Second, many households have strong preferences for the self-supplied version in activities such as shopping, meal preparation and child care. Third, household production may yield utility directly, as in gardening for enjoyment.

painting, F, exceeds unity. This outcome minimizes the value of the time resources devoted to painting the house.

Suppose now that the payroll tax rate is $s = .24$, the consumption tax rate is $m = .30$ and the labor income tax rate is $t = .3$. It remains socially optimal to hire the professional provided that F times the household's relative wage exceeds unity. However, personal taxes induce the household to opt for self supply so long as this product is less than $(1+s)(1+m)/(1-t) = 2.3$. Hence, personal taxes can more than double the social cost of painting the house in this example.

This type of production distortion also undermines efficient consumption allocations. To see this point, recall the standard marginal rate of substitution condition between any pair of households that acquires a given pair of goods in the market. From the optimality condition (2.5),

$$\frac{U_i^h}{U_j^h} = \frac{\tilde{P}(i)}{\tilde{P}(j)} = \frac{U_i^k}{U_j^k} \tag{2.10}$$

for any goods i and j acquired in the market by households h and k. That is, the marginal rate of substitution between any two goods is equalized across all households that acquire both goods in the market.

When personal taxes induce households to substitute away from market provision of good i or j, the efficiency condition (2.10) fails. Instead, these substitution conditions now become determined by some combination of after-tax market prices and the household-specific productivity parameters, $H(i)$ and $H(j)$, depending on which households produce which goods at home.

Note that uniform commodity taxation does not disturb the efficiency condition (2.10) for goods that continue to be produced in the market. By the same token, the consumption inefficiency identified here does not arise in standard models that abstract from home production *or* in models that exogenously specify the set of home-produced goods.

In summary, personal taxes drive scarce productive resources away from the market sector and into households, where production is less efficient on the margin. By reducing the scope for market-mediated production and exchange, personal taxes also undermine the efficiency of consumption allocations between and within households.

2.5 Imperfectly Competitive Product Markets

The preceding analysis easily extends to imperfectly competitive product markets. Let $\alpha(i)$ denote the percentage markup over marginal cost in the market supply of good i, and assume for the sake of simplicity that $\alpha(i)$ is not affected by the tax rate on good i. Then, for any household h that consumes good i and any worker k that engages in the market production of good i, the equilibrium allocation satisfies the following rule:[9]

$$\text{If } [1+\alpha(i)]\frac{[1+m(i)](1+s)}{1-t^h} < \frac{F_k(i)}{H^h(i)}\frac{W^h}{W^k}, \text{ then } h \text{ acquires } i \text{ in the market and } k \text{ engages in the market production of } i\text{; otherwise, } h \text{ produces } i \text{ at home.} \quad (2.11)$$

The key implication of (2.11) is that product market distortions magnify the inefficiencies introduced by personal taxes: A larger markup over marginal cost implies that any given level of personal taxation induces a bigger departure from comparative advantage. By the same token, product market distortions cause greater inefficiencies in the allocation of time and consumption in economies with high rates of personal taxation.

2.6 Labor Market Institutions that Compress Wage Differentials

In many countries, relative wage differentials among workers, occupations and industries are strongly influenced by minimum wage requirements, collective bargaining, centralized wage setting and laws that extend union compensation agreements to non-union firms and workers. A large body of evidence shows that these labor market institutions compress wage differentials compared to outcomes under decentralized wage determination.[10] By compressing wage differentials, these institutions also magnify the production and consumption inefficiencies induced by personal taxes.

Consider, first, the impact of institutional forces that raise wages for less-skilled, lower wage workers. Activities with easy substitution between home and market production – such as cooking, cleaning, laundry, gardening and personal services – tend to rely heavily on less-skilled workers in the production process. Hence, wage floors for less-skilled workers raise the cost of production by a larger percentage in activities with greater scope for substitution

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[9] The proof proceeds in the same way as in the competitive case: Given a markup percentage $\alpha(i)$, cost minimization implies that $P(i) = \left[W^k / F_k(i)\right]\left[1+\alpha(i)\right]$ for any worker k that engages in the market production of i. Substituting this expression for $P(i)$ into the cut-off rule (2.6) yields (2.11).

[10] There is also much evidence that the resulting wage compression affects employment and production outcomes. See Blau and Kahn (1999) for an extensive review of the literature. Davis and Henrekson (2000) treat the Swedish experience in some detail.

between home and market production. In this respect, wage floors for less-skilled workers reinforce the departures from comparative advantage induced by personal taxes.

Second, institutional forces that reduce wages for skilled workers affect the choice between home production and market provision for high-wage workers in the same way as higher labor income taxes. In this respect, too, labor market institutions that compress pre-tax wage differentials reinforce tax-induced departures from comparative advantage.

3 Measuring Departures from Comparative Advantage

3.1 Tax-Induced Departures from Comparative Advantage in Sweden and the U.S.

In this section we explore the Swedish and U.S. tax codes in light of the basic relation identified in the previous section. The calculations displayed in *Table 1* show how the tax system in Sweden and the U.S. (California and Texas) require very different productivity differentials and/or wage differentials in order to achieve specialization.

The table provides three examples for Sweden and two for California and Texas. An annual income of SEK 240,000 (roughly USD 24,000 after PPP-adjustment) is associated with the highest marginal tax rate. This income corresponds to a tax factor of 4.07. Assuming a monthly wage of SEK 15,000 – a typical wage for a full-time unskilled worker – the tax factor is 2.72. Make clear that its 1997 we are talking about it.

In the case of identical wages for the buyer and the professional supplier, the tax factor gauges the additional productivity per unit time required for taxed labor to be competitive with untaxed labor. Thus, for the highest marginal tax the buyer must work more than four additional hours to engage the professional supplier for one hour. In order for that to be worth while, the buyer must be at least 4.07 times as productive in his profession as he would be as a producer of the service in question, so that an exchange of services can occur in the market. If this is not the case, "do-it-yourself" is the more profitable alternative. Assuming wages of 180,000 kronor per year, which is about the mean wage income for Swedish men in 1997, this productivity factor is 2.72.

Similar calculations are made for a skilled laborer in California and Texas. Based on an income equivalent to SEK 180,000 kronor, the productivity factor is just 1.40 and 1.36, respectively. Hence, the professional need be only some 40 percent more productive at his own trade in order for the transaction to be profitable in California. The corresponding figure for Texas, a low-tax U.S. state, is only 36 percent. Even at a very high annual wage, the

additional productivity required of the professional producer is small compared to the case in Sweden.

In the second U.S. example we assume that the buyer receives an annual salary equivalent to approximately SEK 1 million. By Swedish standards this is a very high income; less than 0.1 percent of all income earners aged 20–64 had an annual (labor) income exceeding 1 million kronor in 1995.[11] As it turns out, the buyer needs to be only 84 percent more productive at his own profession in order to benefit by choosing the market alternative. The corresponding figure for Texas is as low as 67 percent. Clearly there is a large discrepancy between the tax structures of the two countries.

3.2 Time Series Data for Sweden

Discuss Figure 2 here.

3.3 Departures from Comparative Advantage in a Larger Set of Countries

4 Personal Tax Effects on Work Hours and Industry Mix

4.1 Personal Tax Levels and Market Work Hours in OECD Economies

The international comparisons in Table 2 highlight the enormous differences in the extent of market work across OECD economies. For instance, in 1998 market work per person of working age is 67 percent higher in the United States than in Spain.

Can these large differences in the extent of market work be explained by personal taxation? We are not yet prepared to offer a serious treatment of this important question. At this point, we present a simple bivariate plot of work-hours adjusted employment rates from Nickell and Layard (1999) against aggregate measures of tax levels. Two relevant tax measures are readily available: total taxes as a share of GPD and labor taxes as a share of GDP. These relations are depicted in *Figure 3*. We have also included a regression line. In both cases the estimated relationship is negative and statistically significant ($t = -3.09$ and -2.73, respectively). The point estimate indicates that an increase in the tax share by 10 percentage points is associated with a decrease of the work-hours adjusted employment rate

[11] Statistics Sweden, Be 20 SM 9701, Table 2. It is also noteworthy that only 1.1 per cent of the income earners in the 20–64 age group had an annual (labor) income exceeding 500,000 kronor.

by 7–8 percentage points. These are large effects, but it is not clear whether they will survive a more careful and thorough analysis of the data.

4.2 Personal Tax Levels and the Industry Mix of Employment in OECD Economies

Table 3 is all we have to offer at this point.

4.3 Comparison of Household Work Hours in Germany, Sweden and the United States

Drawing on the Freeman-Schettkat (2002) tabulations for Germany and the United States plus our own tabulations for Sweden, we will construct a table that makes two points: (a) The large gap in per capita hours worked between the U.S. and Germany/Sweden vanishes after accounting for hours worked at home. (b) To a large extent, the extra hours worked at home in Germany/Sweden reflect time spend on household activities that have close market substitutes.

5 A Welfare Analysis

5.1 Evaluating a Small Shift between Home and Market Production

Previous efforts to quantify the welfare costs of personal taxes in a model with household production have taken a computable general equilibrium approach with a complete specification of preferences and production technologies. See, for example, the computable general equilibrium analyses of Sørensen (1997) and Piggott and Whaley (1998). We hope to exploit the policy experiment associated with the Danish Home Service Scheme to assess the welfare effects of a small shift in production activity between the home and market sectors using minimal assumptions on preferences and technologies.

5.2 Denmark's Home Service Scheme

Denmark initiated a "Home Service Scheme" (HSS) in 1994 to encourage the market provision of certain types of housework: shopping, cleaning, cooking, dishwashing, laundry, gardening and, since 2000, fetching children from school. HSS goals include improved employment opportunities for persons with limited education, reduced time pressures on

working families, and lower rates of black-market work activity.[12] The HSS grants hourly wage subsidies to companies that provide household services. The size of the subsidy largely offsets the impact of personal taxes on covered activities, as we discuss below.

As of 1998 8% of Danish families without small children made use of the HHS, while 13% of the families with children aged 0-3 bought subsidized services. The use of the scheme was also highly correlated with income: 5% of households with a disposable income below DKK 100,000 used the system in 1997/98, while more than 1/3 of households with an income exceeding DKK 1 million used it. Typical users are senior citizens and households with two employed adults and two or more children. 44 percent of the new recruits under the HSS were either unemployed or outside the labor force between 1996 and 1998. In 1999, 5600 persons (4300 in full-time equivalents) were employed under the HSS. By 1999, expenditures on HSS subsidies had reached DKK 607 million.[13]

The Danish Ministry of Trade and Industry issued an extensive study of the HSS in 2001. According to a later Ministry report, issued in English, the study concluded that the HSS fulfilled its three main purposes: "more benefit for families and the elderly, less do-it-yourself and moonlighting [i.e., black-market work], more jobs for people with a short formal education. The home service scheme thus means that the consumers are able to buy time, as they are saving time that they formerly used on cleaning or gardening. So they are able to work more [in the market sector] or to spend more time with their children, family and friends. The total value of the free time or additional consumption made possible in this way, and that is the total welfare gain of society, is ... DKK 900 million yearly or DKK 3,500 in average for each household that makes use of the home service scheme."[14]

This passage shows that the Danish Ministry regards the HSS as a considerable success, a view shared by other observers.[15] The passage also makes clear that the Danish Ministry sees the HSS, in part, as a way to undo some of the harm caused by the tax-induced misallocation of time and production activity. We now provide our own welfare analysis of the HSS.

5.3 Assessing the Danish Home Service Scheme

[12] Danish National Institute for Social Research (2002), page 39.
[13] One Danish Kronor exchanged for approximately XX U.S. Dollars as of 1999.
[14] Danish National Institute for Social Research (2002), page 40. We have added some punctuation to the original passage.
[15] References.

6 Conclusion

Personal taxes distort the allocation of time, production and consumption among and within households. They distort time allocations by driving a wedge between privately and socially efficient task allocations. The tax wedge raises the threshold level of comparative advantage required for the market solution to obtain, which distorts the choice between market provision and household production. By shifting production activity and exchange out of the market sector, personal taxes also undermine the efficient allocation of consumption goods within the household and among households.

Summarize the empirical results on the size of tax-induced departures from comparative advantage calculations.

It is natural to ask what insights and testable implications emerge from an integrated treatment of personal taxes, household production and market production. First, and most obviously, an integrated treatment yields implications for the effects of personal taxes on hours worked in the home as well as in the market. Second, an integrated treatment leads to testable hypotheses about how personal taxes affect the industry distribution of employment and hours worked within the market sector. Third, our model shows how the law of comparative advantage governs the allocation of productive time across activities and households, and how personal taxes distort comparative advantage. Fourth, our analysis draws attention to fact that the long run supply of labor to the market is intimately tied to the organization of productive activity in the economy. Finally, our analysis provides a simple means to evaluating the efficiency gains from policy reforms that encourage the substitution of market production activity for home production activity.

Summarize the results of analyzing the Danish policy.

Broad changes in the organization of productive activity within an economy are likely to proceed gradually for reasons that we have not explicitly modeled. As a consequence, the full labor supply effects of large changes in an economy's level of personal taxation are also likely to emerge gradually. Hence, our perspective suggests that the long run response of hours worked in the market sector to changes in the level or structure of personal taxation in an economy may exceed the short run response.

As we remarked earlier, the principle of comparative advantage leads to specialization in market work activity. Because home-produced goods are not (easily) transferable across households, the scope for and rewards to specialization within the home sector are far smaller. As a consequence, higher personal tax rates lead to less overall specialization in production.

This observation has several additional and potentially important implications in a dynamic setting. First, as emphasized by Rosen (1983), the returns to investment in specific skills rise with the amount of time devoted to the application of those skills. Hence, by reducing specialization in productive activity, personal taxes erode incentives to invest in specific skills. Second, as a consequence, high rates of personal taxation discourage the accumulation of specific skills.

Continue.

7 References

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Table 1 Tax-Induced Departures from the Law of Comparative Advantage.

Examples Based on the 1997 Swedish Tax Code and the 1996 Tax Codes for California and Texas

Country or State	**Sweden**	**Sweden**	**Sweden**
Annual Earnings, Buyer	SEK 240,000	SEK 180,000	7.5 base amounts
VAT/sales tax rate, m	0.25	0.25	0.25
Mandatory social security contribution rate, s	0.3292	0.3292	0.3292
Buyer's marginal tax rate, t	0.592	0.389	0.567
Tax factor, $\frac{(1+s)(1+m)}{(1-t)}$	4.07	2.72	3.83

Country or State	**Texas**	**Texas**	**California**	**California**
Annual Earnings, Buyer	$17,822	$100,000	$17,822	$100,000
VAT/sales tax rate, s	0	0	0	0
Mandatory social security contributions, s	0.153	0.153	0.153	0.153
Buyer's marginal tax rate, t	0.151	0.311	0.179	0.374
Tax factor, $\frac{(1+s)(1+m)}{(1-t)}$	1.36	1.67	1.40	1.84

Notes:

1. The bottom row in each panel shows the tax factor. See the text for a discussion of how the tax factor affects the choice between household and market activities.
2. Sweden: Each column assigns the 1997 average local income tax rate of 31.7%. Differences across columns reflect the gradual phase-out of deductions for social security in the personal income tax system, the gradual phase-out of the "basic" deduction, and the income tax rate levied by the central government on incomes above SEK 232,000 (in 1997). The central government tax rate is 25%.
3. California: s is set to zero to reflect no sales tax on services. For the low-income case, we use a marginal federal tax rate of 15%, a marginal state tax rate of 3% and a social security tax rate of 15.3%. State income tax payments are deducted from taxable federal income. For the high-income case, we use a marginal federal tax rate of 31% and a marginal state tax rate of 9.3%. All U.S. calculations assume a self-employed buyer who is not eligible for the Earned Income Tax Credit.
4. Texas: Identical to California except for a state income tax rate of zero.
5. 17,822 U.S. dollars is equivalent to 180,000 Swedish kronor based on the average 1996 exchange rate, adjusted for purchasing power parity, of 10.1 kronor per dollar.

Source: Authors' calculations and statutory tax rates.

Table 2 The Level of Employment in Selected OECD Countries in the mid 1990s.

Country	Average annual hours of work per employed	Employment rate (%)	Work-hours adjusted employment rate (%)
Australia	1,850	68.2	61.3
Austria	1,610	67.3	51.6
Belgium	1,580	56.1	42.6
Canada	1,714	70.6	59.0
Denmark	1,510	75.0	54.5
Finland	1,768	67.1	57.1
France	1,654	59.8	47.4
Germany	1,610	65.2	50.0
Ireland	1,720	53.2	44.8
Italy	1,730	54.0	44.9
Japan	1,965	73.4	69.2
Netherlands	1,510	62.2	45.2
Norway	1,437	73.3	50.4
New Zealand	1,812	68.0	59.8
Portugal	2,004	69.3	66.6
Spain	1,820	47.5	41.6
Sweden	1,485	75.6	52.0
Switzerland	1,637	78.6	62.0
U.K.	1,720	69.6	58.6
U.S.	1,919	73.1	68.2

Note: The employment Rate is defined as total employment as a share of total population of working age (15–64). The work-hours adjusted employment rate is defined as employment rate times (average annual hours of work per employed person/2,080). Note that 2,080 hours equals 52 weeks times 40 hours per week.

Source: Nickell and Layard (1999).

Table 3 Employment Shares and Growth Rates in Sweden and the United States, Selected Service Industries

Industry	Percent of total 1994 employment		Employment growth rate, 1970–94 (%)	
	U.S.	Sweden	U.S.	Sweden
Wholesale Trade	5.1	5.0	57.1	17.6
Retail Trade	11.3	7.5	46.3	–11.2
Eating and Drinking Establishments	6.0	1.5	175.7	35.8
Hotels and Lodging	1.2	0.8	112.2	19.0
Repair services, n.e.c.	1.1	0.2	125.6	–22.7
Laundries and Cleaning Services	0.6	0.2	–22.3	–56.3
Domestic Services	0.8	0.02	–44.1	–98.9
Financial Institutions	2.9	1.6	97.0	34.1
Insurance	1.9	1.2	68.3	58.4
Legal Services	0.9	0.2	234.8	140.0
Business Management and Consulting	0.7	0.3	124.5	500.2

Note: These figures reflect an equal weighting of full-time and part-time workers. Part-time work is very important in several U.S. and Swedish service industries. It is unclear whether the impact of part-time employment biases the country comparison.
Source: Various U.S. sources and tabulations by Statistics Sweden, as described in Davis and Henrekson (2000).

Figure 2. The evoution of the tax factor for three types of workers in Sweden, 1952-2001

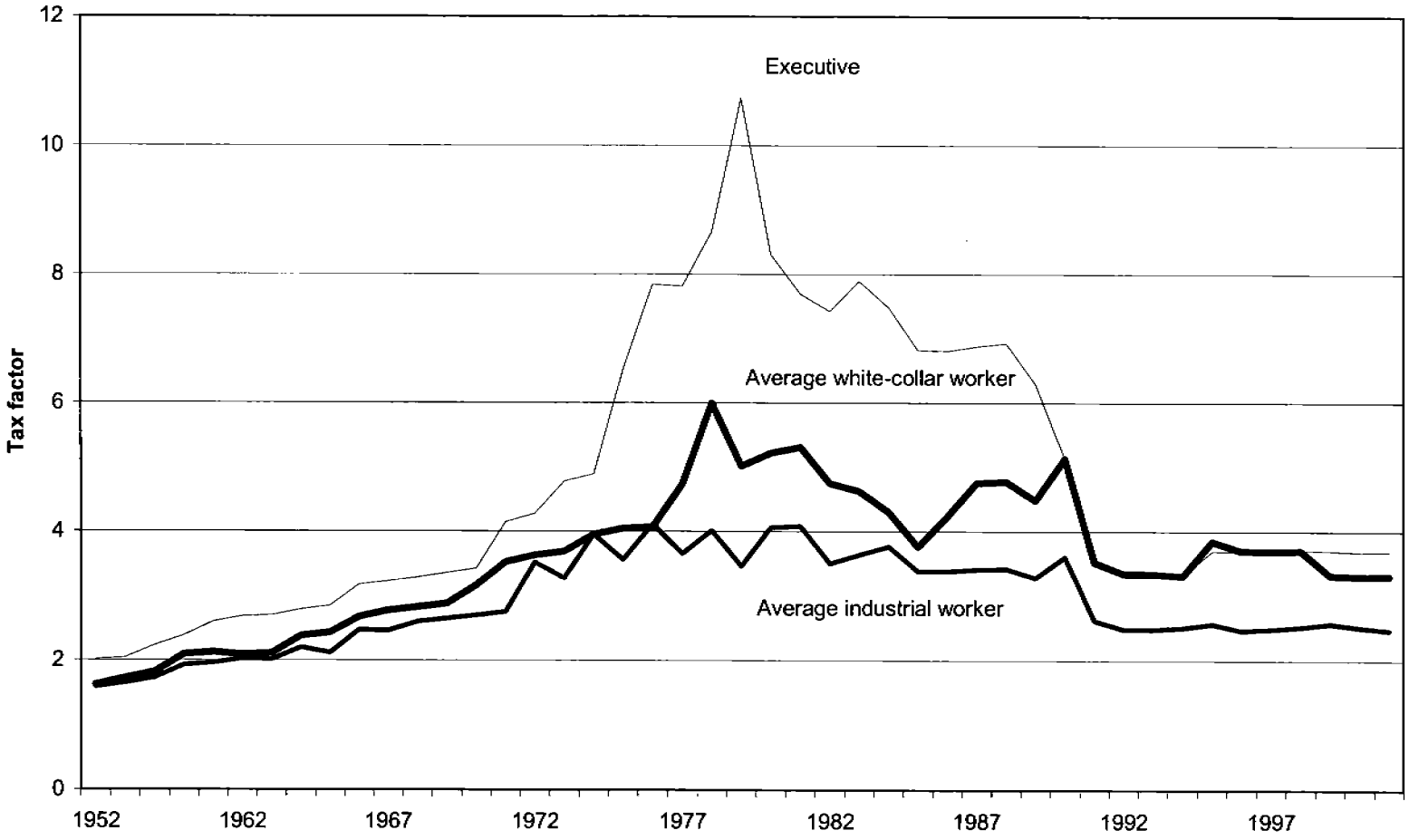
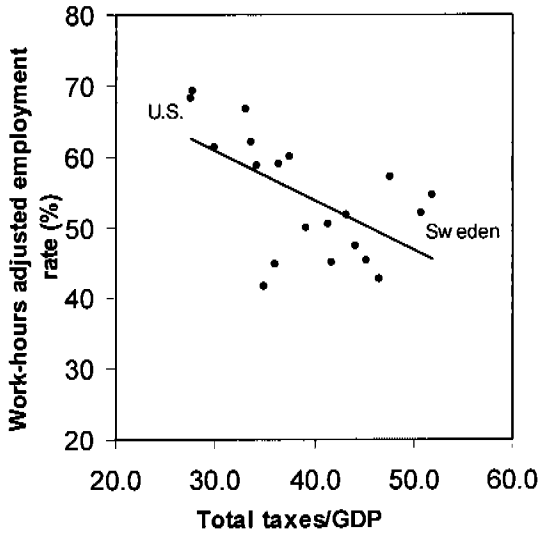


Figure 2 Total Marginal Tax Wedge for Industrial Workers, White-Collar Workers and Executives in Sweden, 1952–2000 (percent).

Note: The marginal tax wedges are evaluated at mean earnings each year. "Executive" is defined as an individual in the management group (below the CEO) in a private firm. The tax rate includes mandatory social security contributions paid by the employer or the employee, the marginal income tax and indirect taxes on private consumption. All income is assumed to be spent for private consumption purposes. Property taxes are excluded. The tax wedges for executives and average white collar workers coincide between 1991 and 1998.

Source: Du Rietz (1994) and updated calculations supplied by Du Rietz.



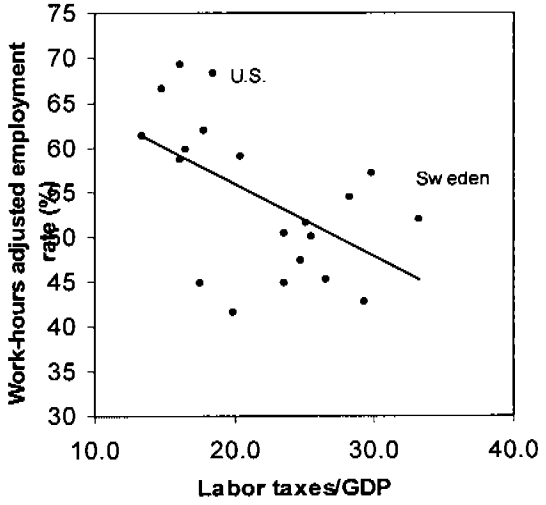


Figure 3 The relationship between the level of taxation and the work-hours adjusted employment rate in 20 OECD countries, 1994.

Note: Work-hours adjusted employment rate = [(average annual hours worked per employed times employed persons)/(2,080 times population aged 15–64)] times 100. Labor taxes/GDP are for 1992. For a list of included countries, see Nickell and Layard (1999).

Sources: Work-hours adjusted employment rates are from Nickell and Layard (1999), Taxes/GDP are from *OECD Revenue Statistics 1965–1996,* and Labor taxes/GDP from OECD (1995).

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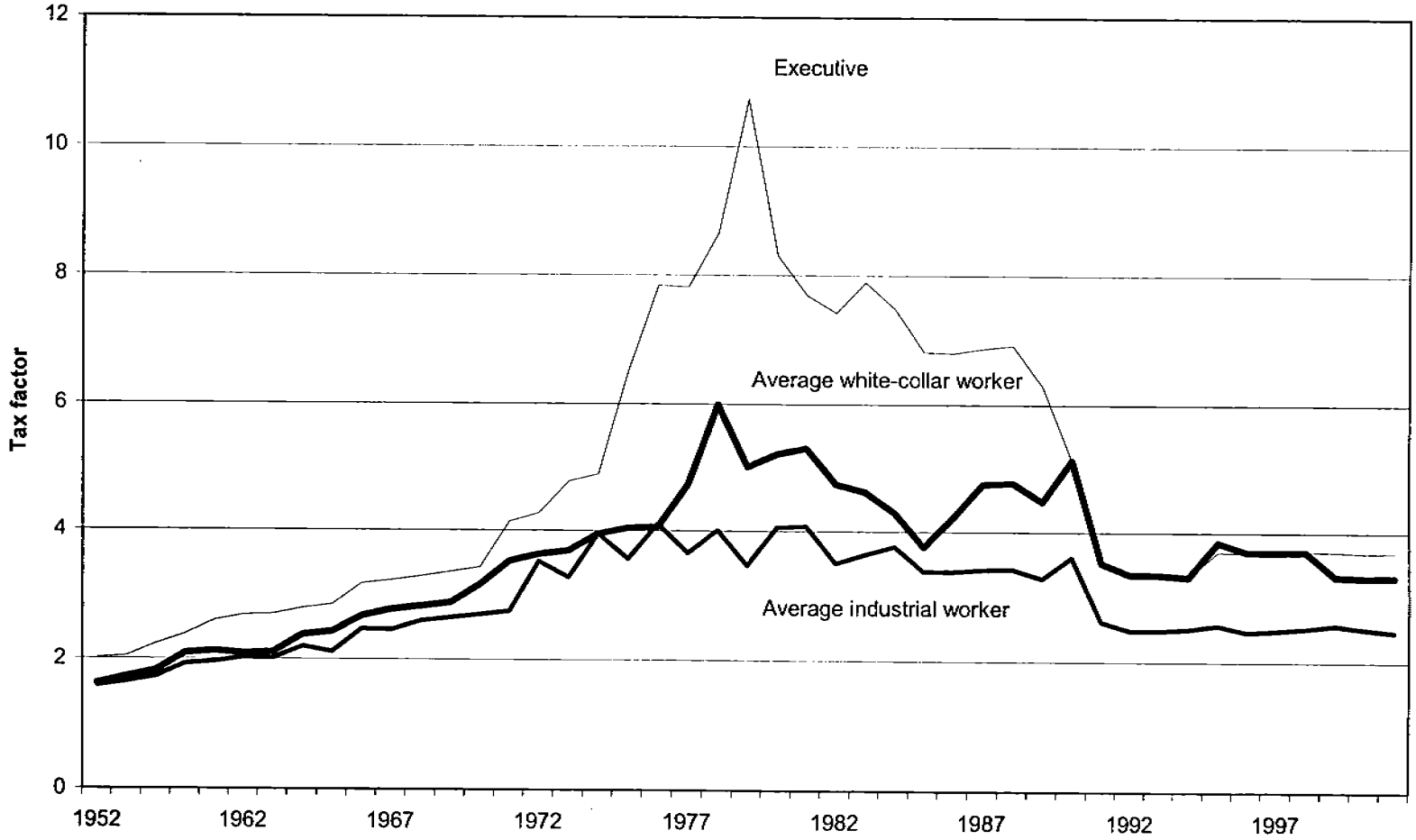

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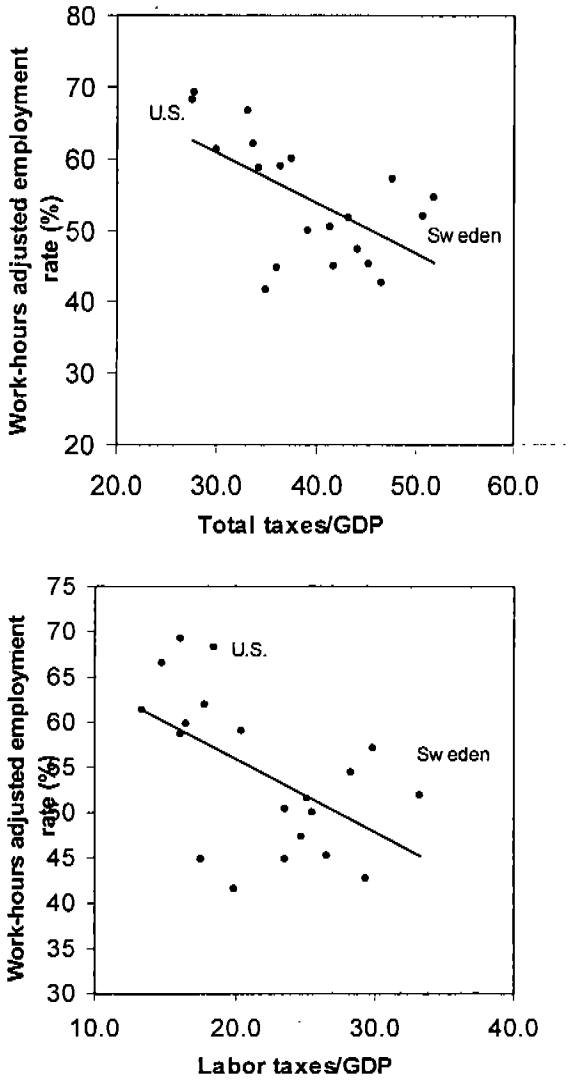

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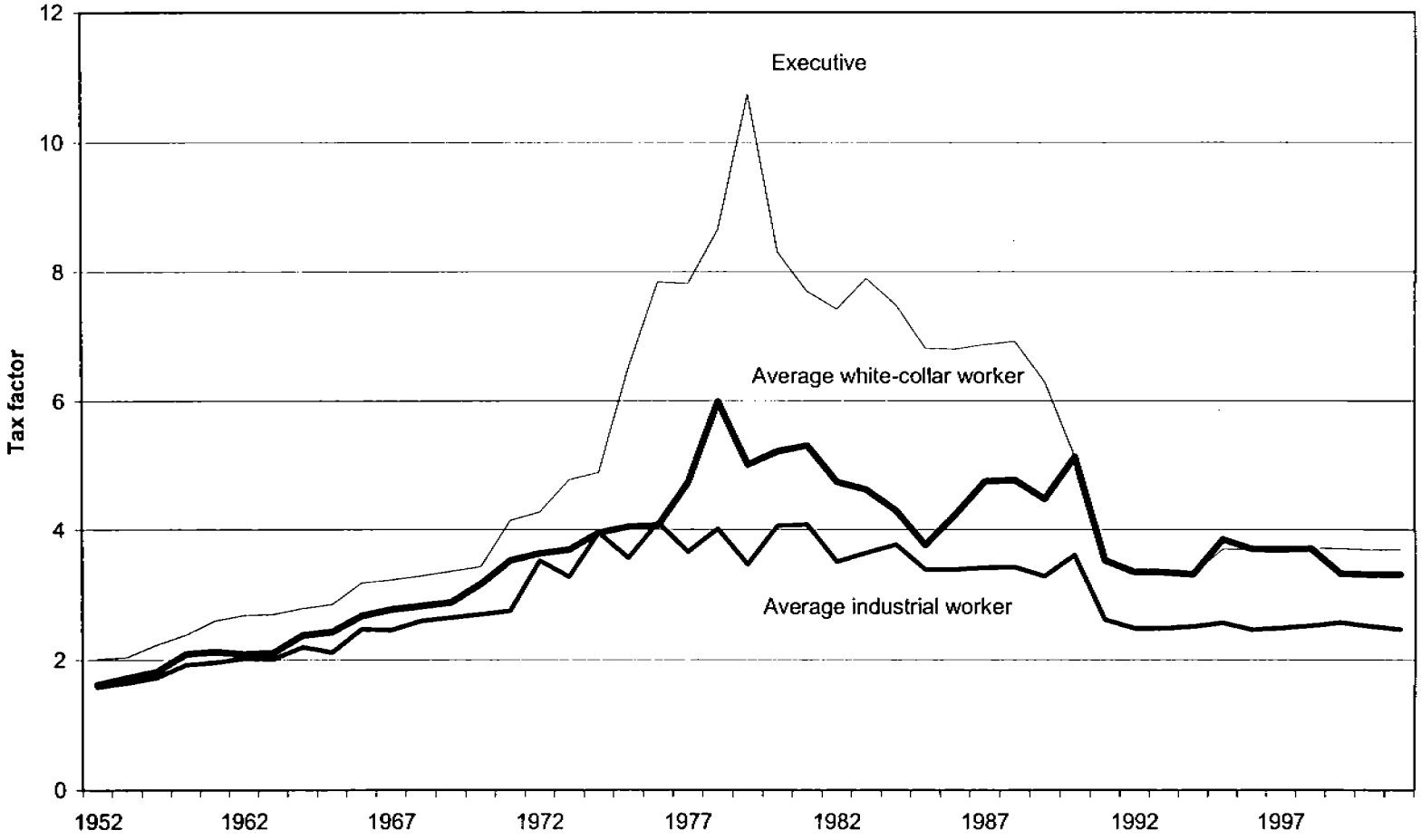

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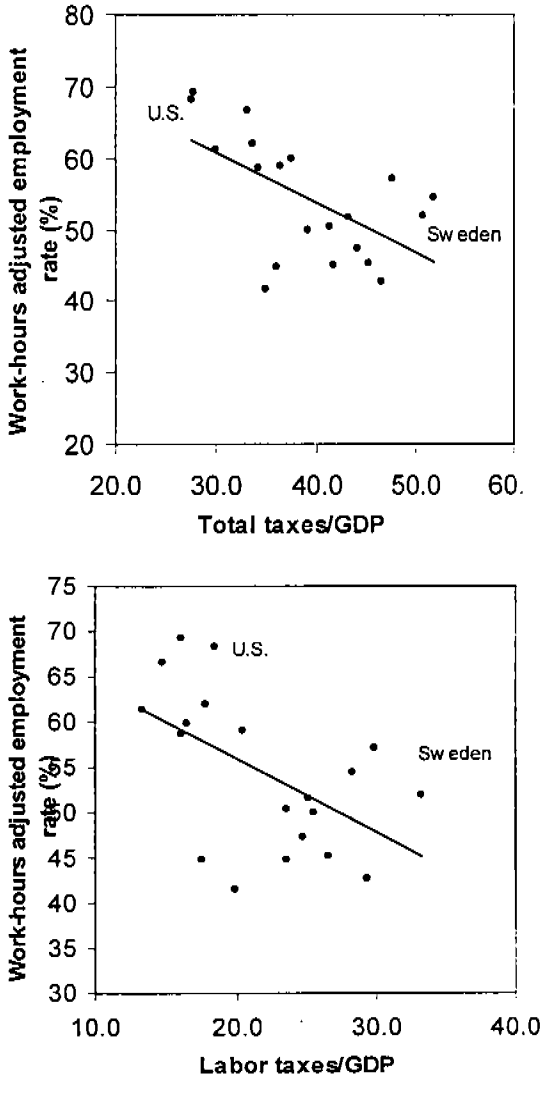

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