

Tax Effects on Work Activity, Industry Mix and Shadow Economy Size: Evidence from Rich-Country Comparisons*

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Abstract

We investigate the long run total response among rich countries to differences in tax rates on labor income, payrolls and consumption. To guide our investigation, we rely on a simple theory of time allocation and task assignment between market and non-market production sectors. The theory implies that higher tax rates reduce work time in the market sector, increase the size of the shadow economy, shift the industry mix of market activity, and twist labor demand in a way that amplifies negative effects on market work time and concentrates the effects on the less skilled.

In OLS regressions on rich-country samples in the mid 1990s, a unit standard deviation tax rate difference of 12.8 percentage points is associated with 122 fewer market work hours per adult per year, a 4.9 percentage point reduction in the employment-population ratio and an increase in the size of the shadow economy amounting to 3.8 percent of GDP. A unit standard deviation tax difference also involves 10 to 30 percent lower employment and value added shares in (a) retail trade and repairs, (b) eating, drinking and lodging and (c) a broader industry group that also includes wholesale trade and motor trade and services, confirming a key prediction of the theory. We describe conditions under which these OLS results yield unbiased estimates of the total response to observed tax rate differences, inclusive of indirect effects that work through government spending responses to available tax revenues.

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1. Introduction

Taxes on labor income and consumption expenditures encourage households to substitute away from market production activity in favor of untaxed activities – leisure, household production and underground activity. We investigate these substitution responses by relating measures of employment, market work hours, shadow economy size, and the industry mix of market production activity to tax rate differences among rich countries.

Our main goal is to assess the long run total response of these outcomes to persistent differences in the tax rates on labor income, payrolls and consumption – collectively, personal taxes. By “total response,” we mean the direct effects of personal taxes working through labor supply and demand plus indirect effects that involve government spending responses to available tax revenues. In the spirit of Brennan and Buchanan (1980), Krusell et al. (1996), Persson and Tabellini (2002), Becker and Mulligan (2003), and others, we recognize that taxing capacity affects government expenditures. In turn, many government expenditure programs affect labor supply incentives. Leading examples include publicly funded programs for unemployment and disability insurance.

We also recognize that the cross-country relationship between tax rates and the outcome variables under study can vary with the reasons for the tax rate differences. In light of this observation, we describe conditions under which OLS regressions yield unbiased estimates for the total response to exogenous tax rate differences among countries.

Our focus on broad international comparisons has inherent limitations. Perhaps most important, a sample of rich countries offers a modest number of data points. Moreover, the available data lead us to rely mainly on cross-country differences in the 1990s as the basis for inference. For this reason, our data are not well suited for assessing the dynamic response path to tax reforms or changes in tax rates.

Despite the limitations, several considerations point to a useful role for the broad-brush international comparisons that we undertake. First, a focus on national outcomes provides information about the combined effect of taxes working through labor supply and labor demand channels. In this regard, it is important to recognize that the effect of taxes on hours worked and other outcomes cannot be inferred from labor supply elasticities alone. As we show in Section 3, a simple theory of time allocation and task allocation implies that personal taxes have disproportionately large negative effects on the demand for labor in market activities that intensively utilize less skilled workers. By most accounts, labor supply is also more elastic for less skilled workers. Hence, personal taxes alter the composition of labor demand in ways that amplify negative effects on hours worked and employment, and that concentrate those effects on the less skilled.

Second, countries with high tax rates on labor and consumption tend to have generous tax-funded programs for social security, disability insurance, sick leave assistance, unemployment insurance and general assistance. The benefit sides of these programs alter labor supply incentives in ways that can reduce hours worked, increase employment in the underground economy and alter the industry mix of market production activity.¹ Insofar as government spending on these programs responds to the availability of government revenues, the full response to differences in taxing capacity includes the indirect effects that work through the expenditure side of government behavior. Conceivably, the indirect expenditure effects on the outcome variables under study are as large as the direct effects of taxes.

Third, there are large, highly persistent differences among countries in tax rates on labor and consumption and in the scale of tax-funded social insurance programs. This variation partly compensates for a modest number of data points. Moreover, labor demand responses to persistent tax rate changes are probably bigger over the longer term, as imperfectly mobile

factors of production gradually shift sectors (or depreciate away) in the wake of tax changes. And, as we discuss in Section 2, research on unemployment and welfare-state dynamics highlights the potential for slow-working responses to taxes and social insurance programs. The persistent character of between-country differences in personal tax rates makes them well suited for estimating long run effects on outcome variables.

These considerations suggest that broad international comparisons help to inform our thinking about the economic effects of taxes and taxing capacity. At a minimum, our international comparisons provide useful inputs for assessing the performance of economic theory and the success or failure of public policy, tax policy in particular. In this regard, Prescott (2002) argues that French welfare in consumption-equivalent terms would rise by 19 percent if France lowered its labor and consumption taxes to U.S. levels. He bases this assessment on the cross-country empirical relationship among taxes, factor inputs and output per working-age person, as interpreted through the lens of a standard one-sector growth model. If Prescott's assessment is correct, it implies that France and many other nations bear enormous costs for high rates of taxation on labor and consumption.²

In terms of Prescott's framework and analysis, our study is useful for two reasons. First, the view that France's relatively high tax rates cause its relatively low output per working-age person suggests other hypotheses that we address. Evidence on these hypotheses serves to confirm or disconfirm the basic view that underlies Prescott's conclusion. Second, more detailed evidence about whether and how personal taxes affect work time and productive activity provides inputs for improved model-building and more refined policy analysis.

¹ We make no effort to summarize the vast body of research on the labor supply incentives associated with social insurance programs, but studies of the Swedish case by Aronson and Walker (1997) and Henrekson and Persson (2004) highlight many of the issues.

² Prescott's assessment is by no means universally shared among professional economists. Lindert (2002), for one, advances a much more favorable assessment of economic policy and performance in developed economies with high taxes and social spending.

Before proceeding, it will be useful to spell out some conventions regarding terminology. For our purposes, “market production” refers to output produced and incomes generated in legal markets, and which are declared to the government and captured in the National Income and Product Accounts. The “shadow” or “underground” economy refers to the output and incomes generated in markets, but which are not declared to the government, particularly the taxing authorities. “Household production” refers to output produced for own consumption, as distinct from output produced and sold in formal or informal markets. “Leisure” refers to the time devoted to rest and intrinsically enjoyable activities that are otherwise non-productive. In line with this terminology, we think of household time as allocated among market production, underground production, household production and leisure.

The paper proceeds as follows. Section 2 provides some background on the household and underground production sectors and additional motivation for our focus on long run cross-country comparisons. Section 3 develops a theory of time allocation and task assignment between market and non-market production sectors. The theory identifies characteristics of production technologies and factor intensities that lead to high or low tax responsiveness. Since these characteristics differ markedly across industries, the theory yields testable implications for the cross-country relationship between personal tax rates and industry-level employment and value-added shares. Section 4 considers the identification issue mentioned above and clarifies the interpretation of cross-country evidence on the effects of personal taxes. Section 5 describes the data in our sample of rich countries, and Section 6 reports evidence on the cross-country relationship of personal tax rates to the outcome measures. Section 7 reviews other evidence that speaks to the long run total response to personal taxes, and Section 8 offers concluding remarks.

2. Household Production, Underground Activity and Welfare-State

Dynamics

Taxes on labor and consumption lead to tax avoidance and tax evasion on several margins. The tax-induced substitution of household production and leisure for market goods and services are legal forms of tax avoidance. The tax-induced substitution of underground work activity for employment in the legal market sector, and the consumption of goods and services produced in the underground economy to escape taxation, are illegal forms of tax evasion. The size of the household and underground sectors suggests the potential for a significant tax-induced diversion of productive activity away from the legal market sector.

Eisner (1988, Table S.4) reports several estimates for the value of labor services supplied to the household production sector in the United States, ranging from 24 to 48 percent of official GNP. Juster and Stafford (1991) report that time devoted to household production by a typical U.S. married couple is about three-quarters as large as hours worked for paid compensation. Greenwood et al. (1995) cite this evidence as motivation for business cycle models with home production in their review of work on the topic. As their survey attests, macroeconomics has increasingly recognized the significance of the home production sector. Nevertheless, few analyses treat both home production and taxation.³

Much economic analysis of taxation also neglects the underground sector. However, available evidence indicates that the shadow economy is sizable, even in developed economies, and that taxes are a major stimulant to underground activity. In their survey of research on the shadow economy, Schneider and Enste (2000, Table 7) report that the value of

³ Boskin (1975) provides an early analysis of tax incidence and efficiency in a two-sector general equilibrium model with market and home production. Sandmo (1990), Piggott and Whalley (1998) and Kleven et al. (2000) analyze optimal taxation in models with home production. Tax effects on the choice between market and household production activity play a central role in Rosen's (1997) assessment of the Swedish welfare state and in Sørensen's (1997) analysis of European unemployment.

shadow economy output in the mid 1990s amounted to 16 percent of official GDP in the average OECD country, ranging from about 7 percent in Austria and Switzerland to 22 percent or more in Belgium, Greece, Italy, Portugal and Spain.⁴ According to Giles and Tedds (2002, page 66), “there is a consensus that in almost every country that has been studied the underground economy has been growing relative to GDP or GNP over the past two or three decades.”

The importance of taxation is well established in previous research on the determinants of shadow economy size. In the words of Giles and Tedds (2002, page 7), “Perhaps the single most commonly cited ‘driving force’ of the underground economy is the actual, or perceived, tax burden.” Likewise, Schneider (2000, page 82) writes that “In almost all studies, one of the most important causes of the increase of the shadow economy is the rise of the social security and tax burden.” These research summaries strongly suggest that the impact of taxes on underground economic activity is an important part of the overall response to personal tax rate differences among countries.⁵

The foregoing remarks highlight the potential importance of tax-induced substitution away from production in the legal market sector to household and underground production activity. A distinct body of research on welfare-state dynamics highlights the potential for such tax-induced substitution responses to cumulate over time, leading to much bigger tax effects in the long run than the short run.

Lindbeck (1995) discusses several reasons for delayed private responses to the economic disincentives created by high tax rates and generous social insurance programs. He argues that

⁴ Schneider and Enste report estimates of shadow economy size based on several different methods and types of data. Two methods that have been applied to many countries — the Physical Input (Electricity) Method and the Currency Demand Method — yield similar values for the average size of the shadow economy in the OECD and a similar pattern across countries. See their Tables 6 and 7.

⁵ Johnson et al. (1998) argue that the administrative burden of taxation and the scope for corruption and abuse by the tax authorities, as distinct from tax rates, are key determinants of shadow economy size. We do not dispute this assessment for the sample of countries considered by Johnson et al., but the problems that they emphasize are much less important and probably much less variable among the countries in our sample.

habits, attitudes and social norms restrain the influence of economic incentives on behavior, and that these restraining influences can erode over time as a consequence of high tax rates and generous welfare-state benefits. In this vein, Lindbeck et al. (1999) model the interplay between individual incentives and a social norm favoring work over welfare. The intensity of the norm, as felt by the individual, diminishes with the population share of welfare recipients. This interaction gives rise to the possibility of multiple equilibria and extended dynamics.⁶

Purely economic mechanisms can have similar effects. For example, Ljungqvist and Sargent (1995, section 4.3) model the effects of a breakdown in the monitoring process that deters abuse of the unemployment insurance system. In their analysis, an exogenous increase in unemployment leads to less effective monitoring of benefit claimants, which in turn allows for greater abuse. A sufficiently bad unemployment shock overwhelms the monitoring process and leads to a permanently higher rate of unemployment. Much other research on European unemployment stresses the potential for long and complex dynamic responses to shocks or to changes in unemployment insurance and other labor market institutions. Prominent examples include Ljungqvist and Sargent (1998) and Blanchard (2000).

In the empirical work below, we examine data on tax measures and outcome variables as of the middle 1990s. Broadly speaking, pronounced cross-country differences in tax burdens and social safety nets had been in place for two decades or more by the mid 1990s – presumably long enough for any slow-working effects of taxation to have emerged.⁷ Moreover, the countries in our sample were hit by large negative shocks in the 1970s and early 1980s of the sort that could be expected to expose any latent instability or negative feedback loops that amplify long run effects. In this respect, a focus on outcomes in the mid 1990s is well suited to our main objective.

⁶ Reference to and brief summary of Spiro (1993) and Schneider (1994)?

3. Theory and Empirical Implications

How Personal Taxes Affect Time Allocation and the Choice of Production Sector

Consider a household that chooses between market and non-market solutions for accomplishing a certain task such as painting its home exterior. Under the market solution, the household hires a professional, and the transaction is subject to various taxes. Under the non-market solution, the household applies its own time to accomplish the task and avoids taxation. A third alternative would be to hire someone under the table, thereby evading some or all taxes without incurring the time cost of a do-it-yourself approach. The analysis below focuses on the first two options, but it will be clear that a similar analysis holds for any choice between taxed and untaxed (or less taxed) alternatives.

How exactly do personal taxes affect the choice between market and household modes of production? To address this question, assume initially that labor is the only input used to perform the task. For convenience, refer to the household making the choice of production mode as the “buyer”. Assume that the good or service in question is produced and consumed in a given quantity, and define the following notation:

C_H = do-it-yourself cost in household production.

C_M = cost of buying the service in the market from a professional supplier.

W^B = buyer's pre-tax wage per unit of time.

W^P = pre-tax wage of the professional supplier.

H^B = time required to accomplish the task by the buyer.

H^P = time required to accomplish the task by the professional.

t = marginal tax rate on the buyer's labor income, including his or her mandatory contributions to social insurance funds.

s = payroll tax rate levied on employers (i.e., the buyer).

m = valued-added tax (VAT) rate or sales tax rate.

Note that (H^B / H^P) measures the professional's relative productivity at the task in question. When $H^B > H^P$, the professional is more productive, and we may say that the

⁷ However, there is a broad upward drift in personal tax rates during the decades that precede our sample period,

professional has an absolute advantage in the activity. This case is likely to prevail in most circumstances, but the buyer could have an absolute advantage in certain cases. For example, the buyer might be highly able in many tasks, not just in her market specialty.⁸

The cost of production in the do-it-yourself case equals foregone after-tax wages:

$$C_H = W^B(1-t)H^B \quad (1)$$

That is, the time cost of the do-it-yourself option amounts to $W(1-t)H^B$ in foregone expenditures on other consumption goods. The cost of buying the service in the market is

$$C_M = W^P(1+s)(1+m)H^P \quad (2)$$

It follows immediately that the buyer prefers the market solution if, and only if, $C_H > C_M$; that is,

$$C_H > C_M \Leftrightarrow \frac{W^B}{W^P} \frac{H^B}{H^P} > \frac{(1+s)(1+m)}{1-t} \quad (3)$$

Equation (3) says that the market solution dominates when the professional's comparative advantage – his relative productivity times the buyer's relative wage – exceeds the tax factor,

$\frac{(1+s)(1+m)}{(1-t)}$. For any given tax structure, the comparative advantage ratio $\frac{W^B}{W^P} \frac{H^B}{H^P}$

determines task assignment and time allocation. Taxes alter private choices regarding time allocation and task assignment by changing the threshold comparative advantage ratio at which the market solution dominates.

This analysis is useful for evaluating the effects of personal taxes on substitution between market and household (or underground) activities. The analysis implies that, in the absence of taxes, the privately optimal choice assigns the task to the person with comparative advantage. To see this point, observe that the right side of (3) equals one when $s = m = t = 0$.

as we show in Section 6.

⁸ In addition, many households have strong preferences for the self-supplied version in activities such as meal preparation and child care. And household production can yield utility directly, as in gardening for enjoyment. It would not be hard to incorporate these considerations into the analysis.

The no-tax task assignment is also socially optimal, because it minimizes the value of scarce time resources applied to the task.

The analysis also shows that personal taxes raise the minimum comparative advantage required of the professional for the market solution to obtain. In this way, personal taxes drive a wedge between privately and socially optimal task assignments. Too few tasks are carried out in the market sector because of taxes, and too little time is spent working in the market. Conversely, too many tasks are carried out in the household (or underground) sector, and too much time is spent working outside the legal market sector.

Davis and Henrekson (2002) derive a version of (3) as a property of competitive equilibrium in a model with a continuum of consumption goods and households that allocate time among market production, household production and leisure. In their model, the market sector combines capital and multiple labor inputs to produce goods according to production technologies that exhibit constant returns to scale and smooth substitution among inputs. Households differ with respect to market wages, efficiency of home production technologies, and preferences over consumption goods. Thus, although we derived (3) in a very simple setting, it holds more generally. The key requirement underlying a condition like (3) is that the household be on the margin between working for paid compensation in the market and spending time at household production in *some* activity. Almost every working household is likely to satisfy this condition, especially in the long run when the household can exercise choice over market work hours.

Choice of Production Sector with Capital Inputs

It is straightforward to extend (3) to the case where production uses capital and labor in fixed proportions. Let K denote the amount of capital applied during production, and let P^K be the price per unit of capital. The rental rate on capital equals the sum of the interest

rate, r , and the geometric rate of depreciation per unit time, δ .⁹ The costs of the market and non-market solutions become

$$C_H = W^B(1-t) + (r+\delta)(1-t)KP^K H^B, \text{ and} \quad (4)$$

$$C_M = W^P(1+s)(1+m)H^P + (r+\delta)(1-t)KP^K H^P, \quad (5)$$

where we assume that capital and labor income are taxed at the same rate, and that capital goods are not subject to a VAT or sales tax. The buyer now prefers the market solution when

$$\frac{W^B}{W^P} \frac{H^B}{H^P} + (H^B - H^P) \left[\frac{(r+\delta)KP^K}{H^P W^P} \right] > \frac{(1+s)(1+m)}{1-t} \quad (6)$$

The second term on the left side of (6) is positive so long as the professional has an absolute advantage in the task. In this case, capital costs push the buyer toward the market solution. For given capital intensity, the capital cost effect rises with the professional's absolute advantage. When the buyer and professional are equally productive in the task, the capital cost effect vanishes and the decision rule reduces to (3).

The professional's absolute advantage favors the market solution because a do-it-yourself approach engages capital inputs for a longer time spell, raising capital rental costs in household production relative to market production. This basic logic clearly extends beyond capital inputs. In particular, whenever the buyer's absolute disadvantage means that household production ties up cooperating factors for a longer time spell, the buyer is pushed toward the market solution. The cooperating factors of production could be capital inputs, but they could also be other workers required to accomplish the task. For this reason, the allocation of time to household production is relatively unattractive for activities that rely on team production methods with significant complementarities among inputs. *Clarify this – complementarity in the sense of time spent working together.*

⁹ Depreciation that is proportional to production adds equal amounts to the cost of the market and non-market solutions. Hence, such depreciation drops out of the decision rule, and we can ignore it. The same point applies to market-supplied intermediate inputs that are used up in production.

Equation (6) implicitly rests on frictionless rental markets for capital or, equivalently, on an assumption that the idle time of capital goods is the same whether deployed in the household or market production sectors. In fact, rental markets for capital goods are not frictionless, and the idle time of capital inputs is often much greater in the household sector. In terms of the home painting example, a professional might make use of a spray painter on a weekly basis, whereas the same piece of equipment might sit idle nearly year round when acquired for household production.

As a polar alternative to the frictionless case, consider the situation with no rental or resale market for the capital input in question. Suppose that the professional supplier fully utilizes capital inputs in the market sector, and let γ be a parameter that reflects the time interval between uses of the capital input in the household production sector. For example, if the time unit is one week, and a household sector makes use of a spray painter once every two years, then $\gamma = 104$.

With no capital rental market, the decision rule governing choice of production mode has the same form as before, but now γ replaces H^B in the second term on the left side of (6). The strength of the capital cost effect now depends on the idle time of the capital input rather than the buyer's absolute disadvantage. This idleness effect can be quite powerful for capital-intensive tasks. Returning to the example of the spray painter, suppose that H^P equals one week, H^B equals two weeks and the household wants its home exterior painted once every two years. Then the capital cost component is twice as large in household production as in market production for the case of a frictionless rental market, but it is 104 times as large for the case of no capital rental market.

In practice, the capital-cost differential between household and market production will typically lie between these two polar alternatives. Idleness will be low for frequently used capital inputs such as cooking equipment, and for equipment with well-established rental

markets such as light trucks for transporting household goods. In contrast, the prospect of high idleness and the absence of rental markets for, say, specialized wood-cutting equipment will discourage the assignment of certain carpentry tasks to the household sector, even when the professional does not have a large comparative or absolute advantage.

The basic character of the decision rules (3) and (6) will be familiar to readers who are versed in the literature on assignment models. See Sattinger (1993) for an excellent synthesis of work in this area, and Davis (1997) for a simple model of assignment based on absolute advantage in a setting with team production. The central ideas in the assignment literature appear to have found little explicit application to questions about the effects of taxation, although the concept of comparative advantage is widely appreciated.

Calculating Tax Factors: An Illustration

The right side of the time allocation and task assignment rules (3) and (6) depend only on personal tax rates, and they are readily calculated from suitable data. As an illustration, Table 1 calculates tax factors for low-income and high-income workers in Sweden, California and Texas for 1996 and 1997. Texas is a low-tax state, and California has relatively high tax rates compared to most other states in the United States. The PPP-adjusted exchange rate during these years was about 10 Swedish Kronor per U.S. Dollar, so an annual salary of SEK 240,000 corresponds to about 24,000 U.S. Dollars.

The table shows that U.S. tax factors are around 1.4 for low-income workers and 1.8 for high-income workers. The Swedish tax factor is around 2.7 for low-income workers and around 4 for middle-income and high-income workers. To appreciate the implications of these tax factors, consider the simple case where labor is the only input and the buyer earns the same wage as the professional. In this case, a tax factor of 4 means that the buyer chooses the do-it-yourself alternative unless the professional is at least four times more productive on the

task. For example, the buyer prefers to spend 38 hours on the task, even if a professional who earns the same wage can perform the task in only 10 hours.

Empirical Implications

The theory implies that personal taxes cause productive activity to migrate from the legal market sector to the household and underground production sectors. Other things equal, the theory predicts that higher rates of personal taxation lead to fewer hours worked in the market sector, a bigger shadow economy relative to GDP, and more time devoted to household production activity.¹⁰

The theory also carries implications for the type of productive activities that are most responsive to personal tax rates, i.e., most easily shifted from market to household or underground production modes. In this regard, the theory identifies comparative advantage, absolute advantage, capital intensity and capital idleness as key factors. Greater comparative and absolute advantage on the part of professional suppliers in the market, greater capital intensity in production and a higher degree of capital idleness in the non-market sector act as deterrents to tax-induced substitution away from market production modes. Team production with complementary labor inputs also discourages substitution away from the market sector.

The comparative and absolute advantage of professionals is greater when the market production mode relies intensively on highly skilled and highly specialized labor inputs. Hence, the theory predicts that employment and value added in skill-intensive industries are relatively insensitive to personal tax rates. For reasons that are already clear, the theory also predicts that employment and value added in capital-intensive industries are relatively insensitive to personal tax rates. If we interpret firm and establishment size as proxies for the

¹⁰ Marginal tax rates matter for households on the intensive labor supply margin (hours worked), but average tax rates matter for households on the extensive margin (employment). In practice, payroll and consumption taxes are approximately proportional to their respective tax bases, so that our empirical measures of s and m are both

importance of team production methods, then the theory predicts that employment and value added are relatively insensitive to personal tax rates in industries where large firms and establishments predominate.

Put the other way round, the theory predicts high tax responsiveness of employment and value added in industries that rely intensively on less skilled labor and where smaller firms and establishments predominate. Personal services, domestic household services, cleaning and laundry services, and eating and drinking establishments fit this description quite well. Unfortunately, except for eating and drinking establishments, the measurement and classification of these production activities is not well harmonized across countries.

The empirical work also considers value added and employment shares in lodging and retail trade. Lodging is capital intensive, but three aspects of its production technology point to easy substitution away from the legal market sector.¹¹ First, the production of lodging services relies intensively on less skilled labor, so that comparative and absolute advantages do not strongly disfavor non-market production modes. Second, scale economies and team production methods are of modest importance, as evidenced by the many small establishments that provide lodging. Third, many households have underutilized living space, so that lodging services supplied outside the formal market sector do not involve large capital rental costs. So, despite the capital-intensive nature of lodging, neither absolute advantage nor idleness strongly deters tax-induced substitution out of the legal market sector.

Retail trade also exhibits some characteristics that, according to the theory, facilitate tax-induced substitution away from market production. As in lodging, the retail sector relies heavily on less skilled labor, and small establishments are commonplace. These attributes lead to high tax responsiveness. Working in the other direction, the retail sector is capital intensive,

marginal and average tax rates. Our empirical measures of t , the tax rate on labor income, are much closer to average than marginal tax rates.

¹¹ As a practical matter, lodging is aggregated with eating and drinking establishments for most of the countries in our data.

principally in the form of structures and inventories. On balance then, the theoretical presumption for high tax sensitivity in the retail sector is weaker than for the other sectors mentioned above.

Another factor might play an important role in the tax responsiveness of the retail sector. In particular, measured production in retail trade bundles the outputs of production processes that involve quite different factor intensities. The inventory services produced by the sector are highly capital intensive, whereas the customer services are intensive in less skilled labor. Hence, even though the overall output bundle produced by retail trade is capital intensive, the scope for tax-induced responses in the customer service component of retail output is probably large. If so, the tax-responsiveness of employment and value-added shares in the retail sector will be high, despite relatively high capital costs in the sector. Admittedly, a similar point could be made about other sectors, so our decision to single out retail trade in this respect involves some judgment.

Our empirical investigation omits child care and elderly care from the analysis, even though these activities exhibit the characteristics identified by the theory as conducive to high tax sensitivity. Perhaps partly for this reason, rich countries with high tax rates tend to provide large direct or indirect subsidies for market (or state) provision of child and elderly care services. Rosen (1997) provides a detailed and provocative analysis of U.S.-Swedish differences in this regard, and Rogerson (2003) argues that this observation helps to explain high Scandinavian employment rates in the face of generally high tax rates. We do not seek to identify tax effects on choice of production mode for these activities, because we lack suitable and comparable data on the effective tax rates applied to these activities and on market-based employment and value added in these activities.

Our last point about the theory pertains to the impact of personal taxes on relative labor demand and the interaction with heterogeneity in labor supply elasticity. The theory

implies that personal taxes alter the composition of labor demand in ways that amplify negative effects on hours worked and employment. To see this point, recall that greater skill intensity in production implies less scope for tax-induced substitution away from the market sector. Team production technologies work in the same direction, and it is well established that skill intensity rises with employer size.¹² These theoretical effects mean that personal taxes lower the relative demand of less skilled labor. By and large, empirical studies find that labor supply is more elastic for less skilled workers. In short, personal taxes reduce the relative demand of less skilled workers, and market work activity by less skilled workers is more responsive to labor demand shifts. So the tax-induced shift in the composition of labor demand magnifies the negative effects on employment and hours worked.

4. Identification

The empirical investigation considers regression equations of the form

$$H_C = a + b T_C + v_C \quad (7)$$

where C indexes countries, T is a monotonic function of the tax factor, and H is the average number of hours worked per adult or other outcome variable. Recall that our objective is to estimate the total response to tax rate differences among countries, inclusive of follow-on responses that involve government spending behavior.

Our approach to identification relies on the assumption that personal tax rates differ among countries for reasons that are exogenous to the outcome variables. Given this assumption, there remain at least two important issues of identification. First, the total response to personal tax rate differences among countries can depend on the reason for the tax rate differences. Second, personal tax rates are measured with error. We concentrate on the first issue.

¹² See, for example, Troske (1999) and the discussion on pages 33-36 in Brown et al. (1990).

With respect to the reasons for cross-country variation in personal tax rates, it is helpful to distinguish among three categories:

- *Taxing Capacity*: Exogenous differences in taxing capacity and the efficiency of tax collection. Such differences can arise from constitutional provisions that affect taxing power, the degree of competition among autonomous tax authorities within the country, accidents of history when there is inertia in the political process that determines tax policy, and other causes.
- *Welfare State Preferences*: Exogenous differences in the desire or political support for social welfare programs that distort labor supply decisions and perhaps alter the structure of labor demand. These differences can arise from constitutional provisions that affect the political feasibility of redistributive tax and transfer programs, the degree of ethnic, linguistic and racial fragmentation of the population, accidents of history, and other causes.¹³
- *Revenue Requirements*: Exogenous differences in net government revenues from non-distortionary (or less distortionary) sources. As examples, at any given level of welfare-state spending, higher tax revenues on petroleum exports or lower spending on national defense means less need to rely on distortionary forms of taxation.

In line with this three-way categorization, consider a simple structural model for the outcome variable H , the tax variable, welfare state spending and net revenue requirements:

$$H_c = \alpha^H + \beta^H T_c + \gamma^H W_c + u_c^H \quad (8)$$

$$W_c = \alpha^W + \beta^W T_c + \theta^W G_c + u_c^W \quad (9)$$

$$T_c = \alpha^T + \gamma^T W_c + \theta^T G_c + u_c^T \quad (10)$$

¹³ Alesina et al. (2001) argue that greater ethnic, linguistic and racial fragmentation leads to less political support for social insurance and redistribution. The model of Persson et al. (2001) implies that a presidential-congressional regime entails greater separation of powers than a parliamentary regime and, as a result, leads to smaller government and less redistribution in political equilibrium. Persson and Tabellini (2002) discuss theory and evidence related to the impact of political regimes and electoral rules on the size and composition of government spending.

where W is the welfare spending variable, G is an exogenous determinant of the government's net revenue requirements, and u^H , u^W and u^T are random disturbances that are uncorrelated with each other and with T , W and G . Equation (8) describes the structural dependence of the outcome variable H on the tax and distortionary spending variables. Equations (9) and (10) describe the joint determination of taxation and distortionary spending.

The total response of hours worked to an exogenous tax rate difference is given by

$$\left. \frac{dH}{dT} \right|_{\Delta T} = \beta^H + \gamma^H \frac{\partial W}{\partial T} = \beta^H + \gamma^H \beta^W, \quad (11)$$

where the ΔT notation signifies that the variation originates with an exogenous difference in taxes. According to (11), the hours worked response to an exogenous tax difference is the sum of a direct effect and an indirect effect that works through government expenditures. The magnitude of the indirect effect rises with the impact of welfare spending on hours worked (γ^H) and the sensitivity of welfare spending to personal tax rates (β^H).

To obtain the total response of hours worked to tax rate differences that originate with exogenous variation in welfare spending, compute the total derivative of (8) with respect to W and rescale to obtain a unit change in T :

$$\left. \frac{dH}{dT} \right|_{\Delta W} = \beta^H + \gamma^H \frac{1}{\gamma^T}. \quad (12)$$

Similarly, the total response of hours worked to tax rate differences that originate with exogenous differences in net revenue requirements is given by

$$\left. \frac{dH}{dT} \right|_{\Delta G} = \beta^H + \gamma^H \frac{\theta^W}{\theta^T}. \quad (13)$$

Comparing (11), (12) and (13), we see that the total response to tax rate differences among countries is the same, irrespective of the reasons for the differences, when

$\beta^W = 1/\gamma^T = \theta^W/\theta^T$. This condition says that welfare spending varies with personal tax rates

in the same manner regardless of the source of tax rate variation across countries. We refer to this condition as the equal spending-response condition.

We are now in a position to clarify the interpretation of regressions (7) estimated on cross-country data. Suppose that the data are measured without error and that the structure (8)-(10) describes the data-generating process. If the equal spending-response condition holds, then OLS regression on (7) provides an unbiased estimate of the total response to tax rate differences across countries. In this context, “welfare state spending” should be interpreted broadly to mean any aspect of government behavior that varies systematically with personal tax rates and that has a direct effect on the outcome variable.

The equal spending-response condition strikes us as a reasonable basis for interpreting OLS regressions on (7), but it is hardly an unassailable identifying assumption. When the equal spending-response condition fails, then OLS on (7) yields a weighted average of the total response expressions in (11), (12) and (13). The precise weights depend on the relative importance of the underlying sources of tax rate variation. OLS still yields an unbiased estimate of the average total response to personal tax rates and, for this reason, still provides useful information about long run tax effects on market work activity, shadow economy size and the industry mix of market activity.

Recent research on the constitutional and political determinants of government spending suggests why the equal spending-response condition might fail. Several models of political equilibrium imply that proportional elections (large voting districts) lead to more government spending and higher taxes (Persson and Tabellini, 2002). The model of Persson et al. (2000) implies that parliamentary regimes also lead to more spending and higher taxes than presidential regimes. Persson and Tabellini (2002) find empirical support for both propositions, but they also find weaker evidence that these two dimensions of constitutional design differ in their implications for the share of government spending devoted to welfare-

state programs. Taken at face value, this empirical evidence means that the equal spending-response condition fails in a sample of countries that differ with respect to both electoral rules and the choice between parliamentary and presidential regimes. This discussion also makes clear that the identification issue is not resolved simply by finding an instrument for exogenous variation in tax rates across countries. Instruments that isolate different sources of tax rate variation can yield different total response estimates.

5. The Country-Level Data

Our empirical investigation considers data for nineteen countries on several outcome variables: the ratio of employment to the population of working age (15-64 years), annual hours worked per employed person, annual hours worked per adult, the size of the shadow economy relative to measured GDP, and value added and employment shares for selected industry groups. Except for measures of shadow economy size, we draw our data on the outcome variables mainly from OECD sources. In turn, the OECD data derive from national sources that are not fully harmonized in the way they measure employment, hours worked and value added.

Internationally comparable data on employment and value added shares in the industries that we identified in Section 3 are not available for many countries. For this reason, our industry share comparisons involve smaller samples. By and large, more aggregated industry categories allow for larger samples and greater consistency among countries in the classification of production activities. We found reasonably consistent data for nine countries in Retail Trade and Repair Services, fourteen countries in Eating, Drinking and Lodging, and fourteen countries in a broader category that encompasses Trade, Repair Services, Eating, Drinking and Lodging. Wholesale trade activities plus vehicle trade and repair services are included in the broader category but excluded from Retail Trade and Repair Services. We

were unable to construct usable samples for personal services, domestic household services, or cleaning and laundry services.¹⁴

There are many methods for estimating the size of the shadow economy, as discussed at length in Schneider and Enste (2000) and Giles and Tedds (2002). We use data based on two quite different methods – the Currency Demand Method and the Electricity Method. To the best of our knowledge, these are the only methods that have been widely applied in a consistent manner to the countries in our samples.

The Currency Demand Method has a long history that dates to Cagan (1958), but recent implementations follow Tanzi (1980). Under this method, the researcher specifies a multiple regression model for the ratio of currency to bank deposits or overall money holdings. The regression model relates the currency demand ratio to interest rates, per capita income, tax rate measures and other variables. The difference between the predicted currency value at actual tax rates and the predicted value at zero tax rates (or to tax rates in a base year with, by assumption, no shadow economy) yields an estimate for the currency demand arising from tax evasion in the underground sector. Given an assumption about income velocity in the underground sector, typically that it equals income velocity in the legal market sector, one obtains an estimate of shadow economy size by multiplying the underground currency demand by the underground income velocity.

Under the Electricity Method, the ratio of electricity usage to GDP in a base period is used to estimate shadow economy size in other periods. In practice, this method typically relies on two assumptions: unit elasticity of total output (measured plus unmeasured) with

¹⁴ The best we could do from OECD sources, by combining all three types of activities, results in a sample of only seven countries with data on our preferred tax measure. Regressions for this sample show a negative relationship between taxes and the employment and value added shares, as predicted by the theory, but the results are not statistically significant. An earlier version of this paper reported an effect of personal taxes on the shares for this industry group. However, upon further review of the data, we deleted two countries from our original sample because of incompatible classifications, and we corrected the U.S. data. We have milder concerns about the consistency of the classification and measurement of these activities in the remaining countries. For these reasons, we concluded that our sample for this industry group does not provide a suitable basis for inference.

respect to electricity usage, and total output equal to measured output in the base period. The gap between the total output implied by the posited relationship to electricity usage and official GDP then provides an estimate of shadow economy size. Obviously, this method rests heavily on the posited relationship between total output and electricity usage. This relationship can be disturbed by changes in output composition, the relative price of electricity and the technological requirements for electricity usage.

For our purposes, the Electricity Method also suffers from a conceptual problem in that it fails to distinguish between household production and other production activity that takes place outside the legal market sector. For example, if personal taxes shift the preparation of meals from restaurants to home cooking, they also shift electricity usage from the market to household production sectors. This substitution response shows up as a larger shadow economy under the Electricity Method, but it is more appropriately characterized as a shift in favor of production for own use and away from markets altogether.

For country-level data on average personal tax rates, we rely on Nickell and Nunciata (2001) and Schneider (2002). Roughly speaking, the data from Schneider measure average tax rates paid by the average worker, but major components of personal taxes for a typical worker – such as payroll taxes – are proportional to earnings. Hence, we think that Schneider’s data capture much of the cross-country variation in marginal tax rates for the average worker. Schneider’s tax data are also better suited for our purposes in other respects, because they provide enough detail to construct the tax factor in (3) and (6), and because they do not mix taxes on capital income with taxes on labor income.

Schneider’s tax data lack a panel dimension and are available for fewer countries. Hence, we also consider data from Nickell and Nunciata, who measure the sum of average tax rates on payrolls, consumption expenditures and household income using data from national accounts. Their data run from 1960 to 1995 (with some missing observations), which enables

us to characterize broad trends in the evolution of country-level personal tax rates. The Data Appendix provides a fuller description of the tax measures and other variables in our study.

Table 2 reports descriptive statistics by variable and sample. (See Table A2 in the Data Appendix for the composition of each sample.) There is much variation in both the outcome variables and the tax variables. Focusing on Sample D, the standard deviation across countries is 162 hours per adult for annual work time, 9.8 percentage points for the employment-population ratio, and 5.1 percentage points for the shadow economy relative to GDP. Our broadest industry group accounts for 19.8 percent of employment and 14.0 percent of GDP, on average, with standard deviations of 3.1 and 3.6 percentage points, respectively. The standard deviation of the average personal tax rate is 11.3 percentage points in the Nickell-Nunciata data and 12.8 points in the Schneider data.

As we proceed to the empirical relationship between tax rates and the outcome variables, it should be kept in mind that the data undoubtedly contain considerable noise. At a minimum, national differences in the measurement of the outcome variables lead to spurious variation in the data. However, there is no apparent reason why this source of measurement error in the outcome variables is correlated with the explanatory tax variables. Measurement error in the tax variables is a more serious concern, and it may well lead us to understate the impact of personal taxes on the outcome variables.

6. Cross-Country Evidence on the Effects of Personal Tax Rates

Personal Tax Rates and their Evolution in Recent Decades

Table 3 reports average personal tax rates (the sum of t , s and m) by country and decade. For each year, we measure the average personal tax rate as the sum of tax rates on payrolls, consumption expenditures and household incomes, as computed by Nickell and Nunciata. We then average over years within the decade to obtain the reported values.

The table documents three key points. First, average personal tax rates vary greatly across countries, ranging in the 1990s from 31 percent in Japan to 77 percent in Sweden. Second, there has been a broad and pronounced upward drift in personal tax rates during recent decades, but the pace of drift slowed greatly or halted after 1985. The simple average of national tax rates rose by only 1.4 percent points from 1985 to 1990 and then fell slightly from 1990 to 1995. Third, the structure of relative tax rates has been fairly stable since the 1970s, as seen by comparing the two rightmost columns in the table. The main outliers are Italy, Portugal and Spain, which experienced relative tax increases of 10 percentage points or more between the 1970s and 1990s, and the Netherlands, which experienced a relative tax decrease of 17 percentage points over the same time interval. No other country underwent a relative tax change of more than 6 percentage points between the 1970s and 1990s.

In short, Table 3 establishes that average personal tax rates differ greatly among the countries under study *and* that these pronounced differences were largely intact for more than a decade prior to 1995. Moreover, the overall level of personal tax rates changed little after 1985. Taken together, these observations imply that our data from the mid 1990s are well suited for an investigation into the long run effects of personal tax rates.

Employment and Hours Response to Personal Tax Rates

Empirical studies on the relationship between aggregate outcomes and personal tax rates typically use the sum of t , s and m , or something similar, as the explanatory tax variable. This sum equals the natural log of the tax factor up to a first-order approximation. We experimented with both the sum of tax rates and the tax factor as explanatory variables. The regression fit is typically as good or better for the sum of rates when the dependent variable is a measure of work hours, the employment rate or shadow economy size. In contrast, the tax factor yields much better fits when the dependent variable is an employment or value-added

share. Hence, we report results using the tax factor variable for the share regressions and the sum of rates otherwise.

Table 4 reports cross-country regressions of the employment rate and hours worked measures. Figure 1 displays the regression line and corresponding scatter plot of annual work hours per adult against the tax variable. As seen in the table, the measure of the tax variable based on Schneider's data yields better regression fits and larger tax effects. Partly for this reason, and partly because it is closer to the theoretical tax measure, our discussion in the text focuses on results for the Schneider-based measure when both tax sources are available.

According to the Sample D results, a unit standard deviation tax difference of 12.8 percentage points lowers annual work time in the market sector by $(12.8 \times 9.5 =)$ 122 hours per adult. This is a very large effect that amounts to three weeks of full time work per adult per year. This work time effect operates on both the intensive hours margin and the extensive employment margin. In particular, the estimates imply that a unit standard deviation tax difference reduces the employment-population ratio by 4.9 percentage points and work time per employed person by 63 hours per year.

For reasons explained in Section 2, we think that the cross-sectional regressions in Table 4 provide a proper basis for inference about the long run effects of personal taxes, and a better basis than panel regressions that exploit high-frequency time variation within countries.¹⁵ Nevertheless, some readers may want to consider panel regressions of the outcome variables on average personal tax rates. Table 5 reports these panel regressions for available data, and Figure 2 displays one of the corresponding scatter plots. Since the Schneider data pertain only to the mid 1990s, all of the panel regressions make use of the Nickell-Nunciata tax data.

Standard errors are large in the panel specifications that isolate within-country time variation. This is unsurprising in light of the stable relative tax structure documented in Table

3. The only panel regressions with country and year fixed effects that yield statistically significant coefficients on the tax variable are for the employment-population ratio. In these regressions, the estimated tax effects are about half as large as the ones in Table 4 using the Schneider data but larger than the ones using the Nickell-Nunciata data.

The sign of the estimated tax effect on the employment-population ratio reverses when the panel specification omits fixed effects. Coupled with the results in Table 4, this reversal implies a positive cross-sectional relationship between personal tax rates and the employment-population ratio in the earlier years of the sample period. Note that the pattern of results differs sharply for the measures of hours worked. In fact, the negative relationship between tax rates and hours worked per employed person is much stronger when the regression specification omits fixed effects. These patterns merit further attention.

Tax Effects on Industry-Level Employment and Value-Added Shares

Table 6 reports cross-country regressions of the industry-level employment and value-added shares on the tax variables, and Figures 3 and 4 display many of the corresponding scatter plots. The regressions in Panels A and B of Table 6 show a uniformly negative relationship between the level of personal tax rates and the industry shares, as predicted by the theory in Section 3. Every regression shows a statistically significant effect at the 10 percent level, despite small sample sizes.

The point estimates imply sizable tax effects on the industry mix of market activity. Consider an increase in the tax factor of 25 basis points, about one standard deviation. According to Table 6 (and using Table 2), this increase lowers the employment share in our broadest industry group by 2.4 percentage points, or 12 percent of industry employment evaluated at the mean. Similarly, the estimates imply that a 25 basis point rise in the tax factor

¹⁵ In principle, panel methods and country-level case studies that investigate longer term responses to persistent

lowers the employment share by 1.4 points (31 percent) in Eating, Drinking and Lodging and by 0.7 points (9 percent) in Retail Trade. A 25 basis point rise in the tax factor lowers the value-added share by an estimated 1.9 points (13 percent) in the broad industry group, by .7 points (28 percent) in Eating, Drinking and Lodging and by 1.3 points (25 percent) in Retail Trade. The specifications that are linear in the tax rates imply highly similar responses in the industry shares.

As suggested by Figures 3 and 4, the industry share regressions are more fragile for value added than for employment. Figure 4.A, in particular, reveals that Canada and the United States are large outliers in the value added regression for the broad industry group. As seen in Panel C of Table 6, the tax effect on the value added share for the broad industry group is smaller and statistically insignificant when we delete Canada and the United States from the sample. In contrast, the corresponding employment share regression is not sensitive to the exclusion of data for Canada and the United States.

Tax Effects on Shadow Economy Size

Table 7 reports cross-country regressions of shadow economy measures on the sum of personal tax rates, and Figure 7 displays one of the corresponding scatter plots. When measured by the Currency Demand Method, the regression results imply large, highly significant effects of tax rates on shadow economy size. Using Schneider's tax data, a unit standard deviation increase in the average personal tax rate increases shadow economy size by $(12.8 \times .30 =) 3.8$ percent of measured GDP, which corresponds to a 24 percent increase in the size of the shadow economy evaluated at the mean. This is a large effect, and it implies that differences in the level of personal tax rates are a major determinant of differences in the extent of shadow economic activity among rich, industrialized countries.

tax rate changes are potentially quite useful as a basis for inference about long run tax effects. However, as Table

Insert additional remarks about the interpretation of the regressions based on the Currency Demand Method.

The results based on the Electricity Method are much less clear cut. When using the Electricity Method and the Nickell-Nunciata tax measure, the estimated tax effect is small and statistically insignificant. When using the Electricity Method and the Schneider tax measure, the estimated tax effect is positive and statistically significant at the 10 percent level, but it is only half as large as in results based on the Currency Demand Method.

As remarked in Section 2, many previous empirical studies find evidence that high personal tax rates boost the size of the shadow economy relative to GDP. Schneider and Enste (2000) and Schneider (2002) also show that tax rates and shadow economy size are positively related in a cross-section of rich countries. In this regard, our main contribution is to place the empirical relationship between taxes and shadow economy size into a larger context. In particular, our theory and our empirical results indicate that the tax-induced stimulus to the shadow economy is part of a broader response pattern that includes important effects on market work hours, market employment and a systematic shift in the industry mix of market activity.

Assessing the Results

Product demand and technology shocks that alter the market wage rate for certain workers or skills can have a similar impact on the shadow wage rate in the underground economy or, for many types of work, in the household production sector. General human capital can also affect productivity in market and non-market activities in similar ways, or at least in the same direction. As a result, these sources of variation in market wage rates will often elicit small labor supply responses. In contrast, personal taxes directly alter the *relative*

4 shows, there is not much low-frequency country-specific variation in personal tax rates in our sample.

return to legal market work as compared to underground and household production activity. This observation implies that the elasticity of labor supply with respect to the tax rate is larger, perhaps much larger, than the elasticity with respect to pre-tax wage movements. It follows that estimated labor supply elasticities derived from non-tax wage variation do not provide a sound basis for assessing tax-induced substitution responses between market and non-market production activities.

Some evidence suggests that much underground productive activity revolves around a network of social relationships that take time to establish when tax rates rise and that are slow to dissolve when tax rates are lowered. If correct, this characterization of the underground economy implies that the tax-induced diversion of work time from the legal market sector to the underground sector is greater in the long run than the short run. Many labor supply studies are poorly suited to capturing slow-working responses to after-tax wages. Indeed, the canonical theory of labor supply that undergirds much of the empirical work in the area implies bigger substitution responses to transitory wage variation than to permanent changes. The opposite may hold when the relevant substitution margin is between market and underground production in response to taxes.

Sections 2 and 3 identified several other reasons why it is treacherous to form inferences about the long-run effects of personal taxes on market work activity based on traditional labor supply studies. First, labor supply is not the whole story, because personal taxes alter the structure of labor demand in ways that reduce relative demand for less skilled workers. A uniform increase in a proportional tax rate on labor income or consumption expenditures has a bigger impact on less skilled workers. Less skilled workers are also likely to exhibit more responsive labor supply behavior, so that a tax rate increase alters the structure of labor demand in ways that amplify the supply responses. Second, tax-induced shifts in labor demand are likely to elicit greater responses over the longer term. These points

are relevant, even if one seeks to hold fixed or abstract from the indirect effects of personal taxes that work through the expenditure side of government behavior.

Third, the indirect effects are important, if the goal is to assess the total long-run response to personal taxes, as defined in Section 4. In our view, there are important circumstances – e.g., the design of constitutional provisions that affect tax and spending powers – where the total long-run response to tax rate changes is a central concern. Assessing these full long-run effects is difficult, partly because of the potential for complex long run dynamics of the sort that we discussed briefly in Section 3.

To be continued.

7. Other Evidence

This section summarizes other evidence on two issues related to our study: the effects of personal taxes on the mix of market production activity, and the cross-country relationship between personal tax rates and time devoted to household production activity.

Piggott and Whalley (1998) analyze 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. They 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. This change in the composition of consumption expenditures indicates that the Canadian VAT induced a large substitution away from the market provision of food preparation and dining services.

Freeman and Schettkat (2002) investigate the large gap in female employment rates between high-tax Germany and the low-tax United States. They find that German women actually work as many hours as U.S. women after accounting for time devoted to household work. Housework activities like cleaning and cooking account for a major part of the extra

time worked at home by German women. Freeman and Schettkat also find that expenditure shares on restaurant meals and personal services are much lower for German than for U.S. households. These U.S.-German differences in household work activity and the composition of consumption expenditures are consistent with our cross-country evidence, and they fit the implications of the theory of time allocation and task assignment developed in Section 3.

Empirical studies find that tax evasion is relatively prevalent in retail trade, restaurants, and hotels (and, to a lesser extent, in taxi services and professional consulting). See Skolka (1985) and Giles (2000). This evidence is usually interpreted to mean that tax evasion is relatively easy in these sectors, but our theoretical analysis provides another interpretation – namely, that the costs of underground production activity in terms of foregone comparative and absolute advantages and capital idleness are relatively low in these sectors. Of course, these explanations are not exclusive, and it seems likely that both the ease of tax evasion and the relatively modest efficiency consequences of underground activity play a role in the prevalence of tax evasion in these sectors.

To be completed.

8. Concluding Remarks

The current draft provides only a cursory conclusion.

We have studied the long run total response among rich countries to differences in tax rates on labor income, payrolls and consumption. To guide our investigation, we relied on a simple theory of time allocation and task assignment between market and non-market production sectors. The theory implies that higher tax rates reduce work time in the market sector, increase the size of the shadow economy, shift the industry mix of market activity and alter the composition of labor demand in ways that amplify negative effects on work hours and employment, concentrating those effects on the less

skilled. We also described conditions under which OLS yields an unbiased estimate for the long run total response to taxes on labor income and consumption expenditures.

In OLS regressions on rich-country samples in the mid 1990s, a unit standard deviation tax rate difference of 12.8 percentage points is associated with 122 fewer market work hours per adult per year, a 4.9 percentage point reduction in the employment-population ratio, and an increase in the size of the shadow economy amounting to 3.8 percent of GDP. We also find that a unit standard tax difference lowers employment and value added shares by 20 to 30 percent in retail trade, personal and household services and eating, drinking and lodging establishments, confirming a key prediction of our theory.

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Data Appendix

The appendix provides additional information about the data used in our study.

A. Tax Measures

We obtain data on tax rates from two sources that differ in coverage, sample period and method of calculation. Table 10 in Schneider (2002) reports (a) the value added tax rate (average sales tax rate in the United States), (b) the direct tax rate on labor income, (c) the social security contribution rate of employees and (d) the social security contribution rate of employers. The notes to his table define (b) as the sum of all income taxes paid on wages and salaries (including income of the self employed), divided by “gross labor costs of an average income earner in the country.” The notes also state that (c) and (d) are “calculated on the basis of the annual gross earnings of an average income earner.” The source for the data, covering 16 countries in 1996, are Schneider’s “own calculations and OECD working paper 176.” In calculating the tax factor on the right side of equations (3) and (6) in the main text, we use (a) to measure m , the sum of (b) and (c) to measure t , and (d) to measure s .

There are at least three issues with respect to Schneider’s tax data. First, the meaning of “gross labor costs” and “annual gross earnings” is unclear. Our tax factor calculations interpret both terms as synonymous with workers’ pre-tax earnings.

Second, the U.S. figure of 13.8% for the employer social security contribution rate in column (5) of Schneider’s Table 10 appears to be too high. Mandatory employer contributions in the United States consist mainly of payments for the federal Old-Age, Survivors and Disability Insurance (OASDI) and Medicare Hospital Insurance (HI) programs, the federal and state unemployment insurance system, and state worker compensation programs. As of 1996, the OASDI rate was 6.2% on the first \$62,700 in earnings, and the HI rate was 1.45% on all earnings. The federal unemployment insurance tax rate was 0.8% on the first \$7,000 of a worker’s annual earnings, zero at the margin for most workers, and less than 0.3% of

covered wages (U.S. House of Representatives, 2000, pages 305-306). The average state unemployment insurance tax rate in 1995 was 2.2% of taxable wages and 0.8% of total wages (U.S. House of Representatives, 1996, Table 5.10). Employers costs for worker compensation programs averaged 1.66% of covered wages in 1996 (Williams et al., 2003, Figure 1). Using the 0.8% and 2.2% figures for unemployment insurance taxes, U.S. payroll tax rates sum to 12.3%, which is 1.6 percentage points lower than Schneider’s figure. Average marginal payroll tax rates in the United States are clearly much less than 12.3%.

Third, the notes to Schneider’s Table 10 indicate that payroll and manpower taxes are counted as part of direct taxes on labor income. From this description, it sounds as if certain payroll taxes are counted in both columns (3) and (5) of his Table 10, but this interpretation appears incorrect in light of the fact that Schneider includes columns (3) and (5) in calculating the total tax and social security burden. On this basis, we treat his columns (3) and (5) as measuring different aspects of the tax system.

Nickell and Nunciata (2001) report the average tax rate on payrolls, household income and consumption expenditures. They measure tax rates using the London School of Economics CEP-OECD database, which draws on the OECD National Accounts and other sources. Their “tax wedge” measure is the sum of three components: An “employment tax rate”,

$$\frac{\text{Employer contributions to social security, welfare plans and private pensions}}{\text{Total employee compensation, in cash or in kind, less the numerator}},$$

a “direct tax rate” on household income,

$$\frac{\text{Employee contributions to social security + household income taxes}}{\text{Current receipts of households}},$$

and an “indirect tax rate” on household consumption,

$$\frac{\text{Indirect taxes less subsidies}}{\text{Private final consumption expenditures}}.$$

The employment tax rate corresponds to the variable s in the tax factor formula, except that it includes employer contributions to private pensions as part of the tax on payrolls. The direct tax rate corresponds imperfectly to the variable t in the tax factor formula in that it includes taxes on all household income. Likewise, the base in this tax rate measure includes all household income.¹⁶ The indirect tax rate corresponds to the variable s in the tax factor formula. Nickell and Nunciata report the sum of these three tax rates as the “tax wedge,” which we use as a measure of the average personal tax rate.

Nickell and Nunciata report annual data on 20 OECD countries for varying sample periods over the time period from 1960 to 1995. For Australia, we impute the 1985 value to 1990 and 1995 (Samples A and C). For New Zealand, we impute the 1986 value to 1995 (Sample C).

B. National Employment, Population and Work Hours

Our data on the employment-population ratio and hours worked in the market sector are drawn or derived from the following OECD sources:

- *OECD Employment Outlook*, 1998 and 2002, Statistical Annex.
- Online source at www1.oecd.org/scripts/cde/viewbase.asp?DBNAME=ifs_data.

Sample A contains data on annual hours per employed person, annual work hours per adult and the ratio of employment to working-age population (15-64 years old) for 13 countries in 1977, 1983, 1990 and 1995. We impute hours worked for Belgium and Ireland in 1977 based on their 1983 values. Sample B contains data on the employment-population ratio from 1977 to 1994. The remaining samples contain data for 1995.

C. Size of Shadow Economy

Unless noted otherwise, our data on shadow economy size as a percent of GDP are from the column headed “Average 1994/95” in Table 3 of Schneider (2002). These estimates of

¹⁶ We are uncertain about the precise meaning of “current receipts of households” and “household income

shadow economy size are based on the Currency Demand Method, except for New Zealand which is an average of values based on the Currency Demand and MIMIC Methods. Our data on shadow economy size for 1996 are drawn from Schneider's Table 10. Our data on shadow economy size in 1990 based on the Electricity Method are drawn from Table 6 in Schneider and Enste (2000). We use observations on shadow economy size in Great Britain for the United Kingdom.

D. Industry Value-Added and Employment Shares

For data on value-added and employment by industry group, we rely mainly on the 2000 and 2001 editions of the OECD report, *Services: Statistics on Value Added and Employment*. The coverage of these data includes “non-market services” produced by the government and non-profit institutions and provided free of charge or at a fee well below production costs. We use data on value added at current prices and data on total employment, which includes “working proprietors and unpaid family workers of unincorporated units as well as employees.” There are differences among countries in the methods used to measure value added and employment.

Many countries do not report service sector data that are sufficiently disaggregated for our purposes. In addition, even for the broad industry groups we consider, there are inconsistencies among reporting countries in the classification of certain service sector activities such as trade in motor vehicles, repair services, and eating and drinking establishments. Classification differences appear to be minor for our broadest industry group – Trade, Repairs, Eating, Drinking, Lodging,

Classification inconsistencies led us to suppress the Canadian data for Retail Trade and Repairs. In addition, we suppressed the Spanish data because they are highly implausible. For example, the reported Spanish figures imply “Restaurants and hotels” is two-thirds larger than

taxes,” the terms that Nickell and Nunciata use in describing the construction of their “direct tax rate” measure.

“Retail trade and repairs” based on value added data, in sharp contrast to other countries, but one-third smaller based on employment data. For the United Kingdom, we used data on number of employees, because industry-level employment data are not reported. For the United States, classification inconsistencies led us to construct our own figures for value added and employment in Retail Trade and Repairs and in Eating, Drinking and Lodging. Details are available from the authors upon request.

Table A1 reports our country-level data on value added and employment shares. Table A2 shows the composition of each sample used in our study.

Table A1. Data on Industry-Level Employment and Value-Added Shares

<i>Country</i>	<i>Employment Shares</i>			<i>Value Added Shares</i>		
	(1) Trade, Repairs, Eating, Drinking, Lodging	(2) Eating, Drinking, Lodging	(3) Retail Trade and Repairs	(1) Trade, Repairs, Eating, Drinking, Lodging	(2) Eating, Drinking, Lodging	(3) Retail Trade and Repairs
Austria	20.44	6.00	7.30	15.84	3.69	4.48
Belgium	16.50	2.83		12.81	1.51	
Canada	23.88	6.26		11.77	2.29	4.79
Denmark	18.55	2.84	7.02	13.28	1.57	3.85
France	16.13	3.08	6.66	12.17	2.40	4.27
Germany	19.13	3.77	8.72	11.24	1.22	3.92
Ireland	20.65	5.44		10.94	2.35	
Italy	20.33	5.07	8.84	16.16	3.14	6.02
Netherlands	19.38	2.97	7.56	14.01	1.74	3.89
Norway	16.87	2.54		11.36	1.22	
Spain						
Sweden	15.35	2.61		10.83	1.22	
Switzerland	22.19	5.68	8.96	18.82	3.0	7.85
United Kingdom	22.27	5.48	9.87	12.97	2.58	4.50
United States	25.94	7.72	9.11	23.59	5.14	7.76

Note: Column (1) covers everything in columns (2) and (3) plus wholesale and commission trade, trade in motor vehicles, and motor vehicle repair services. Column (3) excludes motor vehicle repair services but includes other consumer repair services. Column (3) does not include eating and drinking establishments, nor does it include vehicle repair services.

Sources: OECD (2000, 2001) and authors’ calculations, as described in the Data Appendix.

Table A2. Sample Compositions for Country-Level Data

<i>Country</i>	<i>Sample</i>					
	A	B	C	D	E	F
Australia	X		X			
Austria					X	X
Belgium	X	X	X	X	X	
Canada	X	X	X	X	X	
Denmark		X	X	X	X	X
Finland	X	X	X			
France	X	X	X	X	X	X
Germany		X	X	X	X	X
Ireland	X	X	X	X	X	
Italy	X	X	X	X	X	X
Japan	X	X	X		X	
Netherlands		X	X	X	X	X
New Zealand			X			
Norway	X	X	X	X	X	
Portugal		X	X			
Spain	X	X	X	X		
Sweden	X	X	X	X	X	
Switzerland		X	X	X	X	X
Unit. Kingdom	X	X	X	X	X	X
United States	X	X	X	X	X	X
# of Countries	13	17	19	14	14	9
Years	77, 83 90, 95	1977- 1994	1995	1995	1995	1995
Observations	52	306	19	14	14	9

Table 1. Illustrative Calculation of Tax Factors for Sweden and the United States

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 market and household production.
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. Descriptive Statistics for Country-Level Data

Variable	Sample					
	A	B	C	D	E	F
Annual Work Hours Per Adult	1140 (48)		1124 (176)	1067 (162)		
Annual Hours Per Employed Person	1768 (43)		1703 (166)	1641 (142)		
100× Employment-Population Ratio	64.7 (2.6)	65.4 (2.4)	65.7 (8.7)	64.8 (9.8)		
Shadow Economy, % GDP, Currency Demand Method			15.9 (4.9)	16.2 (5.1)		
Shadow Economy, % GDP, Electricity Method, 1990				14.7 (4.4)		
Value Added Share: Trade, Repairs, Eating, Drinking, Lodging					14.0 (3.6)	
Value Added Share: Eating, Drinking, Lodging					2.4 (1.1)	
Value Added Share: Retail Trade and Repairs						5.2 (1.6)
Employment Share: Trade, Repairs, Eating, Drinking, Lodging					19.8 (3.1)	
Employment Share: Eating, Drinking, Lodging					4.4 (1.7)	
Employment Share: Retail Trade and Repairs						8.2 (1.1)
Sum of Tax Rates from Nickell & Nunciata (2001)	50.8 (3.2)	50.1 (3.2)	49.6 (14.0)	53.7 (11.3)	54.7 (11.2)	54.2 (11.4)
Sum of Tax Rates from Schneider (2002)				62.0 (12.8)	62.3 (12.9)	61.3 (11.4)
Tax Factor, Based on Data from Schneider (2002)				1.91 (.24)	1.92 (.24)	1.92 (.26)
# of Countries	13	17	19	14	14	9
Years	77, 83 90, 95	1977- 1994	1995	1995	1995	1995
# of Observations	52	306	19	14	14	9

Notes:

1. Aside from the bottom three rows, the table entries report means (standard deviations) for the indicated variables and samples. For Samples A and B, the value in parentheses reports the standard deviation after sweeping out year and country fixed effects. See Table A2 in the appendix for sample compositions.
2. Annual work hours per adult equals the ratio of employment to working-age population (15 to 64 years old) times the average annual hours of market work by employed persons.

3. Sum of Tax Rates is the sum of average tax rates on income, payrolls, and consumption expenditures. The Tax Factor equals the product of $(1 + \text{payroll tax rate})$ and $(1 + \text{consumption tax rate})$ divided by $(1 - \text{income tax rate})$. See the text for an explanation and derivation of this tax variable. Income equals labor income in the data from Schneider and household income in the data from Nickell and Nunciata. The tax rate data from Schneider are for 1996.
4. See the Data Appendix for additional information about the data and sources.

Table 3. Average Personal Tax Rates by Country and Decade

Country	1960s	1970s	1980s	1990-95	Deviation from Mean in 1970s	Deviation from Mean in 1990s
Australia	29	35	39	.	-10	-11
Austria	49	55	59	59	11	9
Belgium	41	44	46	50	-1	-1
Canada	34	42	43	51	-3	0
Denmark	37	53	60	59	9	9
Finland	41	54	60	64	9	13
France	56	59	65	67	15	17
Germany	43	47	50	53	3	2
Ireland	26	32	38	40	-13	-10
Italy	57	55	57	68	10	18
Japan	24	26	34	31	-18	-19
Netherlands	50	56	55	45	12	-5
New Zealand	.	29	31	.	-15	-19
Norway	49	60	65	60	16	10
Portugal	.	26	35	40	-19	-10
Spain	22	28	41	47	-16	-4
Sweden	47	65	78	77	21	26
Switzerland	30	324	36	35	-10	-15
United Kingdom	38	45	51	47	1	-4
United States	35	42	44	45	-3	-5
<i>Simple Mean</i>	38	44.2	49.3	50.3		

The 5-year changes in the simple mean of the average personal tax rates for the countries listed in the table are as follows:

Interval	1960-65	1965-70	1970-75	1975-80	1980-85	1985-90	1990-95
Change	3.0	5.3	1.4	3.2	3.0	1.4	-.4

Notes:

1. Table entries report the sum of average tax rates on labor income, payrolls and consumption expenditures using data from Nickell and Nunciata.
2. Before computing the average value over countries in each decade and the country-specific deviations, we fill in missing values using the nearest available observation for the same country.

Table 4. Cross-Country Regressions of Work Hours and Employment Rates on Average Tax Rates, 1995 Data

Independent Variable: Sum of tax rates on income, payrolls and consumption

<i>Dependent Variable</i>	<i>Sample</i>	<i>Source for Tax Rates</i>	<i>Slope Coefficient</i>	<i>Standard Error</i>	<i>P-Value</i>	<i>Adj. R²</i>
Annual Work Hours Per Adult	A	Nickell & Nunciata	-6.5	3.0	.00	.23
Annual Work Hours Per Adult	C	Nickell & Nunciata	-7.4	2.5	.01	.27
Annual Work Hours Per Adult	D	Nickell & Nunciata	-4.1	4.0	.32	.01
Annual Work Hours Per Adult	D	Schneider	-9.5	2.4	.00	.52
Annual Hours Per Employed Adult	A	Nickell & Nunciata	-6.2	1.9	.01	.45
Annual Hours Per Employed Adult	C	Nickell & Nunciata	-6.4	2.6	.02	.23
Annual Hours Per Employed Adult	D	Nickell & Nunciata	-3.9	3.4	.28	.02
Annual Hours Per Employed Adult	D	Schneider	-4.9	2.9	.11	.13
100 × Employment-Population Ratio	A	Nickell & Nunciata	-.12	.18	.49	-.04
100 × Employment-Population Ratio	C	Nickell & Nunciata	-.16	.15	.29	.01
100 × Employment-Population Ratio	D	Nickell & Nunciata	-.07	.25	.77	-.08
100 × Employment-Population Ratio	D	Schneider	-.38	.19	.07	.19

Notes:

1. All regressions are by ordinary least squares.
2. The “P-Value” reports the marginal significance level in a test of the null hypothesis that the coefficient on the tax variable equals zero.

Table 5. Panel Regressions of Work Hours and Employment Rates on Average Tax Rates

Independent Variable: Sum of tax rates on income, payrolls and consumption

<i>Dependent Variable</i>	<i>Sample</i>	<i>Years</i>	<i>Year Effects</i>	<i>Country Effects</i>	<i>Slope Coeff.</i>	<i>St. Err.</i>	<i>P-Value</i>	<i>Adj. R²</i>
Annual Work Hours Per Adult	A	77, 83 90, 95	No	No	-3.1	1.7	.07	.04
Annual Work Hours Per Adult	A	77, 83 90, 95	Yes	Yes	-4.3	3.0	.16	.83 (.03)
Annual Hours Per Employed Adult	A	77, 83 90, 95	No	No	-9.1	1.0	.00	.61
Annual Hours Per Employed Adult	A	77, 83 90, 95	Yes	Yes	-2.2	1.9	.25	.89 (.01)
100 × Employment-Population Ratio	A	77, 83 90, 95	No	No	.17	.08	.05	.05
100 × Employment-Population Ratio	A	77, 83 90, 95	Yes	Yes	-.21	.13	.09	.88 (.05)
100 × Employment-Population Ratio	B	1977- 1994	No	No	.15	.04	.00	.05
100 × Employment-Population Ratio	B	1997- 1994	Yes	Yes	-.22	.04	.00	.94 (.08)

Notes:

1. All regressions are by ordinary least squares, with and without fixed effects, as indicated.
2. The tax rate variable is from Nickell and Nunciata (2001).
3. The rightmost column reports in parentheses the adjusted R^2 value after sweeping out the fixed effects.

Table 6: Cross-Country Regressions of Service Sector Shares on Tax Measures

Dependent Variable: Percentage of Value-Added or Employment in the Industry Group

A. Employment Shares Regressed on Tax Measures

<i>Industry Group</i>	<i>Sample</i>	<i>Tax Measure</i>	<i>Slope Coeff.</i>	<i>Standard Error</i>	<i>P-Value</i>	<i>Adj. R²</i>
Trade, Repairs, Eating, Drinking, Lodging	E	Sum of Rates	-.198	.038	.00	.67
Trade, Repairs, Eating, Drinking Lodging	E	Tax Factor	-9.6	2.5	.00	.52
Eating, Drinking and Lodging	E	Sum of Rates	-.095	.026	.00	.49
Eating, Drinking and Lodging	E	Tax Factor	-5.4	1.3	.00	.55
Retail Trade and Repairs	F	Sum of Rates	-.055	.025	.07	.32
Retail Trade and Repairs	F	Tax Factor	-2.8	1.2	.06	.34

B. Value Added Shares Regressed on Tax Measures

<i>Industry Group</i>	<i>Sample</i>	<i>Tax Measure</i>	<i>Slope Coeff.</i>	<i>Standard. Error</i>	<i>P-Value</i>	<i>Adj. R²</i>
Trade, Repairs, Eating, Drinking, Lodging	E	Sum of Rates	-.142	.069	.06	.20
Trade, Repairs, Eating, Drinking Lodging	E	Tax Factor	-7.4	3.8	.07	.18
Eating, Drinking and Lodging	E	Sum of Rates	-.044	.021	.06	.20
Eating, Drinking and Lodging	E	Tax Factor	-2.7	1.1	.03	.29
Retail Trade and Repairs	F	Sum of Rates	-.100	.029	.01	.57
Retail Trade and Repairs	F	Tax Factor	-5.3	1.3	.00	.67

C. Value Added Shares Regressions, Excluding Canada and the United States in Sample E

<i>Industry Group</i>	<i>Tax Measure</i>	<i>Slope Coeff.</i>	<i>Standard. Error</i>	<i>P-Value</i>	<i>Adj. R²</i>
Trade, Repairs, Eating, Drinking, Lodging	Sum of Rates	-.103	.066	.15	.12
Trade, Repairs, Eating, Drinking Lodging	Tax Factor	-4.8	3.5	.20	.08

Note: Tax rate measures calculated from data in Schneider (2002). See, also, notes to Table 4.

Table 7. Cross-Country Regressions of Shadow Economy Size on Tax Rates

Dependent Variable: Shadow Economy as a Percentage of Official GDP

Independent Variable: Sum of tax rates on labor income, payrolls and consumption

<i>Source for Tax Rates</i>	<i>Sample</i>	<i>Shadow Economy Measure</i>	<i>Slope Coefficient</i>	<i>Standard Error</i>	<i>P-Value</i>	<i>Adj. R²</i>
Nickell and Nunciata	C	Currency Demand	.20	.08	.02	.25
Nickell and Nunciata	D	Currency Demand	.25	.11	.04	.26
Schneider	D	Currency Demand	.30	.08	.00	.53
Schneider	D	Currency Demand (1996)	.31	.08	.00	.53
Nickell and Nunciata	D	Electricity Method (1990)	-.04	.11	.75	-.07
Schneider	D	Electricity Method (1990)	.16	.09	.09	.15

Notes:

1. Data on the size of the shadow economy are averages of 1994 and 1995 values unless otherwise indicated.
2. For the shadow economy size measure based on the Electricity Method, the results are nearly identical whether we use the Nickell-Nunciata tax measure for 1990 or 1995.

See, also, notes to Table 4.

Figure 1: Tax Rates and Annual Work Hours Per Adult
Sample D: 14 Countries in 1995

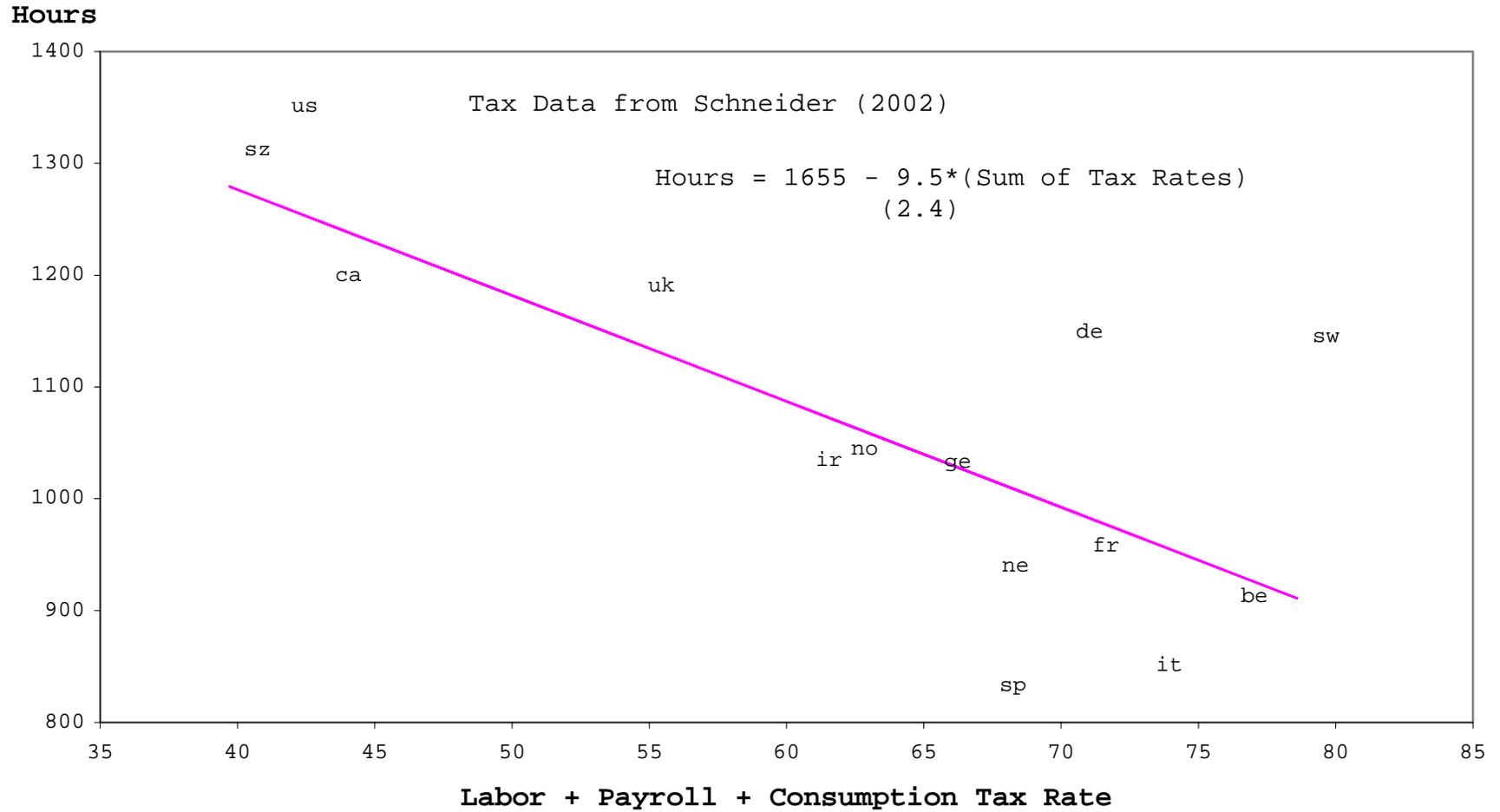


Figure 2: Tax Rates and Annual Hours Per Employed Person
Sample A: 13 Countries with Data for 1977, 1983, 1990 and 1995

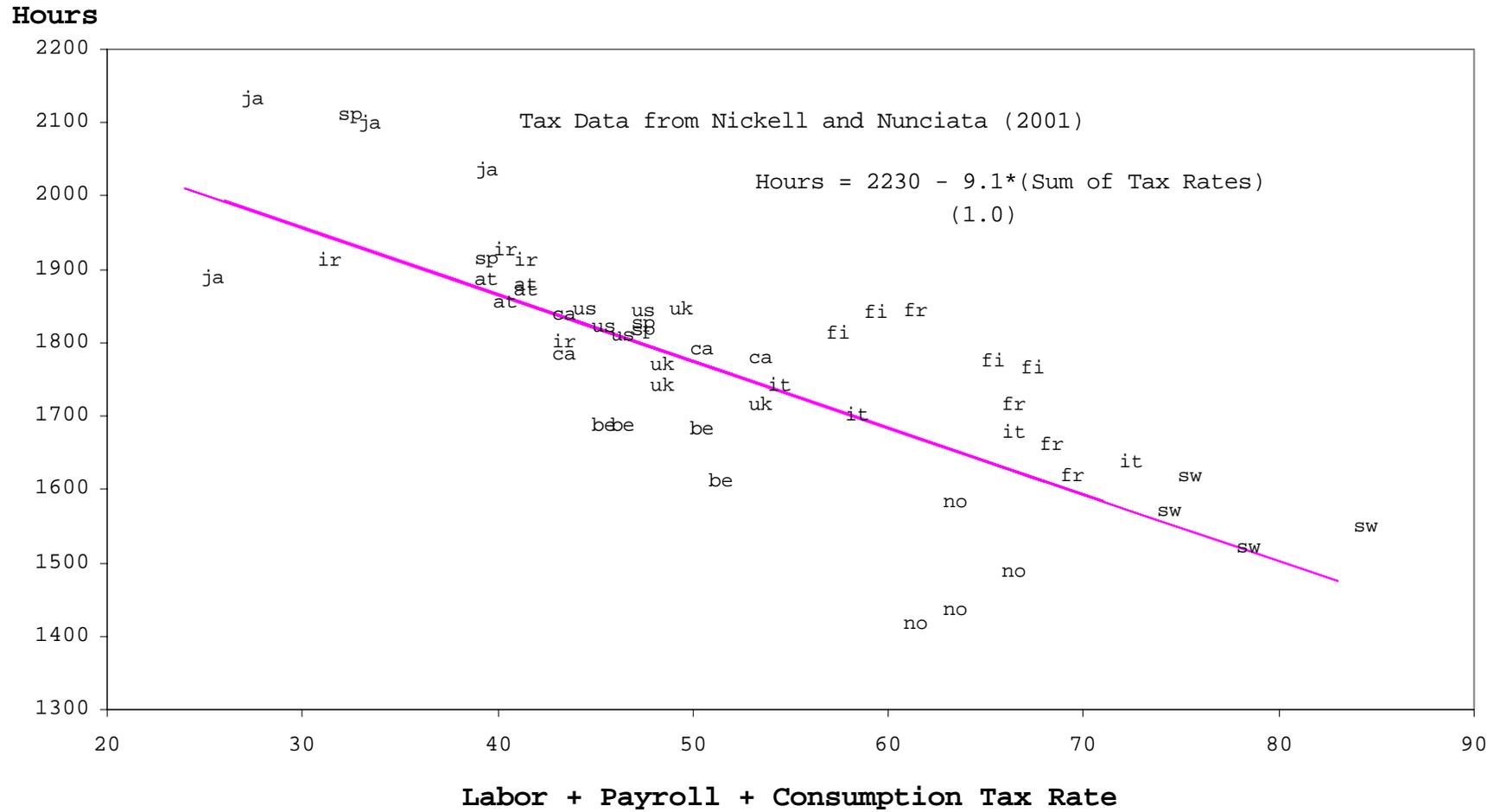


Figure 3.A: Personal Taxes and Employment Shares, 14 Countries in 1995
Industry Group: Trade, Repairs, Eating, Drinking, Lodging

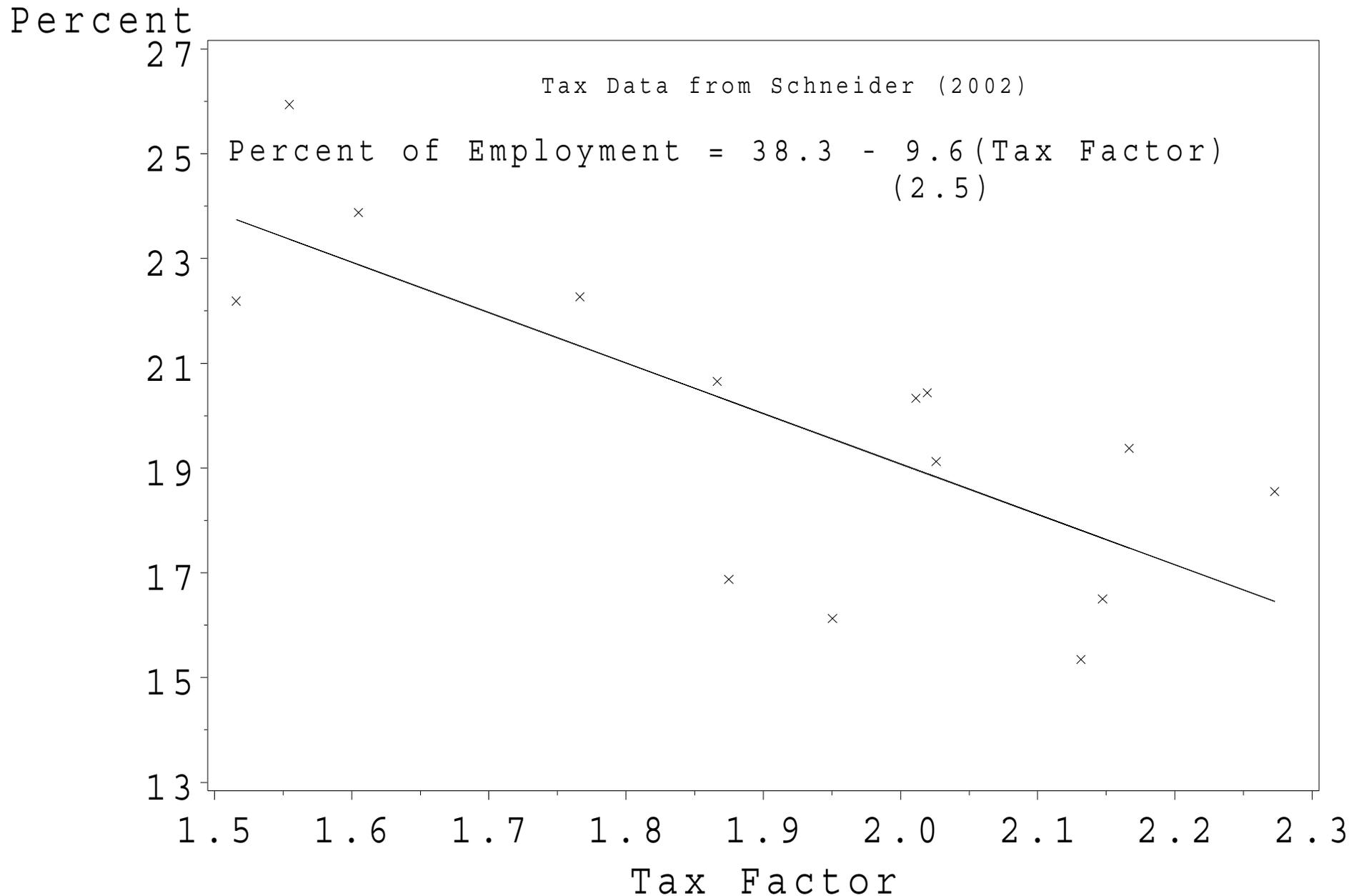


Figure 3.B: Personal Taxes and Employment Shares, 9 Countries in 1995
Industry Group: Retail Trade and Repairs

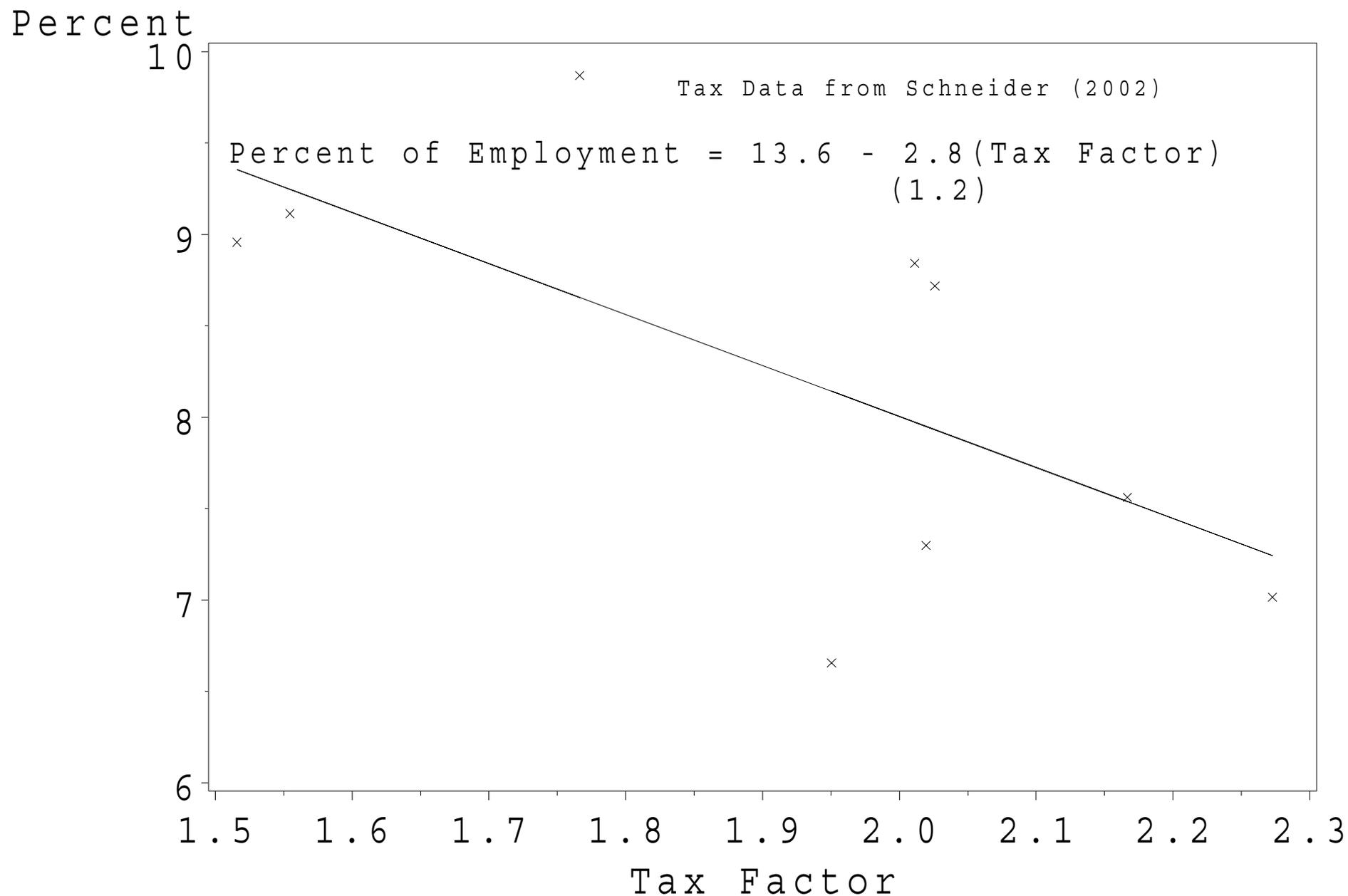


Figure 3.C: Personal Taxes and Employment Shares, 14 Countries in 1995
Industry Group: Eating, Drinking, Lodging

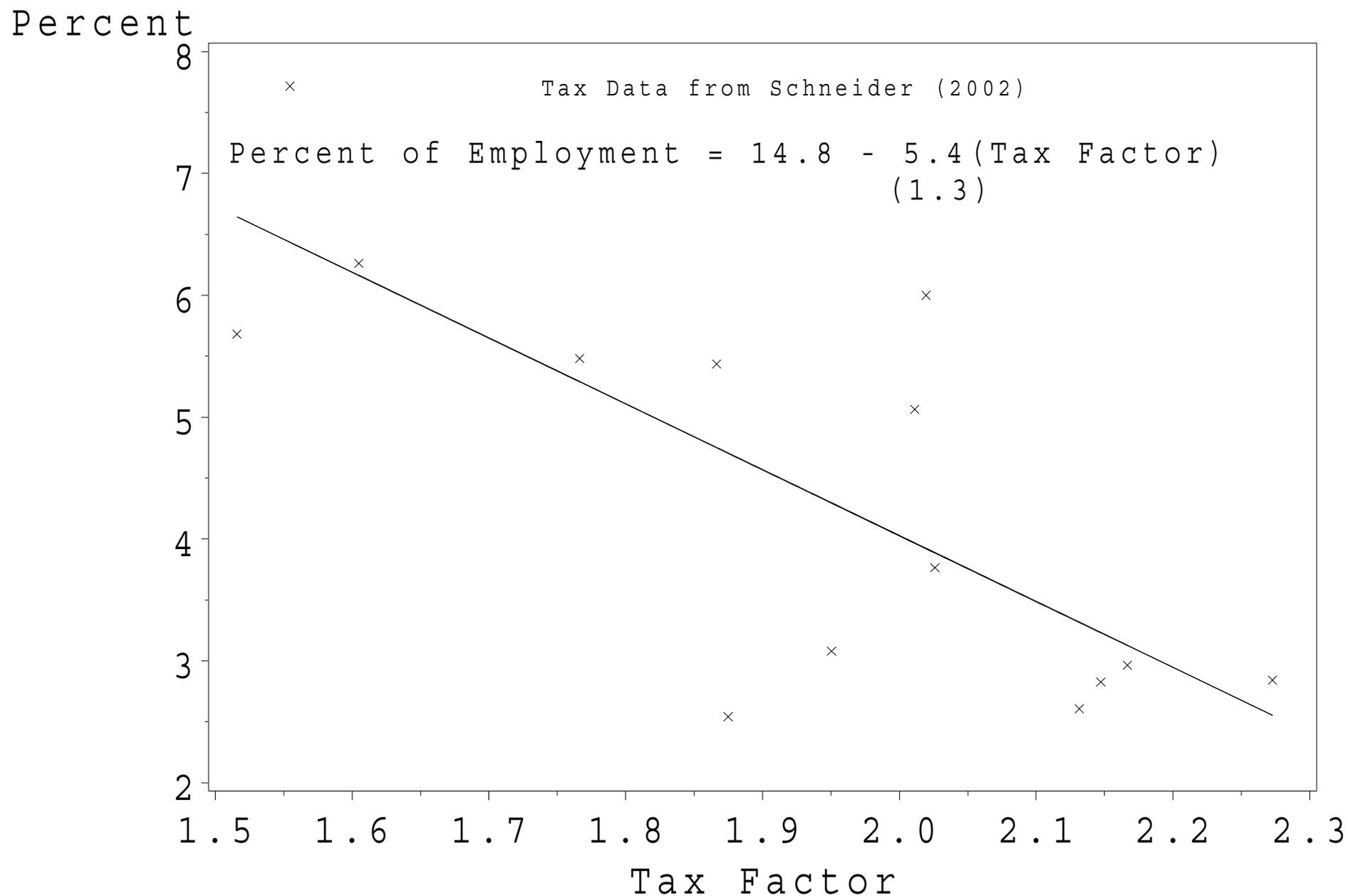


Figure 4.A: Personal Taxes and Value Added Shares, 14 Countries in 1995
Industry Group: Trade, Repairs, Eating, Drinking, Lodging

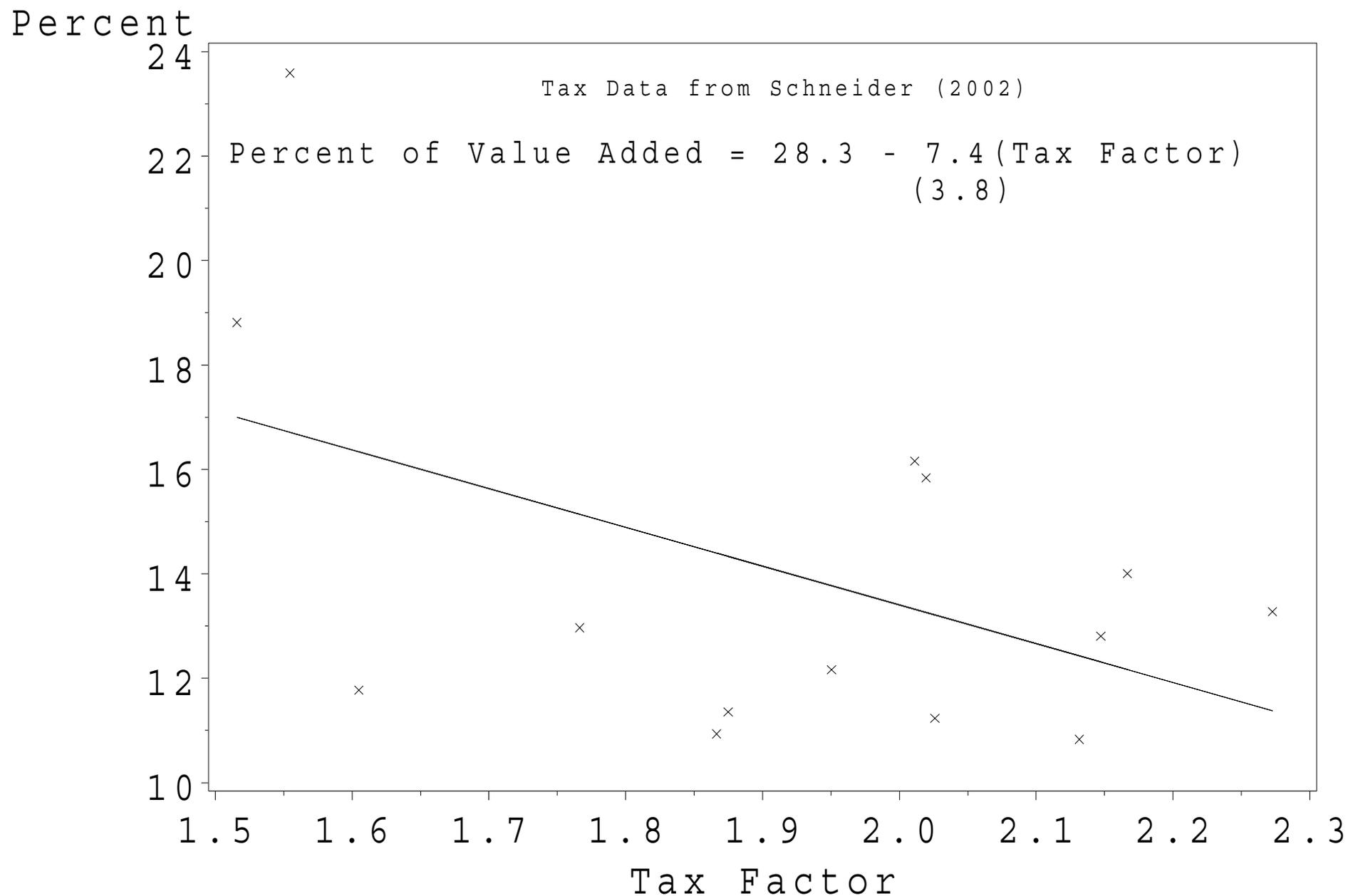


Figure 4.B: Personal Taxes and Value Added Shares, 9 Countries in 1995
Industry Group: Retail Trade and Repairs

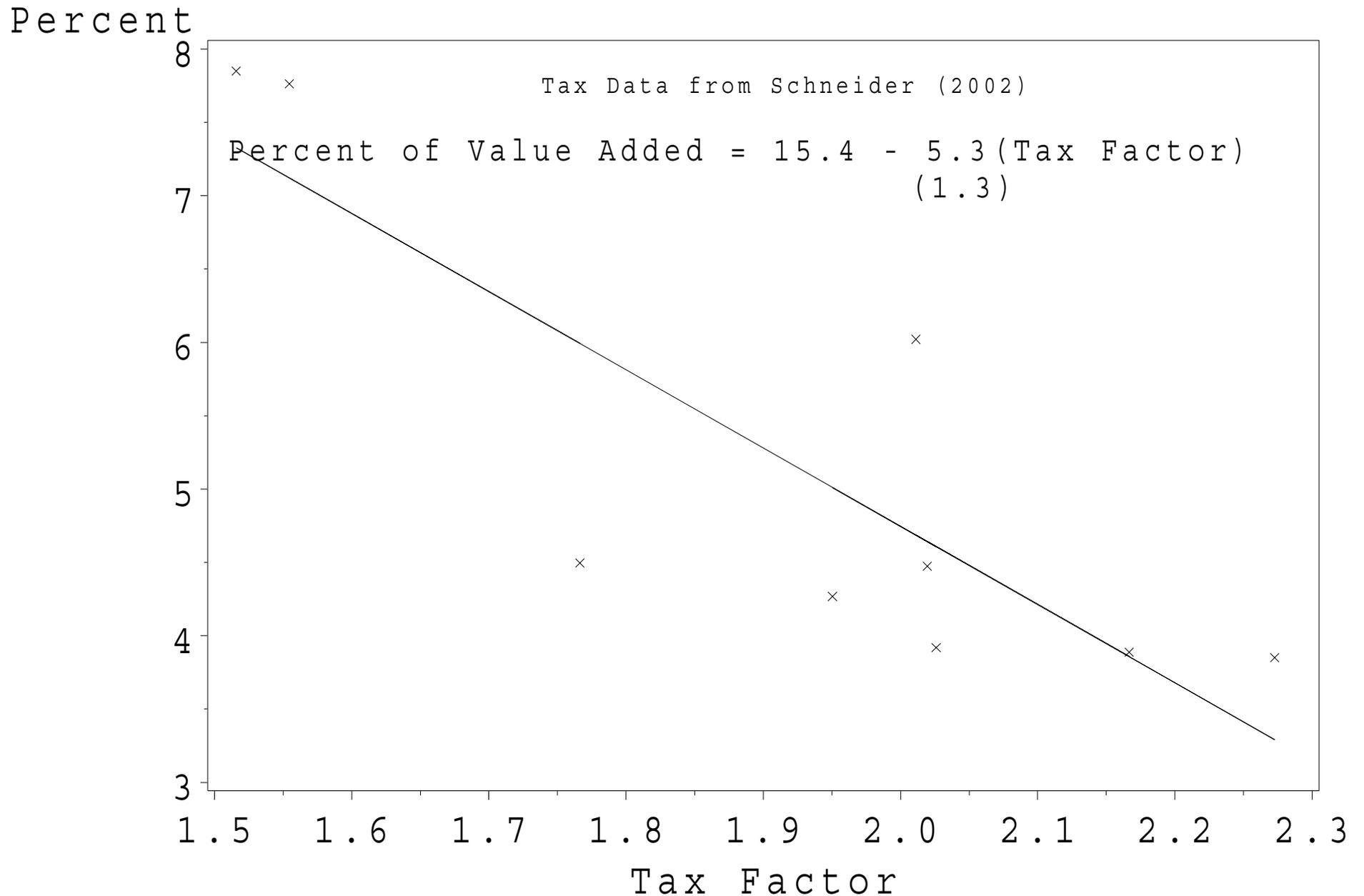


Figure 4.C: Personal Taxes and Value Added Shares, 14 Countries in 1995
Industry Group: Eating, Drinking, Lodging

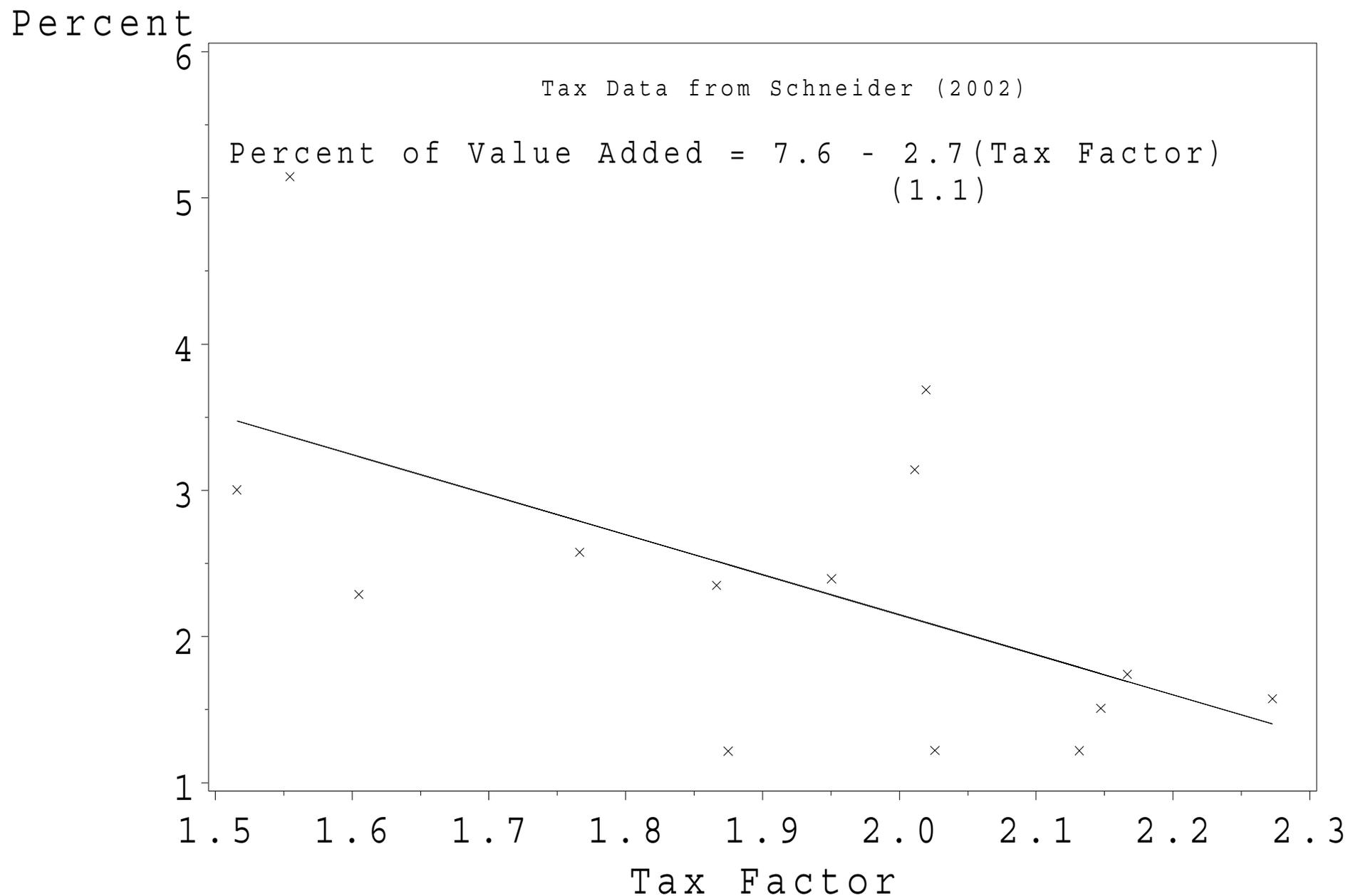


Figure 5: Tax Rates and Shadow Economy as Percent of GDP
Sample D: 14 Countries in 1995

