The Welfare State and Competitiveness

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In all industrial countries, fiscal policy is increasingly about redistribution. In this paper, we study redistribution across different types of agents in a world characterized by the presence of labor unions and distortionary taxation. We show that an increase in transfers financed by distortionary taxation has nonlinear effects on unit labor costs relative to the other countries, depending on the degree of centralization of the wage-setting process in the labor market. We find considerable empirical support for the model in a sample of 14 OECD countries. (JEL E6, F4, H3, J5)

Fiscal policy in industrialized countries is increasingly about redistribution. Table 1 shows that in the OECD countries the share of welfare spending in GDP has almost doubled in the three decades between 1960 and 1990, while the share of government consumption has increased by only 15 percent. As a consequence, by 1990 the two types of government expenditure had approximately the same size. This large change in the composition of expenditure has been accompanied by a large increase in direct taxes on households and social security taxes, the combined share of which in GDP has increased by 60 percent.

Despite the dramatic growth of social expenditure and labor taxation, the academic literature on fiscal policy in an open economy has focused mainly on government consumption, mostly financed by lump-sum taxation. This emphasis on government consumption

does not capture the widespread view in policy circles that the burden of the "welfare state" causes a loss of competitiveness and unemployment. The use and meaning of the word "competitiveness" have recently been questioned on several grounds. Even though possibly phrased with an inappropriate terminology, the concerns about the effects of redistributive expenditure and of the accompanying distortionary labor taxation should not be dismissed lightly. We think that, at a minimum, they deserve a serious investigation.

To this end, we first define the term "competitiveness" rigorously as "unit labor costs in manufacturing in one country, relative to its competitors," so that an improvement in competitiveness is defined as a fall in relative unit labor costs. We then construct a two-country model with three main characteristics. First, since we study redistribution, we need to abandon the representative agent world. Thus, we consider a model with three types of agents: employers and workers (some of whom can be unemployed in equilibrium), who together form the productive sector of the economy, and a sector of unproductive individuals, whom we call pensioners. By assuming homothetic preferences, we can study purely redistributive expenditures, i.e., those expenditures that do not alter either the *composition* or the *size* of demand.

Second, we consider unionized labor markets. In the presence of unions, a redistribution of income among agents (for instance, to the pensioners) has important effects on the cost side of firms because of the use of distortionary

TABLE 1—GOVERNMENT EXPENDITURE AND TAXATION IN OECD COUNTRIES, 1960–1990

	Social expenditure		Government consumption		Labor taxation	
	1960	1990	1960	1990	1965	1990
average[a]	8.3	15.3	15.1	17.3	13.2	21.2
growth rate (percent)	85		14.9		60	

Notes: Social expenditure: social security benefits plus social assistance grants plus other current transfers, general government. Government consumption: expenditure on goods and services, general government. Labor taxation: direct taxes on households, social security taxes paid by employees and by employers, and payroll taxes, general government. The sample includes all current OECD countries, except the Czech Republic, Hungary, Iceland, the Republic of Korea, Luxembourg, Mexico, New Zealand, Poland, and Turkey. For some countries, the starting year is 1965, 1970, or 1975, depending on data availability. Source: *Economic Outlook Database* OECD (1995).
　[a] Weighted average, with weights represented by 1980 GDP in dollars.

taxation to finance the government budget: taxes on labor (income, social security, or payroll taxes) affect labor costs and therefore profitability and competitiveness, to the extent that they are not borne entirely by workers. This point is hardly new, but it has received much more attention in policy debates than in the academic literature. In fact, under a common set of assumptions in the literature, i.e., competitive labor markets with highly inelastic individual labor supplies, these taxes would be almost completely borne by workers and would have very small aggregate effects. By contrast, in the presence of unions the burden of labor taxation will be borne in part by employers and will therefore increase labor costs *even if the individual labor supply is perfectly inelastic*.

The third feature of our model is that we consider differentiated goods produced by monopolistically competitive firms. With differentiated goods, we can easily define sectors in the economy. In turn, this allows us to study how different types of labor markets influence the effects of fiscal policy. This is important because a good understanding—both theoretical and empirical—of the effects of distortionary taxes requires a realistic treatment of the structure of labor markets. The characteristic of labor markets we focus upon is their degree of centralization, defined as the inverse of the number of unions in the economy. This variable is important because unions of different sizes face different elasticities of the de-

mand for labor and internalize macroeconomic constraints to different degrees. Thus, how much wages increase in response to an increase in labor taxation depends on the degree of centralization of labor markets.

The basic idea of the paper is simple. An increase in labor taxation used to finance redistribution to pensioners and/or unemployed workers induces the labor unions to increase wage pressure, which in turn induces higher labor costs and a loss of competitiveness. As a consequence, the demand for exports and employment fall.

Importantly, the distortions caused by fiscal policy depend on the institutional features of labor markets: distortions are low when labor markets are close to competitive, and increase with the average size of the unions. However, at very high levels of centralization of the labor market, when wage negotiations take place at the national level—as in the Scandinavian countries—the mechanism by which labor taxation is transmitted to labor costs changes. In an economywide bargaining, the unions are able to internalize the positive link between higher taxation and social security and welfare benefits, especially if the government also is involved in the negotiation, as it is often the case in Scandinavian countries. This induces the union to moderate its wage claims. Thus, in very centralized labor markets, the distortionary effects of fiscal policy are likely to be lower than in countries with intermediate levels of centralization. The relationship between

changes in labor taxation and changes in competitiveness is therefore hump shaped: a given increase in taxation induces a larger increase in relative unit labor costs in countries with intermediate levels of centralization, and smaller increases in countries with highly centralized and highly decentralized labor markets.

The empirical part of the paper tests the main propositions of the model by estimating the degree of shifting of labor taxation on relative unit labor costs, using a panel of 14 OECD countries for the period 1965–1990. We find that the results are strongly supportive of our theory. For instance, we find that, when taxes on labor increase by 1 percent of GDP from their sample average of about 25 percent, unit labor costs in countries with an intermediate degree of centralization increase by up to 2.5 percent relative to competitors. Furthermore, there is evidence that the degree of shifting of labor taxation is indeed a hump-shaped function of the degree of centralization, peaking in countries with an intermediate degree of centralization.

The role of distortionary taxation on the cost side of firms in imperfectly competitive labor markets is a topic that has received relatively little attention. A prominent exception is Michael Bruno and Jeffrey D. Sachs (1985), who have studied the role of labor taxation in the context of a much broader analysis of the unemployment problem in OECD countries. Two empirical studies that are close to our approach are Anthonie Knoester and Nico van der Windt (1987), who study the effects of taxation on nominal wages in seven OECD countries, and Fiorella Padoa-Schioppa (1990), who analyses the role of Italian unions in shifting taxation on to wages. More recently, Philip R. Lane and Perotti (1996) study theoretically and empirically the effects of labor taxes and of different types of expenditures (wage and nonwage government consumption and transfers) on profitability in alternative exchange rate regimes.

Our paper is also related to the literature on unionization and macroeconomic performance. However, while the latter focuses on the relationship between labor market institutions and employment, we focus on the effects of fiscal policy. Lars Calmfors and John Driffill (1988) and Richard B. Freeman (1988) present empirical evidence on the existence of a hump-shaped relation between the degree of centralization in labor markets and unemployment. A large theoretical body of literature has put forward various explanations for this relationship: among others, Calmfors and Driffill (1988), Michael Hoel (1991), and Steinar Holden and Oddbiøn Raaum (1991), and, more recently, Martin Rama (1994). The list above is far from complete, however: Calmfors (1993) provides an exhaustive survey of the literature on the topic.

Two recent contributions are particularly close antecedents to our paper. In Lawrence Summers et al. (1993), the distortions induced by taxation are a decreasing function of the degree of centralization in labor markets, because larger unions can better internalize the benefits of the social expenditure associated with labor taxation. Hence, when the government trades off the benefits and costs of taxation optimally, the share of government expenditure in GDP should be higher in more centralized countries. Empirical evidence from OECD countries supports this last statement. In our paper, fiscal policy is exogenous, and we study a different, although related, issue, namely the effects of taxation on unit labor costs. Edmund Phelps (1994) shows that in a sample of 17 OECD countries payroll and income taxes have adverse effects on employment and that the sensitivity to shocks in corporatist countries is lower than in the other countries.

The paper is organized as follows. Sections I and II present and solve the model, respectively. We present the empirical evidence in Sections III and IV. Section V discusses the main assumptions of the model and its possible extensions. In the main text, we present our results mainly in intuitive terms. The formal proofs appears in the Appendix.

I. The Model

A. *The Structure of the Economy*

We consider a world composed of two countries ("Home" and "Foreign") that produce a continuum of varieties of differentiated traded goods. In each country, there is a total mass 1 of firms, each producing a differentiated good with a constant-returns-to-scale

technology, $y_i = \alpha n_i$, where y is output, n is labor input, α is productivity, and the subscript i indexes the firm. We assume, for simplicity, that there are no fixed costs in production. Thus, if we allowed for free entry, the equilibrium number of firms would be indeterminate in this model. Since these issues are not the focus of this paper, we assume that in both countries entry by new firms is prevented.

In each country, each individual has the following homothetic preferences over consumption and leisure (see Avinash K. Dixit and Joseph Stiglitz, 1977):

$$(1) \quad U = \left(\int_0^1 X_i^{1/\lambda} \, di + \int_0^1 X_i^{*1/\lambda} \, di \right)^\lambda$$
$$+ (1 - \ell)R, \lambda > 0,$$

where X_i denotes consumption of the i-th variety of goods produced at Home ("exportables" from now on) and a "*" denotes a foreign variable, so that X_i^* is consumption of the i-th foreign variety ("importables"). The elasticity of substitution between two varieties of goods, σ, is governed by the parameter λ through the formula $\sigma = \lambda/(\lambda - 1)$. R is the utility of leisure, and ℓ is the supply of labor. Each agent has one unit of labor, supplied inelastically: ℓ takes the value of 1 if the agent is employed, 0 if he is not.

Three different types of agents live in each country: workers, entrepreneurs, and a class of unproductive agents that only for brevity we call "pensioners".[1] The total mass of workers is $\bar{n}$. The total mass of entrepreneurs is 1, each owning a firm for the production of a differentiated good. Finally, there is a total mass $\bar{m}$ of pensioners whose only source of income is a social security benefit. This last class captures what we think is an important feature of modern industrialized countries, namely the existence of a large constituency of agents whose main stake in fiscal policy is to maximize redistribution.

B. Fiscal Policy

We focus on a simple, but empirically important, type of fiscal policy: the government taxes labor income and redistributes the tax revenues to the "pensioners." This policy alters the distribution of income, but it does not affect either the size or the composition of demand *at the existing prices*, since all agents have the same propensities to spend on different goods. Therefore, all the effects of fiscal policy occur through the effects of taxation on the labor costs of firms and the distortions induced in the labor market.

We consider three types of taxes: an income tax (at rate τ), a social security tax paid by employers (at rate s_{ER}), and a social security tax paid by employees (at rate s_{EE}). Thus, if w_i is the wage in the i-th firm, the after-tax income of an employed workers is $w_i(1 - \tau - s_{EE})$, and total labor costs, or total compensation, per worker is $w_i(1 + s_{ER})$. Unit labor costs in firm i are defined as the ratio of total compensation to real value added in manufacturing: $ULC_i \equiv w_i n_i (1 + s_{ER})/y_i$. From the production function, this expression is equal to $w_i(1 + s_{ER})/\alpha$. Purely for notational simplicity, from now on we assume that $s_{EE} = 0$, or, equivalently, that the income tax rate τ is inclusive of the social security tax rate s_{EE}.

C. The Structure of the Labor Market

In the home country the labor force is organized in unions. For simplicity, we consider the case of monopoly unions that set the wage in order to maximize the expected utility of their members, while in equilibrium employment is determined by the entrepreneurs given the demand function for the differentiated good they produce. It is well known (see for instance Olivier J. Blanchard and Stanley Fischer, 1989 Ch. 9) that this labor market setting leads to inefficient wage-employment outcomes. A more general framework, in which the union and the employers bargain over the wage and possibly over employment, leads to exactly the same qualitative conclusions. We consider the case of monopoly unions only because it is more intui-

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[1] Notice that this is a static model; thus we abstract from intertemporal considerations, including issues of intergenerational redistribution. Hence, the term "pensioners" is simply meant to capture those individuals who are outside the labor force. These individuals would include recipients of old-age, disability, and invalidity pensions, and recipients of several types of welfare benefits.

tive and tractable. We also assume symmetry in union membership: when J unions are present, each union has membership $\bar{n}_J \equiv \bar{n}/J$ and sets the wage for a total mass $1/J$ of firms. Thus, a union also defines a sector, i.e., the mass of firms for which the union sets the wage.

We study different degrees of centralization of the wage-setting process, defined as follows.

Definition 1: The degree of centralization of the labor market is $1/J$, where J is the number of unions.

Hence, as the degree of centralization increases, each union sets the wage for a larger number of firms. The expected utility of a member of the j-th union can be found as follows. Let n_j be the mass of employed union members, each earning a real after-tax wage $w_j(1 - \tau)/\bar{P}$, where $\bar{P}$ is the general price level. This is defined as (see Dixit and Stiglitz, 1977):

$$(2) \quad \bar{P} = \left[\int_0^1 p_i^{1-\sigma} \, di + \int_0^1 p_i^{*^{1-\sigma}} \, di \right]^{1/1-\sigma},$$

where p_i is the price of the i-th variety of exportables and p^* is the price of the i-th variety of importables; $\bar{n}_J - n_j$ is the mass of members of the j-th union who remain unemployed. Their utility is $\bar{V}_j$, which is determined by the employment opportunities available in the other sectors. The representative union takes $\bar{V}_j$ as given. From the utility function (1), the expected utility of a union member is then:

$$(3) \quad V_j = \frac{n_j}{\bar{n}_J} \frac{w_j(1 - \tau)}{\bar{P}} + \frac{(\bar{n}_J - n_j)}{\bar{n}_J} \bar{V}_j.$$

In what follows, we consider only symmetric equilibria, in which all unions set the same wage. Also, for the problem to be interesting at all, one has to consider interior solutions to the problem of the representative union, i.e., solutions such that not all its members are employed. Given the symmetry between sectors, this assumption implies that each union has some unemployed members. As it is customary in the literature, we assume that a monopoly union can prevent nonunion members from being hired in its sector before its un-

employed members are hired. Because all unions have some unemployed members in equilibrium, the members of the j-th union not employed in the j-th sector cannot be employed in any other sector, either. Effectively, this implies that the alternative utility available to unemployed workers, $\bar{V}_j$, is always R.

For simplicity, we assume that the labor market in the foreign country is perfectly competitive, so that full employment always prevails. This assumption allows us to focus on the home country in order to highlight more clearly the basic interactions between fiscal policy and labor markets *within* one country. The model is closed by a condition of equilibrium of the current account, stating that the expenditure on importables by domestic residents be equal to the expenditure on exportables by foreign residents.

II. Fiscal Policy and Labor Markets

A. *Equilibrium in the Foreign Country*

From the point of view of an individual firm that takes all other prices as given, the elasticity of the demand for its output is equal to the elasticity of substitution between any two varieties of goods, σ. Therefore, each firm maximizes profits by pricing its output at the constant markup $\sigma/(\sigma - 1)$ over the marginal cost, w^*/α. If the foreign wage is the numeraire, the price of all foreign goods is

$$(4) \qquad p^* = \frac{\sigma}{\sigma - 1} \frac{1}{\alpha^*}.$$

The value of output in the foreign country, Y^*, is equal to the output price p^* times total foreign output, $Y^* = p^*\alpha^*\bar{n}$, where foreign employment is equal to $\bar{n}$ because of the assumption of perfectly competitive labor market.

B. *Equilibrium in the Home Country*

In each of the J domestic sectors, the wage is common to all firms. Each firm in sector j prices its output at a constant markup over the marginal cost $w_j(1 + S_{ER})/\alpha$:

$$(5) \qquad p_j = \frac{\sigma}{\sigma - 1} \frac{w_j(1 + s_{ER})}{\alpha}.$$

The union in sector j maximizes the expected income of its members, (3), by setting the wage w_j and letting employment be determined by the aggregate demand for labor. With monopolistic competition in the goods market, the demand for labor is derived from the demand for output. It is straightforward, but tedious, to show that the demand for labor in the j-th exportable sector is

$$(6) \qquad n_j = \frac{1}{\alpha J} \frac{E}{\bar{P}} \frac{p_j^{-\sigma}}{\bar{P}^{-\sigma}},$$

where E is the total expenditure by the two countries on exportables and importables, i.e., their total incomes. In setting the wage, the union in the j-th sector takes E as given, but realizes that the price p_j set by all firms in the sector and, therefore, $\bar{P}$, are a function of the wage w_j it sets. Hence, the union realizes that a higher wage affects the demand for labor in its sector through two channels. First, for a given nominal expenditure E the real aggregate expenditure $E/\bar{P}$ falls since $\bar{P}$ increases. We call this the *real expenditure* effect of an increase in the wage. Second, consumers substitute away from exportables towards importables, as captured by the term $p_j^{-\sigma}/\bar{P}^{-\sigma}$. This is the *substitution* effect.

The j-th union maximizes (3) subject to (2), (5), and (6). The solution to the problem of the union gives the real after-tax wage in each sector as a variable markup over the alternative cost of employment to the union, R:

$$(7) \qquad \frac{w_j(1 - \tau)}{\bar{P}} = R \frac{\varepsilon_J}{\varepsilon_J - 1 + \gamma_J},$$

where γ_J is the elasticity of the price index, ε_J is the absolute value of the elasticity of the aggregate demand for labor to w_j, and the subscript "$_J$" indicates the equilibrium value when there are J unions in the economy [see equation (A2) in the Appendix for explicit expressions of these two elasticities].

To understand expression (7), note that except for the term γ_J in the denominator, the right-hand side is analogous to a markup solution for a monopolist (the union) "producing" labor at a constant marginal (opportunity) cost, R. The term γ_J in the denominator reduces the markup charged by the union. This

term is there because an increase in the j-th sector's wage increases the general price level, which in turn reduces the real wages of union members. This leads to lower wage demands relative to the partial equilibrium case of a monopolist taking all other prices as given.

C. *Labor Markets and the Shifting of Taxation*

The difference between the standard partial equilibrium problem solved by a monopoly union and the problem the union solves here is crucial for our analysis. Our main result can be stated in the following definition and proposition.

Definition 2: We define competitiveness as the ratio of the home country's unit labor costs $w(1 + s_{ER})/\alpha$ to the foreign country's unit labor costs $w*(1 + s_{ER}^*)/\alpha*$. When Home's relative unit labor costs fall, we say that "competitiveness has improved." When Home's relative unit labor costs increase, we say that "competitiveness has deteriorated."

PROPOSITION 1: (i) *An increase in redistribution to the pensioners financed by an increase in the labor tax rate τ leads to an increase in relative unit labor costs (i.e., a deterioration in competitiveness); (ii) the shifting of taxation to unit labor costs is larger the more centralized the labor market.*

PROOF:
See the Appendix.

The intuition for part (i) is simple: when the tax rate increases, the union shifts part of the burden of taxation on to the employers by demanding a higher nominal wage. As the output price correspondingly increases, the home country experiences a loss of competitiveness. This leads to a fall in employment for two reasons. First, for a given nominal demand E the demand for exportables falls because of the real expenditure and the substitution effects. Second, to preserve the equilibrium in the current account, the national income and, therefore, the nominal demand E must fall. The reason is that, to ensure a balanced current ac-

count, the domestic demand for importables must fall. Even at constant relative prices, this would require a fall in the home national income. A fortiori, the home national income must decrease because the relative price of importables has fallen. We call this effect the *nominal expenditure* effect of an increase in the wage of the exportable sector. A similar intuition holds for an increase in social security taxation.

As for part (ii), it is useful to think in terms of the effects of taxation on the real wage set by the union. As we showed above, the real wage set by the union is a markup over the alternative utility to the union, R. As expression (7) clearly shows, an important determinant of this markup is the fact that the general price level increases when the union sets a higher wage, with elasticity γ_J. This effect of the wage on the price level dampens the marginal gain from setting a higher wage, and causes a reduction in the markup set by the union.

Proposition 1 is a statement about the *change* in the markup when the tax rate increases, which involves the *change* in γ_J in response to the increase in τ. In particular, part (ii) of the proposition follows from two features of the model. First, γ_J falls as w_j increases. Second, this fall in γ_J is larger, the larger the typical union, i.e., the smaller J [both these features appear clearly in the expression for γ_J, (A2)]. The first feature is due to the fact that, when w_j is high, consumers have substituted away from the consumption of sector j's output; therefore a given percentage increase in w_j affects the general price level less because sector j's output takes up a small part of their consumption bundle. Hence, γ_J falls as w_j increases. As a consequence, the desired markup of the real wage over R also increases as w_j increases. Moreover, the fall in γ_J is larger, the larger the sector, or the lower the number of unions J. To see this, note that, when J is small, the increase in w_j affects a large mass of products, and consequently the fall in the elasticity of the price level γ_J is large. Hence, the markup also increases more when J is small.

D. *Highly Centralized Labor Markets*

The case of a monotonic relationship between the degree of centralization and the shifting of labor taxes illustrates the basic mechanism underlying our model. But at very high levels of centralization this relationship changes qualitatively. Mancur Olson (1982) was probably the first to suggest the idea that organized interests might be most disruptive when they are strong enough to reap substantial rents but not strong enough to internalize the negative effects of their actions. This insight is crucial for an understanding of the real-world relationship between taxation and labor markets. Consider the case of an economywide union ($J = 1$), or, equivalently for our purposes, of economywide wage negotiations between an umbrella organization of unions and a similar organization of entrepreneurs. This description fits the case of all Scandinavian countries and Austria: in these countries, where economywide wage negotiations typically involve also the government, the unions are much more likely to take into consideration the macroeconomic constraints and the adverse effects of wage increases on labor costs and employment.[2]

Obviously, the first macroeconomic constraint that will be taken into account in a centralized wage negotiation is the government budget constraint. In this setting, the union is able to make the connection between the taxes its members pay and the benefits they receive, or will receive, in the form of higher transfers and social expenditure. There is ample anecdotal evidence on this mechanism in Scandinavian countries. For instance, in 1975–1976 in Sweden, social security contributions increased substantially; the centralized system of wage negotiations "might explain why the contractual increases were not even greater than they were: the wage agreement was reached on the understanding that social security payments would subsequently be increased, and the government felt obliged to honor this commitment—*as indeed it had done on similar occasions in the past*." (Robert J. Flanagan et al., 1983 p. 325, emphasis added.)

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[2] For instance, according to Calmfors and Driffill (1988 p. 14): "The success of countries such as Sweden, Norway and Austria in maintaining high levels of employment is usually attributed to centralized bargaining which takes into account macroeconomic considerations."

This type of wage negotiations has a simple formalization in our model. Suppose a third term S appears in the union's utility function (3), representing the stream of social security benefits and other social expenditure; this would be the case if, for instance, each union member cares about his family utility level, with one pensioner for each union member. Alternatively, we would also obtain the same results if S represents unemployment benefits, a case we developed in the working paper version. Enterprise- and industry-level unions take S as given, because they do not internalize the government budget constraint; the analysis of subsection C in this section then carries through exactly to the present case, since the new term is a constant that does not affect the maximization problem of the unions. However, a large union that directly negotiates with the employers *and* the government internalizes the positive link between S and the tax rate τ. In fact, from the government budget constraint, in equilibrium, S is equal to total tax revenues, τwn, divided by the total mass of beneficiaries, $\bar{n}$, and the price level $\bar{P}$. The problem of the union then becomes:

$$(8) \quad V = \frac{n}{\bar{n}} \frac{w(1-\tau)}{\bar{P}} + \frac{(\bar{n}-n)}{\bar{n}} R + \frac{\tau wn}{\bar{n}\bar{P}}$$

$$= \frac{n}{\bar{n}} \frac{w}{\bar{P}} + \frac{(\bar{n}-n)}{\bar{n}} R,$$

which is independent of τ. Changes in τ do not affect the wage set by the union, since the expected real after-tax income of a union member is not affected. Thus, when the union fully internalizes the government budget constraint, there is no shifting of taxation on to the wage and labor costs. In addition, as we showed in subsection C, in less centralized labor markets, where negotiations are primarily industry-based, the degree of shifting is higher than in very decentralized labor markets with mainly enterprise-based negotiations. Hence, the relationship between the degree of centralization of labor markets and the degree of shifting of labor taxation is hump shaped.

Of course, in reality one would still expect some shifting of taxation in highly centralized countries, partly because the union might not fully internalize the government budget constraint, and partly because not all labor taxation is used for redistributive purposes. Nevertheless, the basic idea is that in these countries the shifting of taxation should be lower than in countries with industry-based negotiations.

The following proposition summarizes the results of this section.

PROPOSITION 2: *In highly centralized labor markets with economywide negotiations, the degree of shifting of labor taxation is smaller than in countries with industry-level negotiations. Hence, the relationship between the degree of centralization of the wage-setting process and the degree of shifting of taxation on to unit labor costs is hump shaped.*

In addition, the two reasons above why some shifting might still occur have an additional interesting and easily testable implication. Although the explicit earmarking of tax revenues is rare, in many countries the link between social security contributions and social expenditure is stronger than the link between general income taxation and social expenditure, or at least it is more likely to be perceived as such. Therefore, one would expect the difference in the shifting of taxation among different labor markets to be larger in the case of social security contributions. We test this prediction in our empirical part.

III. Empirical Evidence

A. *Data and Specification*

We estimate the relationship between labor taxation, unit labor costs, and the degree of centralization of labor markets, as summarized in Proposition 2, using annual data on the manufacturing sector[3] for a panel of 14 OECD countries: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan,

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[3] Thus, we take the tradable sector to be the manufacturing sector. In a recent paper, De Gregorio et al. (1994) show that, despite the increased trade in some services, manufacturing is still the sector with, by far, the highest share of trade.

the Netherlands, Norway, Sweden, the United Kingdom, and the United States. To test our theory, we divide these 14 countries into three groups, depending on the degree of centralization of labor markets (the rationale for the three groups will be evident shortly). In general, the period covered is 1965–1990, or a shorter period for some countries, depending on data availability.

The basic specification we estimate is of the form

$$(9) \quad ULC_{k,t} = \beta_0 + \beta_1 C \cdot LABTAX_{k,t}$$
$$+ \beta_2 I \cdot LABTAX_{k,t}$$
$$+ \beta_3 D \cdot LABTAX_{k,t} + \beta_4 TFP_{k,t}$$
$$+ \beta_5 GAP_{k,t} + \beta_6 \mathbf{Z}_{k,t} + \varepsilon_{k,t},$$

where the subscripts k and t refer to the country and the year, respectively. ULC is unit labor costs in manufacturing, TFP is total factor productivity in manufacturing,[4] GAP is the ratio of potential output (as estimated by the OECD) to actual output and therefore captures the cyclical position of the economy,[5] $LABTAX$ is labor taxes as shares of GDP, and $\mathbf{Z}$ is a vector of other controls. Our measure of la-

bor taxation includes the following taxes: direct taxes paid by households, social security taxes paid by employers and employees, and payroll taxes. Note that direct taxes include mainly income taxation, since the breakdown between labor and other income taxation is available only for a few countries.[6] Later on, we discuss some interesting results we obtain when considering direct taxes and social security taxes separately. C, I, and D are indicator variables denoting the groups of countries with highly centralized, intermediate, and decentralized labor markets.

According to Proposition 2, we expect the coefficients β_1 through β_3 to be positive and such that $\beta_2 > \beta_1$ and $\beta_2 > \beta_3$. The relationship between β_1 and β_3 is not determined a priori: it depends on to what extent an economywide union in highly centralized countries internalizes the government budget constraint. We also expect β_4 to be negative, as an increase in total factor productivity obviously leads to a fall in unit labor costs, and β_5 to be positive, since a downturn in economic activity (an increase in GAP) is likely to lead to higher unit labor costs because of labor hoarding.

To estimate our specification, we must rank countries according to their degree of centralization in labor markets. Several indices of this type are available in the literature. The best known is by Calmfors and Driffill (1988), which ranks our 14 countries in descending order of centralization as follows: Norway, Sweden, Denmark, Finland, Germany, the Netherlands, Belgium, Australia, France, the United Kingdom, Italy, Japan, the United States, and Canada (the Calmfors-Driffil index also ranks three more countries—Austria, New Zealand, and Switzerland—which, however, do not appear in our sample).

Each country is assigned a score depending on: (i) the level at which wage negotiations occur (from 3, for wage negotiations at the national level, to 0, for wage negotiations at the enterprise level), and (ii) the number of central union confederations and of central

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[4] Because of the presence of monopoly power, we construct total factor productivity growth using the formula $dy - \mu' \cdot s_L dl - (1 - \mu' \cdot s_L) dk$, where y, l, and k are the logarithms of value added, labor, and capital, respectively, s_L is the share of labor in value added, and μ' is the value-added-based markup. We constructed μ' from the formula $\mu' = \mu(1 - s_M)/1 - \mu s_M$, where μ is the output-based markup and s_M is the share of intermediate input in output, which we assumed to be equal to 0.5, as proposed by Robert E. Hall (1986), and as it is typical in the literature. We averaged the values of μ' obtained by applying this procedure to the output-based markups of Ian Domowitz et al. (1988), Hall (1988), and Catherine J. Morrison (1990), which represent the range of values typically found in the literature, from the highest (1.61, in Domowitz et al., 1988) to the lowest, (1.30 in Morrison, 1990), with the estimate in Hall (1988), 1.37, somewhat in the middle (note that Hall estimates a value-based markup directly). We also experimented with lower and higher values of μ, and the results did not change substantially.

[5] Other measures of the cyclical position of the economy, such as the unemployment rate or the ratio of trend output to actual GDP, give very similar results.

[6] Note that, if the wage were bargained rather than set by a monopoly union, even taxes on property and on nonlabor income would be shifted.

employer confederations (from 3, for one confederation, to 1, if there is no central organization). Thus, this index captures very closely two key factors of our model, namely the number of, and the degree of coordination among, unions, and therefore the extent to which wages move together in different firms or sectors. In addition, the Calmfors-Driffill index has the advantage that it also takes into account the same two factors on the employers' side, which is appropriate for our purposes because the coordination of wage movements across firms in a given sector depends on the extent of coordination of both unions and the employer organizations.[7]

The rationale behind the construction of the Calmfors-Driffill index clearly reveals a fundamental distinction between three groups of countries in our sample: "In Canada, the US, Japan, Switzerland, UK, France and Italy, wage bargaining is ... mainly at the enterprise level, although there are certain elements of industry bargaining in the latter three countries." (Calmfors and Driffill, 1988 p. 16.) "At the other extreme are the Nordic countries and Austria with centralized bargaining between national trade union movements and employer federations. In between, there are countries such as Germany, Belgium, and the Netherlands, where bargaining occurs at the industry level" (p. 14). "The least transparent systems occur in New Zealand and Australia, which have ingredients of both centralization and decentralization" (p. 17).[8] Of the other countries, only the position of France seems subject to some uncertainty, as the elements of industry-wide bargaining might make its system closer to that of Belgium or Germany rather than the United States or Canada (see the discussion in Calmfors and Driffill, 1988).

Thus, with the possible exceptions of Australia and France, the composition of the three groups appears to be rather uncontroversial.[9] The first group of more centralized countries includes Norway, Sweden, Denmark, and Finland, with largely economywide negotiations and the involvement of the government; the second group of countries includes Germany, the Netherlands, and Belgium, with an intermediate level of centralization and mainly industry-based negotiations. The third group of decentralized countries includes Canada, the United States, Japan, Italy, the United Kingdom, France, and Australia, with mainly enterprise-level negotiations.[10]

The criteria used for the construction of the Calmfors-Driffil index are very similar to those underlying the indices of Phillipe C. Schmitter (1981) and David R. Cameron (1984), who however take into account only the union side. Interestingly, using either of these two indices would generate exactly the same grouping of countries as the Calmfors-Driffill index. Recently, Richard Layard et al. (1991) have constructed three indices, aimed at capturing the coverage of wage negotiations, the coordination among unions, and among employers' organizations. If one sums the three scores for each country, the resulting ranking has only minimal differences with that

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[7] Formally, the employer side could be easily incorporated in our model if the wage were decided by bargaining between unions and associations of employers in each sector, as we assumed in a previous version of the paper.

[8] The reason for the uncertainty surrounding the Australian case is that, although negotiations take place mainly at the enterprise level, some coordination takes place indirectly through arbitration courts that tend to enforce common norms. See John P. Windmuller et al. (1987) for a description of the Australian labor market from the 1950's to the mid-1980's.

[9] A reading of more descriptive, but more detailed, contributions (e.g., Flanagan et al., 1983, and Windmuller et al., 1987) also supports this composition rather unequivocally.

[10] A second method of testing our hypothesis consists in interacting our tax variable with the index of centralization. However, our first method, dividing the 14 countries into two groups, has at least three advantages. First, any error in constructing the index that implies an erroneous ranking of the countries *within* each group becomes irrelevant. Second, grouping countries imposes fewer restrictions on the shape of the relationship between labor market centralization and effects of taxation. According to the second method, the same coefficients govern the change in the shifting of taxation when going from values of the Calmfors-Driffill index of, say, 1 to 2 as when going from 13 to 14. Finally, under the method we use, changes over time in the degree of centralization are irrelevant, as long as they do not cause a country to move from one group to the other. For these reasons, we prefer to present results based on our first method; however, the results obtained using the second method are also very supportive of our model, and are available upon request (see also our working paper version).

of the Calmfors-Driffill index, and indeed would give rise once more to exactly the same grouping of countries.

A second important issue concerns possible variations over time in the degree of centralization of the labor market in a given country. This aspect is particularly difficult to quantify because none of the existing indices takes explicitly into account the time dimension. However, several observers have noticed a rather general trend towards decentralization in many countries in the 1980's.[11] For instance, in France in the 1980's there has been a strong movement from industry-level to enterprise-level bargaining. A similar tendency has been evident since the mid-1970's in the United Kingdom (Windmuller et al., 1987 p. 102). However, in all these cases these changes over time do not affect our *grouping* of countries, as they occur within the group of decentralized countries.[12]

We use three sources of data, all from the OECD. The *Intersectoral Database* (1995) contains data on value added at current and constant prices, employment, total compensation, and the capital stock for the 14 countries of our sample. The advantage of this source is twofold: it has been designed to ensure as much consistency as possible across countries, and it contains data on sectoral capital stocks. Thus, this source allows us to construct two consistent series on unit labor costs and total factor productivity in the manufacturing sector. The *Revenue Statistics of OECD Member Countries* (1994) is our source of data for social security taxes and payroll taxes. Finally, the *Economic Outlook Database* (1995) contains all the other data we use in this paper, such as all government expenditure variables, indicators of the cycle, direct taxes on households, etc.

[11] See Windmuller et al. (1987) and Organization for Economic Cooperation and Development (1994) for more details on recent developments in labor markets in the OECD area.

[12] Possibly the only two exceptions to this trend toward decentralization are Italy and Australia, where there are signs of a movement from enterprise-level to industry-level bargaining in the 1980's. In both cases, however, because of the complexities of the bargaining process, these changes are particularly difficult to assess (see Windmuller et al., 1987).

B. *Estimation Results*

Table 2 presents several variants of the basic specification (9). All the variables that appear in (9) are expressed in relation to a trade-weighted geometric average of all the other countries in the sample, with weights equal to their 1980 trade shares. We construct unit labor costs in manufacturing by dividing total compensation by real value added, and then we convert each country's unit labor costs into a common currency by using the nominal exchange rate. Our benchmark specification includes year and country dummies. Because of the high persistence of the data, we log-difference all variables in all regressions.

In column 1, labor taxation is constrained to have the same effect on multilateral unit labor costs in all countries: the estimated coefficient of *LABTAX* is 0.15, with a t-statistic of 1.45. Column 2 shows that, consistent with the results of Section II, this coefficient hides a substantial difference between the three groups of countries: the estimate of β_2, the coefficient of labor taxation in the intermediate group of countries, is 0.75, much higher and much more significant than the estimates of β_1 and β_3, which are 0.20 and 0.04, respectively. A standard F-test on the equality of β_2 and β_3 has a p-value of 2.7 percent. The difference between β_1 and β_2 is also significant at the 10-percent level, as the corresponding F-test has a p-value of 8.6 percent. The coefficients of the other two variables also have the expected signs: *TFP* has a large and very significant negative effect on unit labor costs, while *GAP* has a positive and significant effect.

In column 3 we control for the wage component of government consumption, *CGW*, and its nonwage component, *CGNW*, both as shares of GDP. The former, which includes items like salaries of government employees, teachers etc., captures the production of labor-intensive government services. The latter, which includes items like the purchase of goods for the army, expenditure on infrastructure, etc., captures mainly the purchase of goods produced by the private sector or the production by the government of goods that are not, in general, particularly labor intensive. Therefore, *CGW* should have a bigger effect on unit labor costs than *CGNW*. Column 3 in

TABLE 2—FISCAL POLICY AND RELATIVE UNIT LABOR COSTS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
TFP	−0.73	−0.73	−0.70	−0.61	−0.69	−0.73	−0.65
	(5.85)	(5.92)	(5.58)	(5.26)	(5.73)	(5.58)	(5.20)
GAP	0.72	0.69	0.43	0.45	0.41	0.44	0.36
	(2.45)	(2.35)	(1.21)	(1.32)	(1.20)	(1.16)	(0.93)
LABTAX	0.15	—	—	—	—	—	—
	(1.45)	—	—	—	—	—	—
C·LABTAX	—	0.18	0.20	0.21	0.24	0.18	0.16
	—	(1.14)	(1.21)	(1.27)	(1.49)	(1.06)	(1.01)
I·LABTAX	—	0.62	0.75	0.68	0.63	0.71	0.70
	—	(2.28)	(2.72)	(2.51)	(2.48)	(2.61)	(2.66)
D·LABTAX	—	−0.19	0.04	0.11	0.09	0.04	−0.01
	—	(0.13)	(0.28)	(0.73)	(0.62)	(0.24)	(0.07)
CGW	—	—	0.22	0.10	0.24	0.28	0.35
	—	—	(0.92)	(0.46)	(1.02)	(1.08)	(1.09)
CGNW	—	—	−0.11	−0.09	−0.13	−0.12	−0.02
	—	—	(0.96)	(0.81)	(1.22)	(1.03)	(0.14)
year dummies?	yes	yes	yes	yes	no	yes	yes
country dummies?	yes	yes	yes	no	yes	yes	yes
nobs	281	281	276	276	276	256	259
$\bar{R}^2$	0.09	0.10	0.09	0.09	0.15	0.10	0.10

Notes: Dependent variable: multilateral unit labor costs. *t*-statistics in parentheses. All variables in the regressions are log-differenced. *C* is a dummy variable taking the value 1 in the group of centralized countries, and 0 elsewhere. Countries in group *C* include: Norway, Sweden, Denmark, and Finland. *I* is a dummy variable taking the value 1 in the group of countries with intermediate degree of centralization, and 0 elsewhere. Countries in group *I* include: Germany, the Netherlands, and Belgium. *D* is a dummy variable taking the value 1 in the group of decentralized countries, and 0 elsewhere. Countries in group *D* include: Australia, France, the United Kingdom, Italy, Japan, the United States, and Canada. *TFP:* total factor productivity; *GAP:* ratio of potential GDP to actual GDP; *LABTAX:* ratio of direct taxes on households plus social security plus payroll taxes to GDP; *CGW:* ratio of wage government consumption, deflated by the deflator of "Producers of Government Services," to real GDP; *CGNW:* ratio of nonwage government consumption to GDP. Column (6): France is excluded from the sample. Column (7): Australia is excluded from the sample. Sources: Unit labor costs and total factor productivity in manufacturing: *Intersectoral Database,* OECD (1995); all other variables: *Economic Outlook Database,* OECD (1995).

Table 2 indeed shows that *CGW* has a larger coefficient than *CGNW*, although neither is significant at conventional levels. Note also that the coefficient of *GAP* falls substantially and becomes insignificant: the reason is that government consumption, which is positively correlated with unit labor costs, is also countercyclical, i.e., positively correlated with *GAP*, both because when GDP falls the denominator of *CGW* and *CGNW* falls, and because government consumption might be used for stabilization purposes. In any case, it is important to note that the coefficients of the labor tax rate remain practically unaffected after controlling for government consumption.[13,14]

[13] The effects of government consumption on the relative price of nontradables to tradables has been the subject of renewed interest in recent years. Research by Kenneth A. Froot and Kenneth Rogoff (1991) and De Gregorio et al. (1994) finds, to different degrees, empirical support for the classic Bela Balassa (1964) result that government consumption, which typically falls more heavily on labor-intensive, nontraded services and goods, causes an appreciation of the relative price of nontradables by increasing the demand for labor in the economy. In contrast to this

From now on, column 3 will be our standard specification. To check the robustness of our results, we reestimate this specification with the two remaining possible combinations of year and country dummies (columns 4 and 5). In all these cases, the coefficients of labor taxation change only minimally.

What is the economic significance of the results that emerge so far? During the 1965–1990 period, the average value of *LABTAX* in the group of countries with intermediate levels of centralization was 25.2 percent, with a standard deviation of 5.9 percent. The average estimate of the coefficient of *I·LABTAX* in our benchmark specification in Table 2 is 0.68, with very little dispersion. Using this value, when *LABTAX* in these countries increases by 1 percent of GDP to 26.2 percent, relative unit labor costs increase by 2.70 percent (2.70 = 0.68/0.252). When *LABTAX* increases by one standard deviation, relative unit labor costs increase by a sizable 15.92 percent. These values are large, if one considers that it is not uncommon to observe movements in the share of taxes in GDP of several percentage points, particularly in countries that are adjusting their budgets.

As we discussed in the previous subsection, the composition of the two groups of countries according to the degree of labor market centralization seems relatively uncontroversial, except possibly for the positions of France and Australia, that are slightly more difficult to categorize. Hence, in column 6, we exclude France from the sample; in column 7, we exclude Australia. As one can see, in both cases all the coefficients are virtually unaffected. As our discussion in subsection A of this section suggests, the group of decentralized countries,

D, might also conceal some difference between Canada, the United States, and Japan on one hand, and France, Italy, and the United Kingdom on the other, with Australia somewhat in between. Hence, we also split our group *D* of decentralized countries into group *D*1, which includes Canada, Japan, and the United States, and group *D*2, which includes Australia, France, Italy, and the United Kingdom. One would expect the coefficient of *D*1·*LABTAX* to be smaller than that of *D*2·*LABTAX*: this is indeed the case, although neither coefficient is significant.

IV. Sensitivity and Robustness

In Table 3 we perform some further sensitivity and robustness analysis. One might argue that year-to-year variations in taxation are unlikely to be reflected in increases in unit labor costs in the same year, and therefore that the model might simply be capturing the effects of the cycle on both unit labor costs and taxation. Note, however, that in itself this problem could not account for the asymmetric response of unit labor costs to taxation in the three groups of countries. In any case, to address this issue, in column 1 of Table 3 we have run the same regression as in column 3 of Table 2 with the rates of change of non-overlapping two-year averages rather than with yearly changes. As one can see, our results are, if anything, reinforced. In column 2, the dependent variable is the rate of change of *unilateral*, rather than multilateral, unit labor costs: in other words, we do not divide each country's unit labor costs by a weighted average of its trading partners. Correspondingly, the right-hand-side variables also are not divided by a weighted average of the trading partners. The coefficient estimates are very similar to those of column 3 in Table 2.

So far, we have run all our regressions in log-differences. This was motivated by the high persistence of the data. Moreover, it must be emphasized that, because we have an unbalanced panel, our regressions with *multilateral* unit labor costs cannot be run in log-levels, as the coefficient estimates would depend on the base year one assumes for the computation of the two index variables that appear in the regressions, unit labor costs and

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research, we estimate here the effects of government consumption on relative unit labor costs in the tradable sector.

[14] Besides wage government consumption, another type of expenditure might have direct effects on unit labor costs in this model, over and above the effects of taxation. Specifically, any redistribution of income to the unemployed which increases the unions' reservation utility increases unit labor costs. The correct variable to test for this channel would be the replacement ratio. However, at the moment we do not have a long enough time series of yearly data on replacement ratios in the 14 countries of our sample.

TABLE 3—ROBUSTNESS

	(1)	(2)	(3)	(4)	(5)
TFP	−0.43	−0.71	−0.29	−0.75	−0.75
	(2.27)	(4.99)	(2.45)	(5.91)	(4.18)
GAP	0.37	0.37	0.87	0.46	0.39
	(0.62)	(0.93)	(2.14)	(1.25)	(0.87)
C·LABTAX	0.29	0.26	0.25	−0.02	0.14
	(1.01)	(1.50)	(1.44)	(0.11)	(0.49)
I·LABTAX	1.11	0.80	0.98	0.56	0.77
	(2.31)	(2.62)	(4.14)	(1.77)	(2.01)
D·LABTAX	−0.05	0.14	0.18	−0.08	−0.04
	(0.18)	(0.91)	(1.03)	(0.54)	(0.19)
CGW	0.44	0.21	0.09	0.26	−0.09
	(1.16)	(0.80)	(0.34)	(1.07)	(0.26)
CGNW	−0.17	−0.06	0.22	−0.10	−0.12
	(0.79)	(0.48)	(1.42)	(0.89)	(0.79)
nobs	125	276	290	273	141
$\bar{R}^2$	0.04	0.61	0.998	0.09	0.07

Notes: Dependent variable: multilateral unit labor costs. *t*-statistics in parentheses. All variables in the regressions are log-differenced. All regressions include year and country dummies. (1)—same as column (3) in Table 2, but observations are two-year averages; (2)—dependent variable: rate of change of unilateral unit labor costs, expressed in a common currency; (3)—same as (2), but variables are in log-levels rather than log-differences, and country-specific time trends are included; (4)—tax revenues divided by wages; (5)— tax revenues divided by wages, excluding 1981 to 1990. Sources: see Table 2.

total factor productivity. The basic intuition is the following. Evaluating an index variable at two different base years causes the two resulting series to differ by a multiplicative constant. After taking logarithms, the two series would differ by an additive constant, which would be picked up by the country-specific intercept. However, this is no longer the case when the index variable is constructed as an index divided by a weighted average of the same index in other countries, as our series on multilateral unit labor costs is constructed, *and* not all the countries are included every year in the weighted average. In this case, the difference between the same index variable evaluated at two different base years is not just a multiplicative constant.

However, this issue does not arise when we use unilateral unit labor costs, as in column 2 of Table 3. Therefore, we can now run our regression in log-levels. Our results are virtually unchanged: the coefficients of *LABTAX* in

the three groups of countries are very similar in columns 2 and 3. The only difference is that now the coefficient of *TFP* is smaller in absolute value in the regression in levels than in first-differences (0.29, against 0.71). The reason is that the former includes country-specific time trends, which capture the upward trend in total factor productivity over time.

In columns 4 and 5 of Table 3 we construct our measure of taxation by dividing tax revenues by total wages and salaries, rather than GDP. First, one may argue that total wages and salaries is the correct measure of the tax base for our measure of taxation, that includes mainly labor taxes. Second, using GDP might induce an upward bias in the estimates of the tax coefficients. Consider the simplest regression we have displayed so far, in column 1 of Table 2, where the tax variable on the right-hand side was constructed as tax revenues divided by nominal GDP. The dependent variable is constructed as total nominal com-

TABLE 4—ALTERNATIVE TAX MEASURES

	(1)	(2)	(3)
TFP	−0.73	−0.74	−0.74
	(5.87)	(5.99)	(5.83)
GAP	0.43	0.48	0.43
	(1.19)	(1.31)	(1.20)
C·INCTAX	0.16	—	0.18
	(1.02)	—	(1.15)
I·INCTAX	0.34	—	0.28
	(1.94)	—	(1.60)
D·INCTAX	−0.02	—	−0.03
	(0.24)	—	(0.29)
C·SSTAX	—	−0.04	−0.05
	—	(0.77)	(0.93)
I·SSTAX	—	0.57	0.49
	—	(2.19)	(1.89)
D·SSTAX	—	0.04	0.08
	—	(0.31)	(0.38)
CGW	0.23	0.27	0.26
	(0.92)	(1.12)	(1.06)
CGNW	−0.08	−0.07	−0.05
	(0.68)	(0.67)	(0.47)
nobs	276	276	276

Notes: Dependent variable: multilateral unit labor costs. *t*-statistics in parentheses. All variables in the regressions are log-differenced. All regressions include year and country dummies. *INCTAX:* direct taxes on households, divided by GDP; *SSTAX:* social security and payroll taxes, divided by GDP. Sources: see Table 2.

pensation divided by real value added in manufacturing. Because nominal GDP and real value added in manufacturing are highly correlated, the positive estimated relationship between the tax rate and unit labor costs might be capturing the fact that two highly correlated variables appear at the denominator of the two variables on the two sides of the regression.

By defining the tax rate as tax revenues divided by total wages and salaries, we have, if anything, the opposite problem: two highly correlated variables — total wages and salaries in the economy and total compensation in manufacturing — appear at the denominator and the numerator, respectively, of the two variables on the right-hand side and the left-hand side. Thus, one could interpret the estimated coefficients of the

wage- and GDP-based tax rates as the lower and upper bounds, respectively, of the effect of labor taxation on unit labor costs. Hence, in column 4 of Table 3 we construct our variable *LABTAX* as the share of tax revenues to total wages and salaries. The dependent variable is always multilateral unit labor costs. There is still a substantial difference in the estimated coefficients of the three groups, but as expected on the basis of the foregoing discussion, both the size and significance of the coefficient of $I \cdot LABTAX$ fall.

We now turn to the issue of subsample stability. For brevity, we discuss this issue in the context of the regression with the tax variable defined as share of wages, rather than GDP. However, the conclusions of this part also apply to the regressions with the GDP-based tax variables. In column 5 of Table 3, we reestimate regression 4 leaving out the last decade in our sample, the 1980's. There are two a priori reasons why our results might be affected by the inclusion or exclusion of this decade. First, for most countries the yearly variability of the rate of change of the multilateral nominal exchange rate increased substantially during the 1980's (see our working paper version). This is true even for most countries that participated in the European Monetary System during this period.[15] The higher variability of the nominal exchange rate might increase the noise in the relationship we are trying to estimate. The second reason is the general movement toward decentralization that we discussed above. If one reestimates our model without the 1980's, as in column 5 of Table 3, the point estimates of the coefficient of $C2 \cdot LABTAX$ increases substantially, from 0.56 to 0.74, and is now significant at the 5-percent level.

Finally, in Table 4 we test the corollary to Proposition 2 that we discussed in Section II,

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[15] Note that the foregoing statements refer to the yearly variance of the nominal exchange rate, and therefore also reflect the frequent discrete realignments of the fixed parities of several currencies that were a widespread feature of the European Monetary System until 1987. This is entirely consistent with the nominal exchange rate being less variable in the 1980's at higher frequencies, which is certainly true for those countries that participated in the European Monetary System.

subsection D, by dividing total labor taxation into direct taxes on households, *INCTAX*, in column 1 and social security contributions and payroll taxes, *SSTAX*, in column 2. As we argued above, the difference between the coefficients of the tax rate for the *C* and *I* countries is likely to be larger for the latter type of taxes than for the former. This is indeed borne out by our estimates: the difference between the estimates of β_1 and β_2 is large and significant at the 5-percent level in the case of social security taxes (column 2), much smaller and insignificant in the case of direct taxes (column 1). The same pattern emerges even when social security taxes and direct taxes are included separately in the same regression, as in column 3.

V. Discussion and Conclusions

Several features of the model deserve further discussion. The model assumes that both the labor and the goods markets are imperfectly competitive. It is important to separate clearly the role of each of these two assumptions. In a competitive labor market, taxation could still affect the supply of labor if the individual labor supplies were elastic. Empirically, however, one would not expect large effects of fiscal policy through this channel, since the elasticity of the individual supply of labor is generally considered to be quite low (see for instance John Pencavel, 1986). More importantly, allowing for noncompetitive labor markets becomes crucial if one wants to study, as we do in this paper, the role of institutional factors in the transmission of the effects of taxation. In fact, our formalization, that allows for the number of unions to vary, essentially includes competitive labor markets and highly centralized labor markets as particular cases.

Notice that, with labor unions, the aggregate labor supply becomes elastic, even if the individual labor supply continues to be inelastic. In other words, at an internal solution those union members that are employed supply all their fixed endowment of labor ℓ, while unemployed workers do not work. As it is well known, *ex ante* workers are better off organized in a union than in a competitive labor market, for the obvious reason that a union can exploit its monopoly power. *Ex post*, of course, those union members that remain unemployed would prefer to work at the competitive wage, but are prevented from doing so by the presence of the unions.

Unlike the assumption of noncompetitive labor markets, the assumption of imperfectly competitive goods markets is not critical to many of our results. We could have obtained similar effects of fiscal policy on wages under the assumption of perfect competition in the goods market. However, for unit labor costs to respond to taxation, one would have to depart from the standard Cobb-Douglas production function, and use a production function with elasticity of substitution less than 1. This setup, coupled with the other two features of our model—unionized labor markets and the existence of different sectors—would be practically untractable analytically. In addition, the assumption of monopolistic competition with a CES utility function of the Dixit-Stiglitz type lends itself naturally to the definition of sectors and the analysis of sectoral unions. Thus, we feel that our framework has two main advantages over the most natural alternatives. The simplicity of the production side allows one to enrich its labor market and fiscal policy aspects, and to still derive a tractable closed-form solution.

A particularly important point that we left out of our discussion is the endogenous determination of policies. In our paper redistributive fiscal policies are exogenous. A more complete treatment should show how the different groups interact to generate such policies in a political equilibrium. Our model, that implies meaningful conflicts of interest among groups and sectors, can be a useful stepping-stone in this direction.

Endogenizing fiscal policy in our model could also be useful in the context of the literature on tax competition. Such an extension is likely to be nontrivial, for at least two reasons. First, it is clear that the repercussion effects of fiscal policy, and therefore the equilibrium vectors of fiscal policies, now depend on the structure of labor markets in all competing countries, which generates a very large set of possible cases. Second, the literature on international fiscal policy coordination often emphasizes the incentives to use fiscal policy to influence the nominal exchange rate and therefore prices and demand. A meaning-

ful analysis of nominal exchange rates requires introducing nominal rigidities, which again would generate a large set of possible cases because the effects of nominal rigidities would also depend on the structure of labor markets in all countries. For all these reasons, we cannot pursue this extension here. However, we believe our model can be a useful starting point for the analysis of these issues.

Finally, our model seems well equipped to deal with issues of fiscal adjustments and fiscal reforms. As we show in Alesina and Perotti (1995, 1997) on a sample of 20 OECD countries over the 1960–1992 period, fiscal adjustments have very different characteristics—in terms of their success in reducing the debt/GDP ratio permanently, and in terms of their correlation with changes in relative unit labor costs, investment, unemployment, etc.—depending on whether they are achieved by increasing certain types of taxes rather then reducing certain types of expenditures. For instance, for a given reduction in the budget deficit, multilateral unit labor costs fall substantially if the fiscal adjustment is obtained through a cut in wage government expenditure, while they actually increase if the adjustment is implemented mainly via direct tax increases. Similar considerations hold for the change in the unemployment rate and in investment. These and other results are consistent with the model we have presented in this paper, or some immediate extension of it that incorporates investment.

APPENDIX

PROOF OF PROPOSITION 1:

Consider the first-order condition of the union when there are J unions. In a symmetric equilibrium, it can be written as:

$$(A1) \quad H = \frac{w(1 - \tau)}{\bar{P}}(1 - \varepsilon_J - \gamma_J)$$
$$- R\varepsilon_J = 0,$$

where γ_J is the elasticity of $\bar{P}$ to w_j (or, equivalently, p_j) when there are J unions, and ε_J is the absolute value of the elasticity of labor demand to w_j:

$$(A2) \quad \gamma_J \equiv \frac{1}{J} \frac{(w(1 + s_{ER})/\alpha)^{1-\sigma}}{(w(1 + s_{ER})/\alpha)^{1-\sigma} + (1/\alpha^*)^{1-\sigma}}$$
$$= \frac{1}{J} \frac{p^{1-\sigma}}{p^{1-\sigma} + p^{*1-\sigma}};$$
$$\varepsilon_J \equiv \sigma - (\sigma - 1)\gamma_J.$$

To simplify the notation, we set $s_{ER} = 0$ from now on. Let $\eta_{w\tau}$ be the elasticity of the equilibrium wage to the tax rate. Part (i) of Proposition 1 states that $\eta_{w\tau}$ is positive. Part (ii) states that $d\eta_{w\tau}/\partial J$ is negative.

The proof of part (i) is immediate. We have:

$$(A3) \quad \text{sign } \eta_{w\tau} = \text{sign} \frac{dw}{d\tau} = -\text{sign} \frac{\partial H}{\partial \tau} \bigg/ \frac{\partial H}{\partial w}$$

from the implicit function theorem. From the second-order conditions of the problem of the union, we know that $\partial H/\partial w < 0$. Also, clearly $\partial H/\partial \tau > 0$ (recall that $1 - \varepsilon_J - \gamma_J$ is negative). Therefore, $\eta_{w\tau} > 0$.

To prove part (ii), it is useful to simplify the notation by defining the two new variables $\Pi \equiv (w/\alpha)^{1-\sigma}/((w/\alpha)^{1-\sigma} + (1/\alpha^*)^{1-\sigma})$ and $A \equiv 1 - \varepsilon_J - \gamma_J/\varepsilon_J = \sigma - 1 - (\sigma - 2)\Pi/J/\sigma - (\sigma - 1)\Pi/J$. The equilibrium condition (A1) can then be rewritten as:

$$(A4) \quad H \equiv \alpha \Pi^{1/1-\sigma}(1 - \tau)A + R = 0.$$

Differentiating with respect to τ and w, we have, after some passages:

$$(A5) \quad \left[\frac{1}{1 - \sigma} + \frac{\partial \log A}{\partial \log \Pi}\right]$$
$$\times \frac{\partial \log \Pi}{\partial \log w} d\log w = \frac{\tau}{1 - \tau},$$

where

$$(A6) \quad \frac{\partial \log A}{\partial \log \Pi}$$
$$= \frac{\Pi/J}{(\sigma - (\sigma - 1)\Pi/J)} > 0$$
$$\times (\sigma - 1 - (\sigma - 2)\Pi/J)$$

is increasing in Π and decreasing in J, and

$$(A7) \quad \frac{d\log \Pi}{d\log w}$$

$$= \frac{(1 - \sigma)(w/\alpha)^{\sigma-1}}{(w/\alpha)^{\sigma-1} - (1/\alpha^*)^{\sigma-1}} < 0$$

is decreasing in w. Note also that $\partial \log A/\partial \log \Pi$ is smaller than $1/(\sigma - 1)$, so that the term in brackets in (A5) is negative.

Now consider two values of J, J_1, and J_2, with $J_2 > J_1$. We want to show that dlog w from (A5) is larger when $J = J_1$. Since $w(J_1) < w(J_2)$, from (A7) dlog $\Pi/d\log w$ is smaller, in absolute value, when $J = J_1$. A sufficient condition for our result to hold is therefore $\partial \log A/\partial \log \Pi$ to be larger, when $J = J_1$. In this case, the term in brackets in (A5) would also be smaller, in absolute value, when $J = J_1$. For a given percentage increase in τ, dlog w would then have to be larger when $J = J_1$. In fact, from (A6) $\partial \log A/\partial \log \Pi$ is larger, in absolute value, when Π/J is larger, which is indeed the case when J is smaller.

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