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Tax Distortions and the Inter-Industry Wage Structure*

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resumo

Procura-se saber neste trabalho quais os efeitos da distorção salarial inter-sectores na avaliação de reformas fiscais, em especial daquelas que visam reduzir a dispersão nas taxas de tributação indirecta. O modelo utilizado assume uma pequena economia aberta com preços internacionais fixos, tecnologias exibindo rendimentos de escala constantes e despesas do governo fixas em termos reais. As simulações efectuadas mostram que os efeitos positivos sobre o bem-estar dos consumidores são substanciais e independentes da interpretação que possa ser dada à evidência estatística de diferenças salariais inter-sectores após ajustamento para as variáveis representativas do capital humano. As diferenças entre os ganhos obtidos usando estimativas pontuais para as elasticidades de substituição e aqueles que decorrem de um extensiva análise de sensibilidade, revelam que a utilização apenas dos valores centrais das estimativas pode levar a uma grosseira subavaliação dos efeitos de políticas visando uma completa harmonização na tributação indirecta.

resumé / abstract

Cette étude examine les effets de distorsions salariales inter-sectorielles comme élément d'évaluation des réformes fiscales, en particulier celles visant à réduire la dispersion des taux d'imposition indirecte. Le modèle utilisé est basé sur une économie ouverte de petite taille, avec des prix internationaux fixes, des technologies présentant des économie d'échelle constantes et des dépenses publiques fixes en termes réels. Les simulations effectuées montrent des effets positifs substantiels sur le bien-être des consommateurs, indépendamment de l'interprétation que l'on peut donner à la démonstration statistique de disparités salariales inter-sectorielles, après ajustement des variables représentatives du capital humain. Les différences entre les gains obtenus par utilisation d'estimateurs ponctuels pour les élasticités de substitution et ceux qui découlent d'une analyse de sensibilité approfondie, montrent que se limiter à l'emploi des valeurs médianes des estimations peut conduire à une grossière sous-évaluation des effets des politiques visant une complète harmonisation de l'imposition indirecte.

The study examines, in a general equilibrium framework, the welfare cost of tax distortions in Portugal, and determines how alternative labor markets configurations affect policy evaluation; in particular, how they influence the results of first-best reforms. We assume constant returns to scale production with competitive firms and no terms-of-trade effects. Changes in government revenue arising from counter-factual policies are adjusted through an endogenous replacement tax so that government expenditures are fixed in real terms. We found that the welfare gains from first-best reforms and from full uniformity are robust to the introduction of additional structure in labor markets. However, the reported welfare gains, using point estimates elasticities, significantly lie to the left of a distribution drawn from a systematic sensitivity analysis that randomizes all elasticity parameters independently, irrespective of labor market modelling.

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1. Introduction

This study quantitatively assesses the welfare costs of distortionary domestic taxes in Portugal and evaluates the policy implications of inter-industry wage differences, in particular, how alternative explanations for the existing pattern of wage differentials (adjusted for the skill mix) affect the results of first-best type reforms. A general equilibrium methodology is employed on the grounds that policies whose direct and indirect effects will extend to the entire economy are best accounted for in a framework that explicitly incorporates economy-wide interactions.

The model assumes no terms-of-trade effects, a single household, no capital accumulation, and constant returns to scale production with competitive pricing.

Since we are particularly concerned with how government revenues change in response to our policy exercises, we introduce an explicit replacement tax to assure that the government is always able to purchase the initial bundle of government expenditures. The replacement tax can be either a non-distortionary lump-sum tax on consumers (there is no labor-leisure choice) or any other tax instrument present in the model, especially the VAT (total indirect taxes divided by total value added)[1].

The paper is organized as follows. Section 2 describes the general structure of the model, including model calibration procedures and inter-industry wage differences data. In Section 3 we explore the effects of alternative interpretations of the observed inter-sectoral wage distortions on our results. Finally, in Section 4 we draw our conclusions for policy.

2. A Small Open Economy (SOE) Model

2.1 Model structure

We use a computable general equilibrium (CGE) model following Harrison, Rutherford and Tarr (1992). In the basic version of the model, firms maximize profits subject to a constant returns to scale technology. Price-taking firms purchase primary factor inputs (labor and capital) and intermediate inputs (domestic and imported) to minimize the total cost of production. Firms also allocate their output between the domestic and foreign markets along a constant transformation possibilities curve in order to maximize profits. Capital and labor are mobile within the country, but the model can also include other factors such as land or sector-specific capital.

There is a representative consumer who maximizes utility subject to a budget constraint. Neither investment decisions nor government expenditures are modelled. They are both assumed fixed at the benchmark level (1984). The consumer is endowed with capital and labor, and funding for government expenditures is provided by import duties and indirect taxes net of production subsidies. Since government expenditures and the initial government deficit are assumed constant, and government revenues are a function of counter-factual policies, there is an equal-tax-yield constraint. The endogenous proportional adjustment of VAT rates or lump-sum transfers defined through this constraint will assure that the government can always purchase the initial bundle of government expenditures (i.e. the government maintains its utility level unchanged).

Demand for exports and supply of imports are infinitely elastic at given international prices reflecting the small-country assumption in both exports and imports. Thus, the model assumes fixed terms of trade throughout all policy experiments. There is however national product differentiation *a la* Armington. Domestic consumers and firms differentiate between commodities produced abroad and at home which are imperfect substitutes both in consumption and production[2]. Given the assumption of exogenous international prices in both exports and imports,

1 There is indeed in the model a close substitute for the pure lump-sum tax: for VAT changes in the order of 10%, which is the tax multiplier upper bound on the most of our policy exercises, the welfare changes are relatively small (0.1%).

2 For simplicity (and due to limitations of data) the import composition and import-domestic substitution possibilities in investment, intermediate and final demand are identical.

closure with respect to the external account is made in a simple way through an artificial commodity loosely defined as foreign exchange. Price changes of this commodity will assure the maintenance of the initial balance of trade deficit in foreign units. This means that the exchange rate underlying the balance of trade account is assumed to adjust to keep the current account unchanged as a result of a policy simulation.

The model replicates a historical data set (1984) as an equilibrium. The 1984 Input-Output table is the basic data source. The original 49 sectors were then aggregated to 40 sectors, selecting to aggregate the smallest 10 sectors which account for only 8.6% of the value added of the economy in 1984. Table 1 (see below) presents all 40 production sectors along with a 3-letter acronym for latter reference. In Table 1 we also list indirect taxes (loosely called VAT), production subsidies and import tariffs in the benchmark year (1984). The "wage distortions" column is explained in section 2.2. Using benchmark value-added or imports as weights, the average VAT is 15%, the average production subsidy is 1.7%, and the average import tariff is 3.2%. There is obviously considerable dispersion in the VAT rates across sectors, which turns out to be crucial for our welfare evaluation of their distortionary effects.

The 40-sector aggregation comprises the utility function, Armington aggregates, value added functions, Leontief aggregates of intermediate and value added components, and an equal-tax-yield constraint (and eventually a composite import from ROW and EC). Only constant elasticity of substitution (CES) and constant elasticity of transformation (CET) aggregators are allowed in the model. Figure 1 presents the structure of consumption and production with two production sectors. Model equations for a N-sector aggregation are presented in Teixeira, 1993a.

The benchmark values of all relevant elasticities are derived from an extensive literature search and are documented in Teixeira, 1992. There is, of course, lack of data on many elasticity parameters. This is a common feature of large-scale models, and can be partially addressed through extensive parameter perturbation (Section 3.4 below). We do not underestimate however the value of direct parameter estimation, particularly if it provides better bounds for the sensitivity analysis. There is only one representative consumer. We focus on aggregate effects on welfare, noting that redistribution aspects associated with multiple households can be solved under some weak conditions of demand and ownership, and providing there are aggregate (real) income gains (see Harrison, Rutherford and Tarr, 1992: 9). The model extension needed to accommodate multiple households is a relatively straightforward matter if required data are available.

The SOE model is generated with the GAMS software developed by Brooke, Kendrick and Meeraus [1988] and solved with the MPS/GE software developed by Rutherford [1989].

2.2 Wage distortions

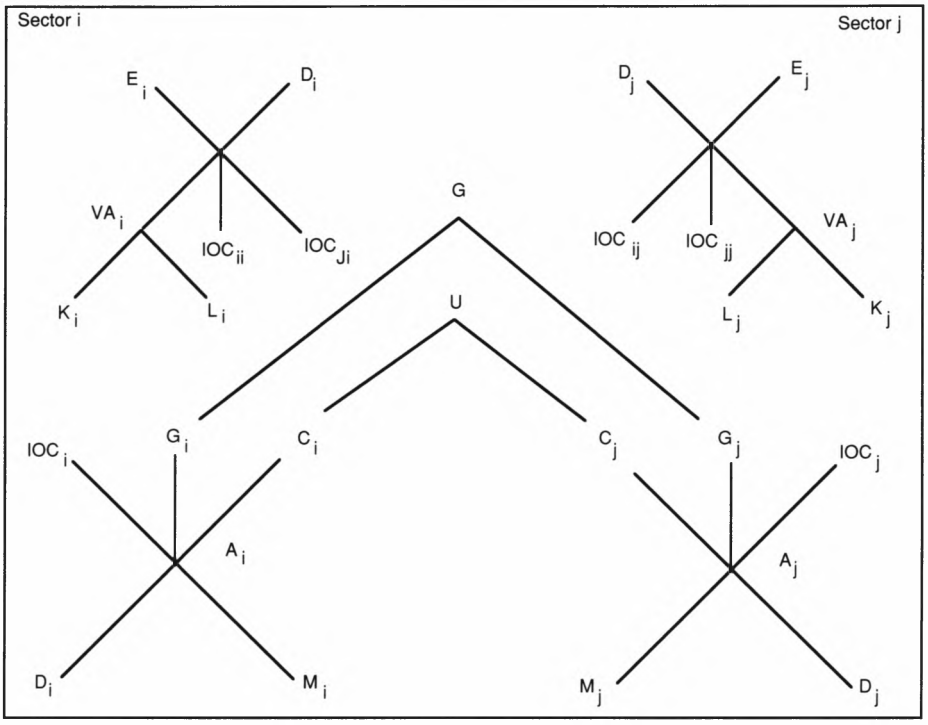
In the absence of wage distortions, all factors of production earn their marginal product and labor is mobile. Hence, the rate of return on labor services is equalized across sectors. Section 3 of the study relaxes this (standard) competitive framework in labor markets introducing inter-industry wage differences.

Three exceptions to the rule of one price in labor markets are provided. The first allows for fixed "tax wedges" on labor services across indusxies. The second takes the wage differences as a result of trade union behavior. The third treats wage differences as reflecting different training technologies across industries and hence different turnover costs.

No direct estimates of wage differentials are provided here. All relevant earnings functions parameter estimates are taken from Kiker and Santos (1990) and Castro and Santos (1991). Using the earnings function parameter estimates, we then normalize the estimated industry wage differentials as deviations from the weighted mean differential. Following Krueger and Summers (1988: 263, fn. 4), we treat the omitted industry variable as having a zero effect on wages, compute the employment-weighted average of wage differentials for all industries, and report the difference between the industry differentials and the weighted average. The resulting key statistic, then, is the proportionate difference in wages between an employee in a given industry and the

average employee. Based on this procedure we compute the estimated wage differentials for 17 industries, which are the raw data for the wage differences estimates shown in Table 1[3]. The estimates for AGR, FOR, and FIS are based on Earnings in Agriculture (Statistical Office of the European Communities, 1988).

Figure 1 - Model Structure



Notes: **U** Utility index; **K**,**L** Factor inputs; **C** Private consumption; **A** Armington aggregate; **VA** Value added; **D** Domestic sales; **M** Imports; **IOC** Intermediate demand; **E** Exports; **G** Government expenditure; **I** Investment.

3. Policy Analysis in the Presence of Wage Distortions

We focused on just three tax reform policies referred to as LIB-ALL, U-ALL and U-VAT. The first exercise liberalizes all distortions by setting them to zero (the "first best" policy); the second sets all domestic and foreign trade distortions equal to their average benchmark value; and the third sets the VAT equal to a uniform value of 15% for all sectors.

Our approach to wage differentials reflects the empirical regularities reported by Krueger and Summers (1988) and Katz and Summers (1989a), who observe that inter-industry earnings differentials persist after controlling for the usual human capital variables, *inter al.* That is, standard competitive models of labor markets cannot fully account for observed differences in inter-industry wages. Observed differences in earnings across industries may of course reflect unmeasured human capital quality. But, assuming a positive association between observed and unobserved quality of labor, inter-industry wage differences ought to narrow sharply with the inclusion of observables such as education, experience, and tenure in the estimation equation.

3 Aggregation procedures are shown in Teixeira (1992).

This is not the case. After controlling for the usual human capital arguments, the fall in the standard deviation of wage differentials is small. Moreover, the analogous argument that industry wage differentials reflect omitted working conditions such as weekly hours, health hazards, commuting time, overtime hours, physical work conditions, and so on, is not supported by the data. Controlling for working conditions does not substantially change either the pattern of industry wages or the standard deviation of the industry (log) wage differentials. Even if it is accepted that wage differences between observationally equivalent workers (workers with similar observed characteristics) can be explained by unobserved characteristics, there is no reason to believe that this relationship should vary across sectors in a systematic manner. In other words, there is no reason to assume a different relationship between observed and unobserved characteristics across industries. Longitudinal evidence also casts some doubt on the hypothesis that inter-industry wage differentials are attributable to unobserved individual heterogeneity. Kruger and Summers (1988) have found that when individual workers move between industries, either by reasons of displacement or voluntary quits, their wage changes mirror existing inter-industry wage differentials. Blackburn and Neumark (1991), testing the unobserved ability hypothesis by incorporating test scores into wage regressions, have also concluded that differences in unobserved ability explain relatively little of inter-industry wage differentials.

As pointed out by Katz and Summers (1989a), even if the proposed (efficiency wage) explanations for the observed pattern of inter-industry wage differences are inadequate, it must be relevant for policy evaluation that, for example, steel workers are typically out of work for nearly a year and end up in other industries earning 25% less, while displaced textile workers usually find a job again within three months and earn about the same on the new job as on the old job. Ultimately, results such as these motivate our empirical enquiry.

This emphasis on possible factor rents, particularly labor rents, is a major departure from the strategic trade policy literature wherein subsidization/protection of some sectors is proposed on the grounds that there are international oligopolistic profits to be exploited by domestic firms. Given the magnitude of labor's share in total value added, the existence of such rents has important allocative consequences and hence strong policy implications. The consequences are two-fold. First, a large share for labor in total value added means that capital rents, if any, are relatively less important. Second, given the possible existence of wage premia in some industries, policies that transfer labor from low wage-low productivity sectors to high wage-high productivity sectors increase output. If, for instance, exports are concentrated in high-wage sectors, it follows that exports subsidies are perhaps to be recommended. Inspection of the structure of Portuguese exports and imports, measured through import penetration and export supply ratios[4], shows unfortunately that exports are predominantly from low-wage sectors while imports are concentrated in high-wage sectors. The policy challenge here is obvious: before policy makers even contemplate the introduction of export subsidies, the very structure of imports and exports has first to be reversed. This very pattern of imports and exports underlies the effects of our counter-factual policies reported in the following sections.

3.1 Exogenous wage differentials

In this section, we simply assume that labor in different sectors is subject to ad valorem taxes levied at different rates. That is, labor services have different user-costs across industries with these "tax wedges" being held constant in all counter-factual experiments. Such wage differences are attributed to sector-specific characteristics without any endogenous modelling of the differences. The wage in the i^{th} sector is then $w_i = w_m\lambda_i$, where λ_i is a coefficient reflecting sector-specific characteristics and w_m is the endogenous wage rate. In this formulation, all workers in a given category have the same productivity, but once allocated to a given industry obtain the sector-specific wage w_i.

4 Import penetration ratios are given by M/(M+Y) and export supply ratios by X/Y, where M is imports, X is exports and Y is gross domestic supply.

Since there are low-wage and high-wage sectors, the results of our policy simulations will be conditional on whether they increase the proportion of workers in high-wage sectors or force more workers into low-wage/low-productivity sectors. However, since our policy exercises rather than target specific sectors are mostly across-the-board reductions or full uniformization packages, the effects of wage distortions hardly make a difference. That is, the gains from either the removal of all distortions or reductions of the dispersion on the indirect taxation regime are strong enough to make any reallocation of workers into the direction of first-best allocations of the second magnitude.

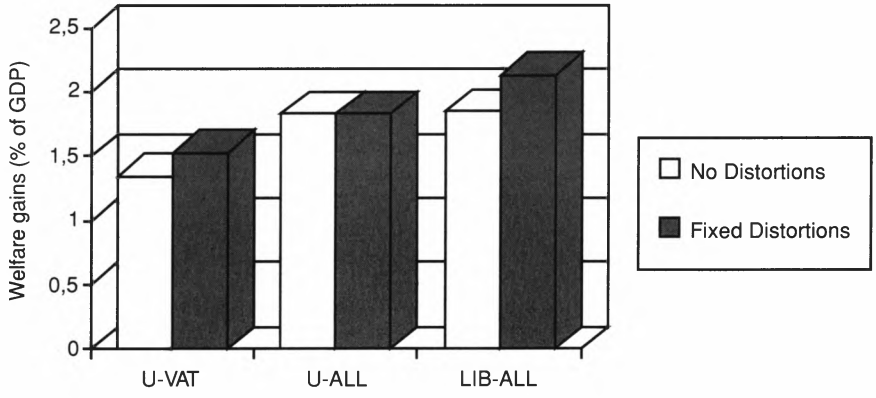
Figure 2 shows the welfare gains of the three tax reform policies under no wage distortions and in the presence of fixed (exogenous) wage distortions. As it is apparent, the introduction of wage distortions generates slightly higher welfare gains in the full liberalization and VAT uniformization packages, and practically no additional improvement in the full uniformization case. Although we do not directly address that issue here, notice that a good fraction of the welfare gains from the first-best reform can be achieved by relatively modest second-best reforms. For example, in the fully competitive model, moving to a uniform set of distortions (U-ALL) generates 98% of the welfare gains of the first-best reform. Moving to a uniform VAT (U-VAT) generates 73% of the possible welfare gains, indicating that the major distortion in the Portuguese economy as modelled here is the dispersion in the VAT rather than its level (Teixeira, 1992; 1993b).

The slight welfare gains increase in the presence of wage distortions is explained by the fact the counter-factual policies actually pull labor away from low-wage sectors. This is particularly clear in the LIB-ALL case, where almost every high-wage sector has gained employment, and almost all sectors with wages lower than the average (i.e. low-wage sectors) have lost employment.

3.2 Assuming wage distortions are determined by trade unions

Our second approach to inter-industry wage differentials treats the coefficients λ_i as a function of trade union behavior. In this formulation unions maximize an objective function reflecting their preferences for employment and wages. The endogenously calibrated wage differentials, λ_i, proxy trade union power, which is the union's ability to extract industry rents arising from unspecified market imperfections in product markets (e.g. regulation limiting entry or full price competition). These rents may also arise whenever unions are able to restrain labor supply even in competitive industries (Farber, 1986). Since the estimated coefficients, λ_i, are ultimately a function of sectoral (derived) labor demands, they will no longer be held constant in the counter-factual exercises as was assumed in Section 3.1.

Figure 2 - Fixed Wage Distortions versus No Wage Distortions



Firms and trade unions are assumed to play the following game: the union selects the wage and management follows by choosing employment under the principle that firms have the "right to manage". That is, the union selects a wage rate to maximize its objective function, and management responds by unilaterally setting employment according to the labor demand curve. Clearly, the solution to this game will depend on the union's objective function and on labor demand parameters.

Trade union preferences are represented by a quasi-concave Stone-Geary utility function $U = (w-w_0)^{\delta} (L-L_0)^{\gamma}$., where δ and γ are relative indicators of the importance of wages and employment, and w_0 and L_0 are reservation values[5]. There are alternative forms based more explicitly on workers' preferences (Addison, 1989; Pencavel, 1985). The major problem in general with objective functions derived from preferences of individual workers is to find a voting rule that guarantees the existence of a voting equilibrium. The main advantage of the Stone-Geary utility index is its tractability.

The game is specified under the assumption that contracts do not typically specify both employment levels and wage rates (declining industries may, for instance, constitute an exception). As is well known, such contracts do not achieve efficiency (Farber, 1986)

Consider w_a the minimum wage that firms have to pay in order to attract workers to the firm. If firms maximize profits

$$\Pi(w,L) \quad \text{s.t.} \quad w \geq w_a, \tag{1}$$

then labor demand is given by L=L(w). Trade unions are assumed to maximize utility

$$U(w) = U(w,L(w)) \quad \text{s.t.} \quad L=L(w). \tag{2}$$

In general, this problem yields $w^* > w_a$, where w^* is the optimal wage.

This equilibrium is inefficient in the sense that alternative contracts can be designed in which both parties are better off, i.e. contracts enabling unions to obtain higher utility and firms to receive higher profits. Since there is evidence that contracts usually do not specify both employment levels and wage rates, we will proceed with the on-the-demand curve, and avoid the contract curve approach[6].

In general, unions will choose among the following set of choices: rent maximization, wage-bill maximization, or some combination of both. It is easily shown that rent, wage, and wage-bill maximization are just particular cases of the more general Stone-Geary function described above.

$$\begin{aligned} &\text{if } \delta=1, \quad \gamma=0, \quad W_0=0 \Rightarrow \text{wage maximization} \\ &\text{if } \delta=\gamma=1, \quad L_0=0 \Rightarrow \text{rent maximization} \\ &\text{if } \delta=\gamma=1, \quad L_0=W_0=0 \Rightarrow \text{wage-bill maximization} \end{aligned} \tag{3}$$

Several empirical studies have shown that unions do not care about wages only (Addison, 1989; Farber, 1986; Pencavel, 1991). That is, the assumptions of rent and wage-bill maximization usually conflict with the data. Nevertheless the finding that unions attach greater weight to employment — than would obtain were they rent maximizers — must be viewed with caution. If employers are very resistant to wage increases in any particular bargaining episode, a narrow focus on wage outcomes (rather than the bargaining process) could lead the analyst to conclude that unions place greater weight on employment than is actually the case.

Note that if unions only care about "insiders" (those currently employed) then little or no weight is given to those who are unemployed. The outcome under this scenario will be a flatter or even

5 Leisure is not an explicit argument in the workers' utility function. Little is lost by making this simplifying assumption (Farber, 1986: 1046).

6 Incentive-compatible contracts are difficult to design and they may be not even be feasible, especially under asymmetric information (Farber, 1986).

horizontal indifference curve. In other words, following a negative shock to employment, the union may raise wage demands up to the point where it is unprofitable for firms to rehire the (now) unemployed workers (Blanchard and Summers, 1986).

We now sketch the derivation of the expression for endogenous wage differential. Let the value added function be

$$VA = [\alpha L^{\rho} + (1-\alpha) K^{\rho}]^{\frac{1}{\rho}}, \quad (4)$$

where L and K are the primary inputs labor and capital. The cost function is then

$$C(p_L, p_K, VA) = VA[\alpha^{\sigma} p_L^{1-\sigma} + (1-\alpha)^{\sigma} p_K^{1-\sigma}]^{\frac{1}{1-\sigma}}, \quad \sigma=\frac{1}{1-\rho}. \quad (5)$$

Applying Shephard's lemma yields the conditional demand function for labor

$$L(p_L, p_K) = [C(p_L, p_K, VA)\frac{\alpha}{p_1}]^{\sigma}. \quad (6)$$

Setting $p_L=w$, the wage in the i^{th} industry becomes $w_i = w_m\lambda_i$, where λ_i reflects the wage distortion introduced by trade union behavior and w_m the endogenous wage rate. Suppose now that workers (normalizing parameters and subscripts being ignored for expositional convenience) maximize the following Stone-Geary utility function

$$MAX\ U = (\lambda w - w_0)^{\gamma} (L - L_0)^{\delta}, \quad (7)$$

subject to

$$L(p_L, p_K) = [C(p_L, p_K, VA)\frac{\alpha}{\lambda w}]^{\sigma}. \quad (8)$$

Substituting equation (8) into equation (7), and imposing $\frac{dU}{d\lambda}=0$, $w_0=w_m$, we obtain the expression for endogenous wage differentials

$$\frac{L-L_0}{L}\frac{\gamma}{\delta\sigma} = \frac{\lambda - 1}{\lambda} \quad (9)$$

L_0 can be then calibrated from equation (9) given that, in the benchmark, L, γ, ρ, δ, σ, and λ are all known parameters.

What, then, can we conclude from assuming that trade unions determine wage differentials?

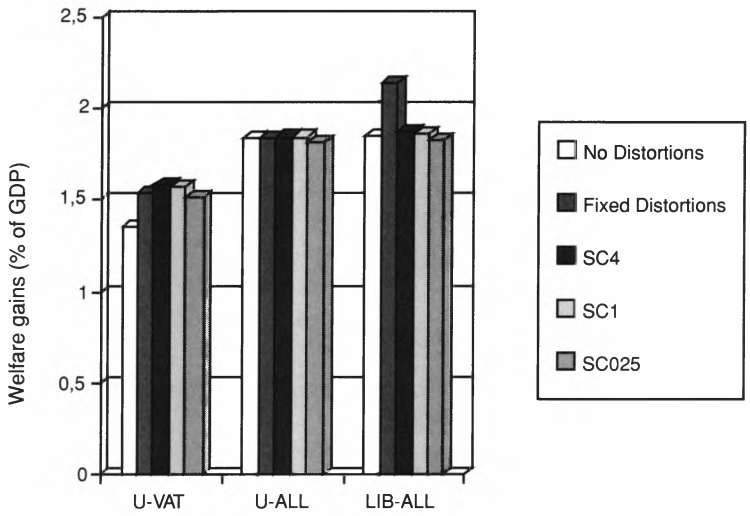
Once observed inter-industry wage differences are endogenized, the relevant policy issue is whether the assumed maximizing behavior by trade unions really makes a difference to outcomes within the framework of the policy packages that were considered in this study. We have argued that trade unions are concerned with both wages and employment. If the economic conditions of a given sector deteriorate, we would expect corresponding changes in inter-sectoral wage differences. Trade unions that are particularly concerned about employment will give relatively more weight to the employment level in their respective objective functions, and may be expected to moderate their wage claims and accept relatively lower wages than otherwise.

In order to assess the consequences of the presence of alternative labor market configurations, we shall focus on (i) welfare effects, and (ii) changes in sectoral employment. The welfare effects associated with each of the three possible labor market scenarios — no distortions or fully competitive case, exogenous or fixed distortions, and endogenous distortions — are presented in Figure 3.

We have also included three scenarios for the endogenous distortions. Lack of data on the weights that unions attribute to employment and wages forced us to proceed in this manner. On SC4 more weight is given to employment ($\delta/\gamma=4$) and on SC025 more weight is given to employment ($\delta/\gamma=0.25$). SC1 is the intermediate scenario ($\delta=\gamma=0.5$). $\delta+\gamma$ is always equal to 1.

To proceed with the exercise, all sectors with positive wage differentials have endogenous wage distortions, and all remaining sectors have fixed distortions. This procedure may sound simplistic, but there is some evidence — from scanty data, we concede — giving support for this procedure. Indeed, using Cerdeira and Padilha (1990) data set on union density, the correlation coefficients between union membership and wage differentials, and between participation in union elections (intended to measure the degree of worker mobilization in the union movement) and union membership are 0.64 and 0.72, respectively. With a few exceptions, it seems that there are few sectors where simultaneously the unionization rate is significantly high and the wage difference is negative.

Figure 3 - The Welfare Effects of Union Behavior



Note parenthetically that unions, rather than being the cause of higher wages, may select high wage industries[7]. For policy purposes this chicken-and-egg problem is irrelevant. In policy terms, it is sufficient to know that there exist "good" and "bad" sectors in the economy, by which we mean high wage-high productivity industries and low wage-low productivity industries. In any event, we believe that the trade union model of the inter-industry wage differences is not the end of the story, and that alternative and perhaps more convincing arguments will have to be introduced to obtain a more complete picture. In the next section we focus on an efficiency oriented explanation for the observed pattern of wage differentials.

As is apparent from Figure 3, the influence of the assumed union behavior is negligible. On the other hand, the different weights given to employment and wages only barely confirm that higher overall benefits are to be expected if unions have greater taste for employment rather than wages. Again, it would have been much easier to determine the welfare impact of alternative union behavior had the counter-factual policy targeted only one or two industries other sectors remaining unchanged (*e.g.* Melo and Tarr, 1991; 1992).

The effects of union preferences on sectoral employment, for all policy scenarios considered, confirm our predictions. That is, the lower the weight given to wages, the greater the changes in

7 The question of whether unions are pro-productive or have rather selected the inherently more productive firms is explored by Addison and Chilton (1993).

employment (and the lower the wage distortions). Of course, given the assumption of a fixed aggregate labor supply, the net change in employment has to sum to zero. Hence, positive changes in some sectors have to be offset by negative changes in other sectors[8]. However, there is no significant additional shift of labor from low wage sectors to high wage sectors after endogenous distortions are introduced (9 out of 19 high-wage sectors have negative employment changes). It follows then that the second-best effect arising from increasing efficiency in labor allocation (reallocation of labor toward high-wage sectors) is the same as under the exogenous distortions case.

To conclude this section, it seems that any gains in welfare arising from eliminating the dispersion in VAT rates, production subsidies, and import tariffs will not be endangered by trade union behavior.

3.3 Endogenous wage differences with labor turnover

We mentioned in Section 3.2 that, rather than being the cause of higher wages, trade unions may have moved into relatively high-wage sectors. Since the initial high wages can reflect efficiency considerations, we explore in this section the hypothesis that high wages are determined by higher industry-specific training costs. The presence of such costs make firms willing to pay a wage higher than would obtain in their absence so as to reduce turnover among trained workers[9].

Within this framework firms do not have the incentive to lower wages even if there is an excess supply of willing applicants waiting in a queue to be hired. Thus, our neoclassical firm has to decide on the wage rate, the quit rate, and the scale of production. Individual workers in turn decide about whether to quit the current job to search for better job alternatives and whether to accept any offers when they are unemployed. Wage differences arise from the fact that the optimal wage for firms to pay will depend on their production/training technologies. It is then natural to suppose that the higher a wage a firm pays, the lower the quit rate and the higher the number of applicants.

Firms bear turnover costs upon hiring new employees. "These are the fixed costs of employment and include recruitment expenditures and other set-up costs as well as firm-specific training such as showing the new employee how to manipulate his machine, where to clock in, and, in general, learning the ropes of the new firm" (Salop, 1973: 322).

The firm controls its labor input (or the quit rate) through its wage policy. If it pays too low a wage it will not attract sufficient applicants. In addition, replacing lost workers can be extremely costly, especially if these workers embody a large amount of training. Since discharges (simple terminations of contracts) of excess labor never occur in equilibrium (discharges are dominated by wage reductions[10]) what remains to be explained is the interrelationship between the wage rate, the quit rate, and training costs. Given the relation between wages and quit/turnover, some firms will follow a high-wage/low-turnover policy, while others will follow a low-wage/high-turnover strategy. The course taken by a particular firm will depend among other things on its particular quit and turnover cost functions as well as the productivity of labor and its expected quit rate, namely, industry characteristics. Approached in this light, firms act as if they are running a training program simultaneously with a standard production activity.

The formal analysis of the quit decision is artificial since it excludes demand uncertainty, layoffs, implicit employment contracts, and other variables, but it allows us to focus on the interaction between experienced and inexperienced workers, and on the effects that firm-specific training costs have on wages.

8 The introduction of a fixed labor supply as opposed to an endogenous labor supply seems to have no significant impact on either employment or welfare changes (Melo and Tarr, 1992: 15).

9 Note that if workers in high-wage sectors are less likely to quit, then they are also more likely to be willing to organize. Also, since unions tend to make employment more stable, they may strengthen the incentives to provide training.

10 Salop (1973: 327).

We now focus on equilibrium wages and employment[11]. New workers must go through a training process immediately following induction. When a new employee joins a firm he does not know its particular nonpecuniary characteristics. These will become known through experience on the job. If the worker is dissatisfied, he quits and joins the unemployment pool to search for an alternative job. Note that even if the new applicant is strictly identical to the lost worker, the firm will have to bear the training cost.

Let training costs be given by $T=T(N)$, where N denotes new workers. The firm's quit rate is $q = q(w/z)$, $q'<0$, where w is its wage rate and z is an index of labor market tightness such as the average wage rate adjusted for the probability of finding a job. It follows that if z is high (high employment) then w/z is low which implies a high turnover. The applicant function is given by $A = a(w/z)$, $a'<0$.

The firm operates in a perfectly competitive output market and chooses a wage of w. That is, the representative firm solves the following decision problem (output price equal to one):

$$\text{MAX } f(E) - w.E - T(N) - F, \text{ s.t.}$$

$$N = q(\frac{w}{z})\,E \qquad (10)$$

$$N \leq A(\frac{w}{z}),$$

where F is the fixed cost associated with the training activity. Assuming that there is always an excess of applicants (the second constraint never binds), the solution vector, $(E,w,N)>\vec{0}$, is then a function of the single exogenous variable z: $E = E(z)$, $w/z = w(z)$, $N = N(z)$.

Each applicant, given that there are A total applicants in the market, observes (w_j,N_j,A_j), chooses a queue, and then maximizes z_j, the expected wage from waiting in firm j's queue, which is equal to $w_j.N_j/A_j$, j=1, ..., n.

The maximizing problem described in equation (10) becomes

$$\text{MIN } E.\{w + T[q(w/z)]\}.$$

Setting $T[q(w/z)] = \theta = \theta(w/z)$, $\theta'<0$, this problem can be written simply as

where τ is the constant marginal training cost per new employee.

$$\text{MIN } w + \tau\theta\,(\frac{w}{z}), \quad \theta'<0, \qquad (11)$$

Making $\theta = \theta(w/z) = \theta(w/w_0)$, where z is taken simply as the average wage w_0, and then assuming the simplest form for this function, i.e. $\theta = w_0/w$, $d\theta/dw_0>0$, substitution into equation (11) yields the endogenous wage rate

$$w = \sqrt{\tau w_0} \ . \qquad (12)$$

Little is known on the extent and nature of training[12]. Furthermore, not much is known on why and how enterprises train, the resource costs and payoffs to training, and whether some labor market structures provide more or different incentives to effective training than others. Presumably, training will vary with age, sex, level of education, and industry. If young workers have higher mobility, firms will tend to offer them little or no training, or training will only be provided after they have proven their stability. There is also evidence that women are less likely to receive formal on-the-job training and/or employer-sponsored outside training; and that better educated workers are

11 Our specification follows Pencavel (1972), and Salop (1973; 1979), while the general equilibrium implementation of turnover costs draws on Rutström (1991).

12 OECD Employment Outlook (1991) provides an extensive survey of enterprise-related training in several OECD countries.

nearly always more likely to receive more training than their less educated counterparts. Enterprise training received by individuals is, moreover, influenced by the formal education taken in schools. Also, if education is a signalling game[13] (e.g. Spence, 1973), those who have greater school-based learning are likely to have more ability to learn additional skills or to acquire them at a lower cost. Thus, education and post-school training would seem to be complements. The obvious consequence is that, on average, less formal schooling limits training opportunities and hence the acquisition of additional human capital. Since the acquisition of human capital impacts earnings, the earnings gap between educated and undereducated groups (the same applies to men versus women) will tend, therefore, to widen further.

First we ought to distinguish between specific and general training. Firm-specific training enhances productivity only in the firm that provides the training, whereas general training can be used in other firms once completed. In the simplest model, firms will never provide general training. This implies that workers will have to pay for general skills. Workers are in general, however, unable to acquire the required amounts of general training. Firms subject to less stringent liquidity constraints, with easier access to capital markets, are in a good position to provide general training, but they need to be sure that their investment will be recouped. Firms will then have to devise wage and compensation schemes that raise job mobility costs. In any event, an infinite mobility cost will be difficult to achieve.

There are no easy ways of allocating training costs. In most cases firms are unable to design contracts that fully protect them from losing their investments in worker training, and the theoretical solution of workers paying for general skills appears not to have been applied very often, perhaps with the exception of beginners or apprentices. As pointed out in the OECD survey (OECD, 1991), the distinction between specific and general training is more theoretical than practical, or at least the line separating the two types of training is much more difficult to draw in practice. The concepts are complementary and conceptually difficult to distinguish.

As already mentioned, one way to "internalize" the investments made is to pay higher wages in order to lower the incentive to quit. Therefore, it may be the case that what determines the amount of training made by a firm is not the nature of the training but, rather, the firm's assessment of the probability that a worker will leave before the investment is recouped.

In sum, there is much to learn about the role of training in labor markets. The data limitations are tremendous and "understanding enterprise training is not simply an issue of comparing quantities of a measure called training" (OECD, 1991: 142).

Now we turn to industry patterns of training. Each industry has its own labor characteristics and its own training needs. According to the model described above, firms maximize profits by choosing the best combination of wages and quit rate. High levels of specific training leads to higher wages for it is the loss of highly trained workers that is particularly harmful to firms.

In the context of our general equilibrium approach, the working assumption is that each industry has a "permanent" quit rate associated with particular characteristics of its labor force so that the lower the quit rate a firm is willing to tolerate, the higher the wage rate (Pencavel, 1972).

According to the OECD survey on enterprise-related training (OECD, 1991), the most significant empirical regularities in training incidence across industries and across countries can be summarized as follows. Non-durable manufacturing industries, such as textiles, clothing, leather, and footwear, tend to have a relatively low incidence of training in most countries. The same obtains for construction, food, hotels and restaurants, and agriculture. By contrast, the financial sector is a high incidence industry in the majority of the cases. Petroleum products, office machinery, electricity, machinery and public services all seem to offer relatively more training. But

13 Even if education is a pure signalling game, that is, even if education does not increase a worker's ability, education is not wasteful because it allows the employer to efficiently allocate (in the separating equilibrium) "low" and "high" ability workers (Rasmusen, 1990: chapter 9).

the fragile nature of the training data, makes comparisons across countries and even across industries hazardous. Consider, for example, the retail sector. This industry is generally associated with high labor turnover, yet its training incidence is typically equal to or even higher than the respective national averages. This may be reflect the measure considered in the OECD study, which takes as its statistical unit the overall incidence of training. Although high turnover encourages employer reluctance to engage in training, it also makes for a continuous training effort, even if it is mostly of short duration.

Very roughly, these rankings match the structure of inter-industry wage differentials as shown in Table 1.

Table 1 - Indirect Taxes (VAT), Production Subsidies (SP), Import Tariffs (T) and Wage Differentials (WD). (Percentages)

ID	Sector	VAT	SP	T	WD
AGR	Agriculture	2.5	0.6	2.2	-10.5
FOR	Forestry	1.2	0.01	0.02	-10.5
FIS	Fishery	3.9	0.2	5.1	-10.5
REF	Petroleum Refining	240.7	1.5	0.2	6.4
EGW	Electricity, Gas & Water	3.1	0.5		30.4
FNF	Ferrous & Non-Ferrous Metals	6.1	0.3	0.6	8.2
ONM	Other Non-Metal Products	5.8	0.2	0.9	2.5
CMA	Construction Materials	7.3	0.7	5.7	2.5
CHM	Chemicals	9.7	2.9	1.5	6.4
FAB	Fabricated Metal Products	3.9	0.3	6.7	4.2
MAC	Non-Electrical Machinery	9.6	0.6	3.6	4.2
ELM	Electrical Machinery	7.9	0.2	8.7	4.2
VEH	Vehicles and Other Transport	45.1	6.9	16.1	4.2
MEA	Meat Processing	8.8	0.01	0.2	-5.2
MLK	Milk	8.8	7.2	1.1	-5.2
CEP	Cereal Products	6.5	0.2	2.3	-5.2
OFP	Other Food Products	6.2	0.3	1.9	-5.2
BEV	Beverages	28.5	0.1	303.4	-5.2
TOB	Tobacco	661.5	0.01	77.1	-5.2
CLO	Textiles & Clothing	4.5	0.2	3.4	-17.5
LEA	Leather & Footwear	4.2	0.2	3.4	-17.5
WOO	Wooden Products	7.5	0.2	2.4	-21.9
PAP	Paper & Printing	6.9	0.5	1.5	-2.6
RUB	Rubber & Plastic Products	28.1	0.03	8.5	-7.6
OMP	Other Manufactures Products	8.2	0.2	5.5	-7.6
CON	Building & Construction	3.3	0.3		-1.9
REP	Recovery & Repair	6.0	0.1	0.3	-1.9
TRD	Wholesale & Retail Trade	48.8	8.5		1.6
RES	Hotels & Restaurants	5.3	0.3		-9.8
INL	Inland Transport	4.1	4.7		6.9
MAT	Maritime & Air Transport	11.7	1.1		6.9
AXT	Auxiliary Transport Services	3.3	4.2		6.9
COM	Communication	5.1	0.1		6.9
BNK	Banking	29.4	4.6		15.3
REN	Rental of Immovable Goods	1.5	1.7		15.3
BSE	Business Services of Education	10.6	1.0		15.3
MSE	Market Services of Education	1.8	0.01		-8.4
MSH	Market Services of Health	1.6	0.01		-8.4
OMS	Other Market Services	74.3	1.9	1.2	-8.4
PUB	General Public Services	0.06	.01		0.6

In Section 3.2 we isolated the effects of trade union behavior from other factors likely to affect inter-industry wage differentials. We proceed in the same manner here. In order to assess the independent contribution of turnover, our CGE implementation takes the observed pattern of wage differences across industries as reflecting optimal responses by firms to different training needs.

Accordingly, the calibration of industry-specific training costs are based on the reported wage differentials and on the benchmark data point. Note that under this scenario wage differences are taken to be endogenous, that is, they are a function of industry conditions as well as overall economic conditions. The tightness of labor markets, for instance, affects the worker's quit decision and hence the firm's optimal strategy mix of wages and quit rate. On the other hand, if the endogenous reference wage w_0 goes down — if the labor market tightness parameter falls — then w_i also falls and the wage premium, w_i-w_0, enjoyed by workers in the i^{th} sector will fall too.

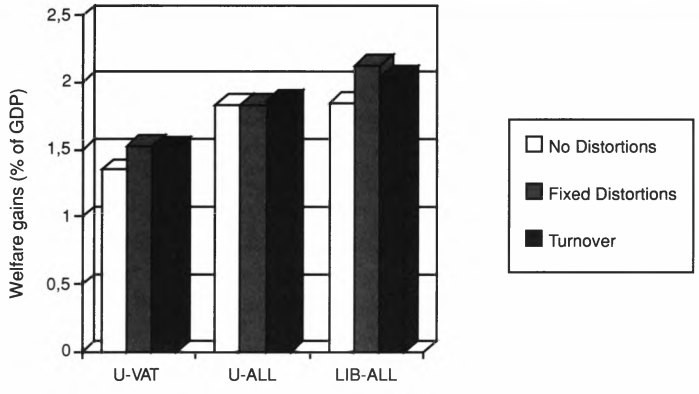
Our reservation wage w_0 is the wage in the low wage-low training sectors, textiles and clothing (CLO) and leather and footwear (LEA). Extending the range of low-training incidence sectors to agricultural sectors, and assigning the latter approximately the same level of training costs, did not materially affect the results.

In this experiment, changes in employment across sectors are mediated by the training activities of each sector. That is, any worker moving from the financial sector to communications, for example, will have to go through a training activity in the latter sector before being fully productive. Since there is no cost-sharing in training costs, all costs arising from firm-specific training are entirely borne by the firm. It is as if firms in the high wage sectors are "charged" twice; besides having higher training costs, they have also to pay higher wages in order to keep their highly trained workers from quiting.

What are, briefly, the main results of the turnover version of the model? We focus again on just three policy exercises (U-VAT, U-ALL and LIB-ALL). They are reported in Figure 4.

The introduction of training costs produces slightly higher welfare gains than the basic model without any wage distortions. This is a common pattern that we have noted throughout the successive versions of the basic model. That is, in the presence of inter-industry wage differences, higher welfare gains are to be expected whenever the counter-factual policies actually pull labor away from low-wage sectors into high-wage sectors — or imply reduced labor turnover in high-wage industries —inducing a second-best reallocation of labor. Virtually all high-wage sectors have higher percentage employment increases (or lower percentage decreases) under the turnover scenario than in the no wage distortions case. The welfare gains under exogenous wage differences and the turnover version of the model are nevertheless much closer to each other.

Figure 4 - Welfare Effects of Labour Turnover



3.4. Sensitivity analysis

Since elasticity parameters play a decisive role in all production and consumption function specifications, and hence influence the results of our experiments, a Monte Carlo simulation is undertaken that randomizes all elasticity parameters independently. The relevant question here is whether or not our reported results are robust to parameter perturbation. The sensitivity analysis described here focuses on the first-best reform (LIB-ALL), and covers all three extensions of the basic model presented in Sections 3.1, 3.2 and 3.3. The welfare results of the sensitivity exercise are shown in Table 2.

In the calibration of the model only point estimates of the relevant parameters were used. As already mentioned, the point estimates were taken from econometric estimations and have known estimated standard deviations. These estimates and their associated distributions (or an a priori distribution if that distribution is not known) are then used in the perturbation exercise. This exercise is undertaken with the MPSS software developed by Harrison (1990), implementing the procedures of Harrison and Vinod (1992).

Table 2 - Sensitivity Analysis

Scenario	Sample Size	PE	Mean	Median	S.D.	P>PE	50% l.b	.50% u.b.
CRTS	2127	1.8	4.4	3.2	4.3	0.74	2.5	8.7
EXOGENOUS	1000	2.1	4.1	3.2	3.5	0.75	2.2	7.5
UNION	1000	2.1	3.2	2.7	1.7	0.66	2.1	4.8
TURNOVER	1000	2.2	4.3	3.4	3.4	0.73	2.5	7.2

The first column of Table 2 identifies the policy scenarios. CRTS is the constant returns to scale case with fully competitive labor markets (the basic model); EXOGENOUS is the scenario with exogenous wage distortions; UNION is the trade union scenario[14], and TURNOVER is the turnover model implementation. The Sample Size column describes the actual number of Monte Carlo runs undertaken under each policy scenario. The Point Estimate column (PE) gives the welfare gains using point estimate elasticities. The three following columns report the mean, median, and standard errors of the sample distribution. P>PE is the probability from the sample distribution that the welfare gain is higher than the point estimate. The remaining columns give the lower and upper bounds of the 50% and 75% symmetric confidence intervals around the median.

Given that we are assuming constant returns to scale production with competitive firms, the first-best policy is simply to remove all tax distortions and replace lost government revenue with a lump-sum tax. What is most notable is the size of the welfare gain when we look at the sensitivity analysis. The average improvement in welfare is 4% and the median improvement is just on 3.1%. These are relatively large welfare gains from the removal of tax distortions, although the size of some of the distortions in VAT rates in Table 1 readily accounts for this.

It is methodologically noteworthy to remark the large disparity between the welfare gains for this first-best reform when we do or do not undertake the sensitivity analysis. The gain is around 2% when we evaluate the new equilibrium using point estimates for all elasticities, but is much higher when we allow these elasticities to vary over a priori plausible ranges. This result is observed on virtually all scenarios, and serves as an important reminder of the need for such sensitivity checks. However, the basic result previously reported — that the introduction of more structure in labor markets does not substantially change the magnitude of the welfare gains associated with just one price in labor markets — seems to be robust, with the exception perhaps of the union formulation.

14 In Section 4.2 we considered three scenarios SC4, SC1, and SC025, according to the different weights given by trade unions to wages and employment in their utility functions. The case reported here corresponds to SC4, a scenario in which unions give more weight to employment.

5. Conclusions

This study assesses the welfare costs of domestic distortions in a small open economy facing fixed terms of trade in both exports and import markets, and in the presence of inter-industry wage differentials. Using independent estimates of inter-industry wage differences, we abandon the rule of one price in labor markets and treat these wage differentials as (i) exogenous distortions arising from unspecified industry characteristics, (ii) endogenous variables reflecting trade union behavior, and (iii) endogenous variables reflecting different training costs across sectors. We found that the welfare gains from first-best reform and from full uniformity are robust to the introduction of additional structure in labor markets. However, the reported welfare gains, using point estimates elasticities, significantly lie to the left of a distribution drawn from a systematic sensitivity analysis that randomizes all elasticity parameters independently.

The finding that adding more labor market structure does not change the magnitude of the results may not stand up under a different set of policy experiments other than across-the-board liberalization or full uniformity in the indirect taxation regime. The additional specifications of labor markets behavior can indeed have a different role if policies are targeted to individual sectors and directly affect labor markets. This issue is not addressed here, but it can be shown (Teixeira, 1992) that if, for instance, turnover costs are assumed to explain the observed pattern of inter-industry wage differences, then a policy that subsidizes "good jobs" — namely, the training costs borne by firms in high-wage industries — produces substantial welfare gains.

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