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Optimal wage setting for an export oriented firm under labor taxes and labor mobility

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Es necesario ensayar una definición de las sociedades actuales, no para construir una sociología global, sino para realizar una observación sociológica situada de la sociedad global.
El supuesto básico de este ensayo es que la globalización es una evidencia de que la sociedad global existe.
Es paradójico que las preguntas simples ¿En qué sociedad vivimos? ¿Cómo podemos vivir en paz nuestras ideas de vida recta y justa? sean las preguntas más complejas de nuestro tiempo. Por supuesto, llama la atención que los autores y editores latinoamericanos, satisfechos con el macondismo, no se planteen ni editen trabajos sobre tales interrogantes.
Por ahora, las respuestas a estas preguntas, apresuradas por el voluntarismo teórico o por las estrategias editoriales, constituyen una constelación de adjetivos articulados al concepto de sociedad, una confusión sumada a la duda sobre la posibilidad de la auto-descripción social.

1. INTRODUCTION

At the beginnings of the 60's the Mexican government established a special program with the goal of attracting foreign direct investment as a policy to encourage the creation of jobs in the north border of the country.[2] The program exempted certain foreign firms of the payment of taxes for temporary factors' imports. This altogether with a significant low cost of Mexican labor gave as a result a successful job creation policy.[3]

The exemption of taxes on tempo-

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[2] The program was called "Program of Industrialization of the North Border".

[3] In Mexico, this type of firms which are subject to taxes on temporary imports are called "maquiladoras". In individual, the maquiladora is considered as an establishment of an economic unit that is a part of the process of final production of a good. The maquiladora is an assembling firm, which is in Mexican territory and by means of a contract, it is commit

rarily imported factors and the low labor cost induced a high concentration of U.S and non U.S firms in the north border of Mexico, because its location minimized the transportation costs of the imported factors. The concentration of the foreign direct investment in the north border cities induced high growth rates of labor demand, with an annual average growth rate for the demand of labor in the period from 1980 and the second quarter of 2002 was 10.63%. As a result the average unemployment rate in the main north border cities in the period between 1987 and the second quarter of 2002 was of 2.18%.[4] Even more surprising the average rate of unemployment for three of the most important cities in the same period was of 1.36%.[5] In other words, in the north border cities with an important concentration of foreign direct investment prevails a situation of full employment, which has generated particular characteristics in its labor markets, one among them; A noticeable labor turnover.

Under the conditions formerly described the wage policy for both domestic and foreign firms in these labor markets plays a very important role. This is so because the optimal wage will be intimately related with the labor's mobility (the labor turnover) which necessarily implies costs.

Labor turnover is costly, the first cost to be noticed is an output's opportunity cost since labor turnover reduces the current level of labor in the firm and hence its output, resulting in a gross profit loss equivalent to the market value of the marginal product of labor.

The other cost associated with labor turnover is the cost for the firm of qualifying a new hired worker with little or none experience in the firm's production process.[6] If the firm's technology is specific this cost might be significant.

From the previously discussed it is of our interest to develop a theoretical model to study the incentives that a labor tax might induce in terms of the optimal wage setting for an export oriented firm. In particular, we analyze the interaction of a

ted with another company, located abroad, to make an industrial process or, to elaborate, or repair merchandise of foreign origin. Once the output is produced or transformed, then it is exported. Given its nature, the assembly plant requires temporary imports, that is the reason why the raw materials and other factors required in the productive process at the most have an authorization of permanence in the country by a determined period of time of a year.

4 There is no available information for previous periods to 1987 for the unemployment rate.

5 These cities are; Tijuana, Ciudad Juarez, and Reynosa.

6 Other costs related with hiring new workers are related with the process of the search and selection of the employees.

labor tax that tends to reduce the wage due the firm is induced to shift backwards the tax burden to its employees minimizing the possible increase in the payroll costs and a fall of profits. However a lower wage *might* not be an optimal response to the establishment of a labor tax because a lower wage might increase the labor turnover and as a result the firm faces both: the output's opportunity cost and the labor turnover cost.

The relevance of the firms' response to a payroll tax relies on: Firstly, an adequate analysis of the firm's incentives that would provide light on the classical analysis of tax incidence which would question: which is the factor that bears the tax burden? And which are the ultimate effects on the firm's behavior? Secondly, on the design of the tax structure. Higher revenue collections can be obtained in the case of an inelastic (or inexistent) response of the firms to a payroll tax due to the presence of high labor mobility. Moreover, the firms' response have also an implication on the equity considerations in the design of tax structure. That is, if the establishment of the payroll taxes reduce the wage then the fiscal burden is primarily borne by the workers since the taxes would regarded as regressive, while if the firm increases the wage the tax liability will fall in the capital owners and the tax will be regarded as progressive. Once a taste for redistribution is included as a parameter affecting the tax structure then a progressive (or regressive) tax will influence the policy maker's decision on the optimal structure of the payroll taxes.

The rest of the paper is organized as follows. Section II includes a brief and selective literature review. The theoretical model that analyzes the interaction of a payroll tax and a tax on the qualification of the workers is shown in section III.[7] Section IV concludes.

2. A BRIEF (SELECTIVE) LITERATURE REVIEW OF TAXES ON LABOR

The persistent level of unemployment in Europe has called the attention to economists about the role of the payroll tax in the determination of labor demand and hence in unemployment. Critics

[7] The motivation for these types of payroll taxes is that many countries use these kinds of payroll taxes, specifically applied to the finance of qualification of workers.

argue that payroll taxation raises the cost of labor, leading to a lower after tax demand for labor services which result is in a higher rate of unemployment. The former analysis considers that even if firms might shift forward (partially or completely) the burden of the payroll taxes then the final goods market price will raise inducing lower output and demand of labor which will tend to increase the rate of unemployment. This is the conventional wisdom from the partial equilibrium analysis.

It is clear that with the establishment of payroll taxes the workers might suffer by either a decrease in labor demand when the firm shifts forward the payroll tax, or/and by a fall in the wage rate that firms will offer after the imposition of the payroll tax when the firm shifts backwards its burden. Consistent with this implication is a recent work by Anderson and Meyer (1997) who presented a theoretical model which incorporates variation in firm taxes both within and across competitive labor markets.

The classical reference for the effects of the taxes on labor is Hausman (1985). Other references include Atkinson and Stiglitz (1980) and Bosworth, Barry and Burtless (1992). On the empirical side see Hammermesh, (1979) and Gruber (1997) who argues that the incidence of the payroll taxes is mixed[8]. For instance the author points out that recent applied research focused in the United States suggests a no disemployment effect. In his article he studied the induced incidence caused by the change in the payroll taxation in Chile, concluding that the shift in financing of social insurance in this country at the beginnings of the 80's had no important repercussions for the efficiency of the labor market.

Now we proceed to characterize the theoretical model.

3. THE MODEL

Assume an economy with two firms, a duopsony, denoted by firms *i* and *j*. The representative firm *i* exports completely its output while its factor's demand is given by a composition of imported and domestic factors. In particular, assume that firm *i* imports the capital and demand the domestic labor. The representative firm *j* is assumed to serve the domestic market and demand domestically capital and labor as well. We consider that both firms seek to maximize its profits with the same technology given by $y_z = f(K_z, L_z)$ for $z = i, j$ which is characterized by

[8] This claim has been rationalized by the general equilibrium analysis undertaken since early 60's.

marginal decreasing returns for all factors of productions, that is, $f_z^{'}(\cdot) > 0$ and $f_z^{''}(\cdot) < 0 \;\; \forall\, z = i, j$.

We consider that the firms face the labor market in the following way:

1) We suppose that there are no costs of job search, that is, the worker has the incentive at any moment to look for another job. Thus, the employees can resign to their work (in any firm *i* or *j*) to look for a better remunerated job.

2) Assume the labor market is competitively imperfect; firms *i* and *j* can affect its flow of vacancies inducing variations in the wage that pay and influencing thus the number of separations of its present employees.

Under these assumptions the total demand of labor depends on the set of labor demand of firms *i* and *j*. On the other hand the labor supply (L_s) depends on the labor force, which is assumed to be fixed, and on the wage offered by the firms. We suppose that the labor supply decision of the workers is positively related with the wage offered by the firms, that is, for a very low wage, workers with a high valuation of leisure will not offer their services in the labor market leading to a high unemployment rate, while for a high wage most of the workers in the labor force are induced to supply their services to the firms. In summary we assume a positively sloped labor supply that is $L_s(w) > 0$ and, $L_s^{'}(w) > 0$, with a maximum capacity of labor supply fixed by the labor force at each period of time. Now we proceed to study the wage setting behavior of the exporter firm *i*.

4. THE EXPORTER FIRM I AND OPTIMAL WAGE SETTING

Assume that the exporter firm sells its output in a perfectly competitive (international) final goods market and the firm maximizes its profits by choosing the optimal level of output and factors' demand. Assume the capital k_i of this firm is imported at price v_t in terms of the foreign currency, while the demand of labor is from the domestic market at price w_i in terms of domestic currency. Assume further that the firm is subject to a proportional tax on labor denoted by t_i.

With respect the labor market consider this is characterized by a high mobility of workers, or in other words, labor turnover. Hence by setting the wage w_i the firm *i* affects its flow of job vacancies by influencing the number of quits of its present employees. That is, the number of quits (let's denote quits by Q_i which are equivalent to the firm's vacancies) might be positive. Since the workers monitor the labor market they might separate from their work in search of a better alternative, if the firms seek to reduce the wage. This means that because of labor turnover ($Q_i >$ 0) the firm can face a difference between the desired (or planned) level of labor (L_{pi}) and the current level of labor (L_{ci}). Hence the number of quits is defined as:

$$Q_i = L_{pi} - L_{ci} \qquad \textbf{(1)}$$

A positive variation in the number of quits necessarily implies costs for the firms since it reduces the current level of labor and hence of output which has a market value of $pf_L\left(K_i, L_i\right)$ where p is the price of the output which is denoted as $f(K_i, L_i)$ and $f_L\left(K_i, L_i\right)$ is the variation of production due, let's say, a reduction of current labor level L_{ci}. Therefore if the export oriented firm has a labor turnover $Q_i > 0$, , the firm will also have an output's opportunity cost given by pf_L (K_i,L_i).

The other cost associated with labor turnover is the cost for the firm of qualifying a new worker with little or none experience, we denote the qualification per unit cost as q which is given in domestic currency (as wages) and use q/e to redefine the per unit cost of turnover in terms of the foreign currency[9]. Moreover we suppose to simplify that q is constant, and e is the real exchange rate (measuring domestic goods in terms of foreign). Thus the cost of labor turnover is expressed by $\frac{q}{e}Q_i$.

Finally assume that the labor turnover is a function of the workers' search for better wages and from the conditions of the labor market. That is we assume that the number of quits in firm i is explained by:

$$Q_i = \alpha\left(w_j - w_i\right)\left(L^D / L^S\right) \qquad \textbf{(2)}$$

From equation (2) we suppose that a differential of wages where the firm j pays a wage $w_j > w_t$, will induce a rotation of personnel from firm i to firm j. On the other hand the quits are also influenced by the situation that prevails in the labor market, for instance, if the labor supply is particularly greater than the demand of work we would have that for a given differential of wages $\left(w_j - w_i\right) > 0$, the firm i would have a low level of labor mobility since the outside's job opportunities for the

9 We consider the cost of qualification of new workers as the time the workers need to learn the production process of the firm instead of being productive. Moreover it is not restrictive to consider that the productivity of the new hired workers is lower than the average increasing thus the cost of a unit produced in the firm.

employees are scarce. The parameter α in equation (2) is the sensitivity of change in labor's turnover in firm *i* for a variation in the difference of wages offered by firms *i* and *j* considering a given labor's demand–supply ratio (L^D/L^S)·.

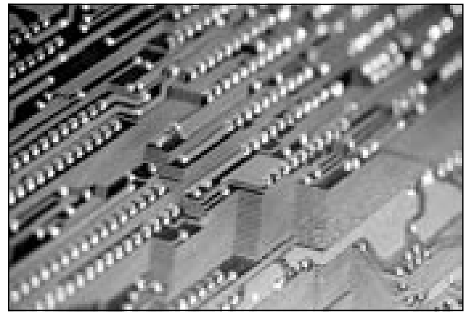
From the former assumptions we have that the cost structure for firm *i* is given by equation (3). The first two terms in (3) are the costs related with labor, where $w_i L_i (1+t_i)/e$ is the payroll cost, t_i is the labor tax and qQ_i / e is the cost related with labor's turnover while $v_i k_i$ is the cost of capital:

$$TC = \frac{w_i(1+t_i)}{e} L_i + \frac{q}{e} Q_i + v_i k_i \tag{3}$$

From the total cost equation we can observe that for firm *i* there is a difference between the labor cost and the wage the firm pays to the workers even in the case in which there is no labor tax (for $t_i = 0$). In this case the unitary labor cost for the firm is given by w_i / e (that is the cost is in terms of the foreign currency) while the return for the worker is w_t (in terms of domestic currency). Let denote this gap as *g*, hence the difference between labor cost and the workers' return for labor services when $t_i = 0$ is

$$g\big|_{t_i=0} = w_i - w_i/e = w_i\left(e - 1/e\right).$$

A higher gap *g* suggests that the



difference between the wage that the worker receives as a return from labor services (w_i) and the labor cost (w_i / e) is more elevated. Clearly the firm has a reduction in labor costs when there is a depreciation of the real exchange rate (that is, assuming for a moment that the domestic and foreign level prices are fixed, then the nominal depreciation is traduced fully as a depreciation of the real exchange rate which means that now it is needed more domestic currency to buy one unit of foreign currency).

The depreciation of the exchange rate implies a positive increase in the difference between the wage and the labor cost which variation is given by $dg/de\big|_{t_i=0} = \frac{w_i}{e^2} > 0$ ·

When a labor tax is established the gap between labor cost and wage received by workers is defined as

$$g\big|_{t_i>0} = w_i - \frac{w_i(1+t_i)}{e} = w_i\left(\frac{e-(1+t_i)}{e}\right)$$

with $dg/de\big|_{t_i=0} = \frac{-1}{e^2} < 0$ ·

The cost of labor is lower when there is a depreciation of the exchanged rate and the difference between the wage paid to workers and the cost of labor under the exogenous increase in e is $dg/de\big|_{t_i>0} = \frac{w_i(1+t_i)}{e^2} > 0$.

The implication of a positive gap ($g > 0$) is that the firm i has more flexibility to manipulate the optimal wage w_i that minimizes the joint costs associated with labor, that is, the optimal wage minimizes the payroll cost $\frac{w_i(1+t_i)}{e}L_i$, the output's opportunity costs and the labor's turnover cost $\frac{q}{e}Q_i$ such that the profits are maximized.

Now we consider the revenue side, the value of the output in the international competitive market for the firm is $pf(K_i, L_i)$ where the price of the goods

$p_i = p$ is given. Since the firms' output is completely exported the revenue function is on foreign currency as well as its profits which are given by π_i.[10]

The firm's objective is to maximize the net profit π_i by choosing simultaneously the optimal labor demand (and hence setting its optimal wage policy). That is the firm seeks to maximize:

$$\underset{\{L_i, w_i\}}{Max} \quad \pi_i = \int \left(pf(K_i, L_i) - \frac{w_i(1+t_i)}{e}Li - \frac{q}{e}Q_i - v_i k_i \right) dL_i \tag{4}$$

Now we characterize the first order condition for the exporter firm for changes in π_i due variations in L_i. The first order condition under the presence of the labor tax $t_i > 0$ is:

$$\left.\frac{\partial \pi_i}{\partial L_i}\right|_{t_i>0} = pf'_{L_i}(\cdot) - \frac{w_i(1+t_i)}{e} - \frac{(1+t_i)}{e}\frac{\partial w_i}{\partial L_i}L_i - \frac{q}{e}\frac{\partial Q_i}{\partial L_i} = 0 \tag{4a}$$

10 Note that the total cost in equation 3 is also specified in terms of the foreign currency.

Equation (4a) states that an increase in labor's demand entails a benefit for the firm because of the extra revenue the firm receives due the increase in output which is valued in the goods market at $pf'_{L_i}(\cdot)$.

difference of wages offered in the market between firms *i* and *j*, inducing a variation in the number of quits. Second the variation, let's say an increase in labor demand from the exporter firm will increase the market ratio L^D/L^S. The formerly discussed effects are formalized by:

$$\frac{\partial Q_i}{\partial L_i} = \alpha\left[\frac{\partial w_j}{\partial L_j}\frac{\partial L_j}{\partial L_i} - \frac{\partial w_i}{\partial L_i}\right]\left(\frac{L^D}{L^S}\right) + \alpha\left(w_j - w_i\right)\frac{\partial\left(L^D/L^S\right)}{\partial L_i} \qquad \textbf{(4b)}$$

However a higher labor demand also entails costs, the variation of labor demand also affects the wage the firm is willing to offer to its employees, the middle part of equation 4a reflects the marginal cost in the payroll. That is the labor cost is a strictly increasing function of labor since it reflects the marginal cost per unit of labor and the effect on the wage of variations in the firm's labor demand. In other words, to increase the current level of labor (L_{ci}) the firm must induce the incentive to the "marginal worker" to supply her labor services by offering a higher wage which also will be the payment for the workers already employed.

The last term in the first order condition (4a) $\frac{q}{e}\frac{\partial Q_i}{\partial L_i}$ shows how changes in labor demand affect the number of quits in the firm. Now we look closer to this relationship, the first to note is that changes in labor demand will affect w_i which in turn will modify the relative

The first term is the effect on the wage policy of firms *i* and *j* of changes in labor demand of the exporter firm, while the second term is its effect on the condition of the labor market due, let's say, an increase in demand for labor from the exporter firm.

The first order condition also reflects the negative effects on profits π_i of the establishment of a tax on labor on the exporter firm, since the tax shits outwards the marginal cost of labor's payroll by a proportion of $t_i > 0$. .

Finally equation (4a) reflects the tradeoff caused by the wage setting behavior of the firm between the cost in the payroll with respect the output and labor mobility costs. To see this consider the desired or planned level of labor as given, $(\overline{L}_{pi})$, then by equation (1) we have that $\frac{\partial Q_i}{\partial L_i} < 0$, which reflects that the cost of having vacancies is now lower (which also means that a lower cost can be seen as having a gain). Therefore equation (4a) reflects that optimality condition which requires that the marginal gain of an extra worker be equal to the marginal cost in the payroll, that is $pf_{L_i}^{;}(\cdot)-\frac{q}{e}\frac{\partial Q_i}{\partial L_i}=\frac{w_i(1+t_i)}{e}+\frac{(1+t_i)}{e}\frac{\partial w_i}{\partial L_i}L_i$.

Due the firm is facing a good's competitive market structure there is no possibility to shift forward the burden of the labor tax to consumers, this might imply a fall in the net profit of the firm. To see this, consider first the optimality condition for the firm i under the absence of the tax, using (4a) and (4b) for $t_i = 0$ we obtain:

$$\pi_i^{;}\Big|_{t_i=0}=\frac{\partial\pi_i}{\partial L_i}\Big|_{t_i=0}=pf_{L_i}^{;}(\cdot)-\frac{w_i}{e}-\frac{1}{e}\frac{\partial w_i}{\partial L_i}Li-\frac{\alpha q}{e}\left[\frac{\partial w_j}{\partial L_j}\frac{\partial L_j}{\partial L_i}-\frac{\partial w_i}{\partial L_i}\right]\left(\frac{L^D}{L^S}\right)-\frac{\alpha q}{e}(w_j-w_i)\frac{\partial\left(L^D/L^S\right)}{\partial L_i}=0 \quad \textbf{(5)}$$

Now let denote the profit maximization level of firm i, under the absence of the labor tax by $\pi_i\big|_{t_i=0}$, and its optimal labor choice as L_i^*, then we have:

$$\pi_i\Big|_{t_i=0}=\int_0^{L_i^*}\pi_i^{;}(w_i,L_i)\Big|_{t_i=0}dL_i \quad \textbf{(5b)}$$

We use the previous result in (5) to re-state the optimality condition (4a) for the case where $t_i = 0$ as:

$$\pi_i^{;}\Big|_{t_i>0}=\frac{\partial\pi_i}{\partial L_i}\Big|_{t_i=0}-\frac{w_i t_i}{e}-\frac{t_i}{e}\frac{\partial w_i}{\partial L_i}L_i=0 \quad \textbf{(6)}$$

Equation (6) concludes that the difference in the marginal profit due the introduction of the labor tax $t_i = 0$ is $t_i > 0$ is $\pi_i^{;}(w_i,L_i)\big|_{t_i>0}-\pi_i^{;}(w_i,L_i)\big|_{t_i=0}=-\frac{w_i t_i}{e}-\frac{t_i}{e}\frac{\partial w_i}{\partial L_i}L_i$.

Similarly the profit maximization level of firm i, under the presence of the labor tax $\pi_i\big|_{t_i>0}$, is (with optimal labor denoted by L_i^{**}).

$$\pi_i\Big|_{t_i>0}=\int_0^{L_i^{**}}\pi_i^{;}(w_i,L_i)\Big|_{t_i>0}dL_i\ .$$

Therefore the total reduction in the profit of the firm because of the establishment of a tax on labor is given by:

$$\Delta\pi_i=\int_o^{L_i^{**}}\pi_i^{;}(w_i,L_i)\Big|_{t_i>0}dL_i-\int_o^{L_i^{*}}\pi_i^{;}(w_i,L_i)\Big|_{t_i=0}dL_i=-\int_0^{L_i^{**}}\frac{t_i}{e}\left(w_i+\frac{\partial w_i}{\partial L_i}L_i\right)dL_i<0 \quad \textbf{(7)}$$

In other words, due the firm is competitive in the final good market p is given, there is no forward shifting, and from equation (7) the burden of the tax must be borne by the capital and/or labor owners.

To analyze the possibility of backward shifting for the exporter firm we need first to characterize the optimal wage policy of the firm in the absence of the labor tax, then to study the incentives that the labor tax induces to the firm in terms of the wage policy taking into account the interaction between firm i and j (the market structure) and the effect of the labor mobility through the labor turnover.

To do so, we characterize the case for the optimal wage policy in which there is a labor tax. We retake the first order condition from equation (6), expressed as:

$$\left.\frac{\partial \pi_i}{\partial L_i}\right|_{t_i>0} = pf'_{L_i}(\cdot) - \frac{w_i(1+t_i)}{e} - \frac{(1+t_i)}{e}\frac{\partial w_i}{\partial L_i}Li - \frac{\alpha q}{e}\left[\frac{\partial w_j}{\partial L_j}\frac{\partial L_j}{\partial L_i} - \frac{\partial w_i}{\partial L_i}\right]\left(\frac{L^D}{L^S}\right) - \frac{\alpha q}{e}(w_j - w_i)\frac{\partial\left(L^D/L^S\right)}{\partial L_i} = 0 \quad \textbf{(6)}$$

From equation (6) we can distinguish the different effects caused by a change in the wage that the firm i offers to workers, in order to evaluate them assume the firm i is considering to increase its labor demand from $L_i^1 > L_i^0$, in order the firm creates the incentives to the workers to offer their services the firm must increase the wage it offers, let's say from $w_i^1 > w_i^0$ where w_i^0 was the initial wage at labor demand of L_i^0 [11]. The increase of both, the wage and the labor demand, have a positive impact over the payroll costs, the effects are denoted in equation (6) by $-\frac{w_i(1+t_i)}{e} - \frac{(1+t_i)}{e}\frac{\partial w_i}{\partial L_i}Li$.

However the increase $w_i^1 > w_i^0$ also affects the relative difference of the wage offered by firms i and j from $\left(w_j^0 - w_i^0\right)$ to $\left(w_j^0 - w_i^1\right)$. As a result there is a negative variation in the labor turnover by reducing the number of quits (vacancies) in firm i, which means that the current level of labor L_{ci} is higher, causing a positive variation of the output which reduces the opportunity cost for the firm of $pf'_{L_i}(\cdot)$ (caused initially by the labor mobility) which is the market value of the marginal product that the firm gains by producing more.

Furthermore the higher wage w_i^1 avoids that current workers quit to their job at firm i lowering the cost for the firm of qualification of new workers (as mentioned before the process of search and selection of the employees could also be considered). The last term of equation

[11] To simplify assume the firm can not wage discriminate, hence its marginal cost of hiring a worker is equal to the average cost of labor.

(4a) reflect this cost by $\frac{q}{e}\frac{\partial Q_i}{\partial L_i}$.

Now we decompose this turnover effect; First the increase of the wage in firm i has an impact on the wage w_j offered by firm j since for the prevailing condition of labor market demand-supply ratio, the firm j might offer a higher wage to avoid observing an increase in its labor turnover.

This is expressed formally by

$$-\frac{\alpha q}{e}\left[\frac{\partial w_j}{\partial L_j}\frac{\partial L_j}{\partial L_i}-\frac{\partial w_i}{\partial L_i}\right]\left(\frac{L^D}{L^S}\right),$$

where $\frac{\partial w_j}{\partial L_j} \geq 0 \;\wedge\; \frac{\partial L_j}{\partial L_i} \geq 0$

Here we have that $\frac{\partial L_j}{\partial L_i} \geq 0$ is the reaction function from firm j to changes in the labor's demand in firm i.

On the other hand due the market structure (the duopsony) the decision of firm i regard its labor demand has an impact on the overall labor demand-supply market condition. In this case for a higher demand of labor in the exporter firm i, the ratio of market's labor demand–supply is higher, formally this is $-\frac{\alpha q}{e}\left(w_j - w_i\right)\frac{\partial\left(L^D/L^S\right)}{\partial L_i}$, where $\frac{\partial\left(L^D/L^S\right)}{\partial L_i} > 0$.

Once considered all the elements, we proceed to characterize the optimal wage setting of the firm i. From the first order condition (equation 6) we conclude that the optimal wage for the case where the labor tax is zero is:

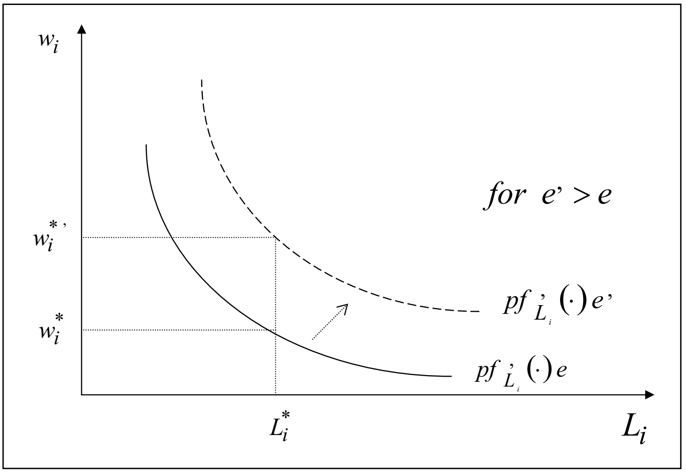
$$w_i^*(e)=\frac{pf_{L_i}^{\prime}(\cdot)e-\frac{\partial w_i}{\partial L_i}Li-\alpha q\left[\frac{\partial w_j}{\partial L_j}\frac{\partial L_j}{\partial L_i}-\frac{\partial w_i}{\partial L_i}\right]\left(\frac{L^D}{L^S}\right)-\alpha q\left(w_j\right)\frac{\partial\left(L^D/L^S\right)}{\partial L_i}}{1-\alpha q\frac{\partial\left(L^D/L^S\right)}{\partial L_i}} \qquad \textbf{(8)}$$

It is worth the trouble to analyze the equation (8) and see that an important element for the exporter firm in the determination of the optimal wage is the effect of an exogenous positive variation in the real exchange rate e; let's say for $e' > e$. Then according equation (8) the market value of the marginal product of labor is now higher under e' since the exporter firm sells its output at foreign currency, while the labor costs are paid in domestic currency. In other words, a depreciation of the exchange rate makes more profitable the contribution of labor in the production function[12]. Hence an optimal response for the exporter firm to an exogenous depreciation of the exchange rate is to increase the wage reducing this

[12] Again, this is so because a depreciation of the real exchange rate for given price levels of domestic and foreign goods is equivalent to exchange more domestic units for one unit of foreign currency. Or in other words one unit of foreign currency "buys" more units of domestic.

way the number of quits and increasing the current level of labor, which results in a reduction of the output's opportunity cost (or alternatively we can considered as the gross profit gain due the current labor in the firm is higher). The formerly discussed is formalized by $\frac{dw_i^*}{de} = pf_{L_i}^{,}(\cdot) > 0$ (see figure No.1). effect are now lower, or alternatively by equation (8) the opportunity cost of a reduction of output because the turnover effect is more significant. Therefore a profit maximizing policy for the firm i, suggests an increase in the wage paid by the firm under a higher exchange rate.

Figure 1
Optimal Wage Setting and Exogenous Changes of the Real Exchange Rate



The optimal response for a change in the real exchange rate $dw_i^*/de > 0$ reflects that for a higher exchange rate the cost of the payroll and the turnover effect are now lower...

Now we characterize the optimal wage for the case where the labor tax is non zero $t_i > 0$, denoting it by $w_i^{**}(e)$. From equation (6) we conclude that:

$$w_i^{**}(e) = \frac{pf_{L_i}^{,}(\cdot)e - (1+t_i)\frac{\partial w_i}{\partial L_i}Li - \alpha q\left[\frac{\partial w_j}{\partial L_j}\frac{\partial L_j}{\partial L_i} - \frac{\partial w_i}{\partial L_i}\right]\left(\frac{L^D}{L^S}\right) - \alpha q(w_j)\frac{\partial(L^D/L^S)}{\partial L_i}}{\left(1 + t_i + \frac{\partial w_i}{\partial L_i}t_i Li\right) - \alpha q\frac{\partial(L^D/L^S)}{\partial L_i}} \quad \textbf{(9)}$$

We can express equation (9) in a more simplified way by relating the optimal wage in the absence of the tax $w_i^*(e)$ from equation (8) with $w_i^{**}(e)$ (where the notation denotes the wage is a function of the exchange rate). That is, by using (8) we can express (9) as:

$$\left[1+t_i-\alpha q\frac{\partial\left(L^D/L^S\right)}{\partial L_i}+\frac{\partial w_i}{\partial L_i}L_i t_i\right]\left[1-\alpha q\frac{\partial\left(L^D/L^S\right)}{\partial L_i}\right]^{-1}w_i^{**}(e)=w_i^*(e) \qquad \textbf{(9a)}$$

Now we define:

$$w_i^{**}(e)=\frac{w_i^*(e)\left[1-\alpha q\frac{\partial\left(L^D/L^S\right)}{\partial L_i}\right]}{\left[1+t_i+\frac{\partial w_i}{\partial L_i}L_i t_i-\alpha q\frac{\partial\left(L^D/L^S\right)}{\partial L_i}\right]} \qquad \textbf{(9b)}$$

From (9b) we have that $t_i+\frac{\partial w_i}{\partial L_i}L_i t_i$ is the shift that the tax on labor imposes in the payroll cost of the firm, while $-\alpha q\frac{\partial\left(L^D/L^S\right)}{\partial L_i}$ is the cost from labor mobility. Now let us assume that before the labor tax is imposed the firm i was setting the profit maximizer wage $w_i^*(e)$. In this case we can re-express (9b) by:

$$w_i^{**}(e)=\frac{w_i^*(e)\left(1-\alpha\ q\frac{\partial\left(L^D/L^S\right)}{\partial L_i}\right)}{\left[t_i+\frac{t_i w_i^*(e)}{\eta}\right]+\left(1-\alpha q\frac{\partial\left(L^D/L^S\right)}{\partial L_i}\right)} \qquad \textbf{(10)}$$

Equation (10) allows us to compare the optimal wage policies $w_i^{**}(e)$ and $w_i^*(e)$ after a labor tax is established, where $\eta>0$ and defines the labor supply elasticity evaluated at $t_i=0$, $-\alpha\ q\frac{\partial\left(L^D/L^S\right)}{\partial L_i}$, is the effect of labor turnover on wage policy, and t_i is the labor tax.

A final manipulation allows us to evaluate equation (10) as the relative ratio between $w_i^{**}(e)$ and $w_i^{*}(e)$ to see that the enforcement of a labor tax leads to $w_i^{**}(e)/w_i^{*}(e) \leq 1$ (see equation 11). The relative ratio of and $w_i^{**}(e)$ depends of the labor demand-supply market condition, the elasticity of supply of labor η, the tax, and of the costs induced by the labor mobility:[13] that its optimal response of the firm results into a lower or at most equal to the optimal wage under the absence of the tax $w_i^{*}(e)$. That is $w_i^{**}(e)$ is bounded above by, therefore $w_i^{**}(e) \leq w_i^{*}(e)$.

Equation (11) also allow us to show the role of the elasticity of labor supply η in the determination of the optimal wage policy under the presence of the labor tax. On this regard consider first

$$\frac{w_i^{**}(e)}{w_i^{*}(e)} = \frac{\left(1 - \alpha\ q\ \dfrac{\partial\left(L^D/L^S\right)}{\partial L_i}\right)}{\left[t_i + \dfrac{t_i w_i^{*}(e)}{\eta}\right] + \left(1 - \alpha q\ \dfrac{\partial\left(L^D/L^S\right)}{\partial L_i}\right)} \qquad \textbf{(11)}$$

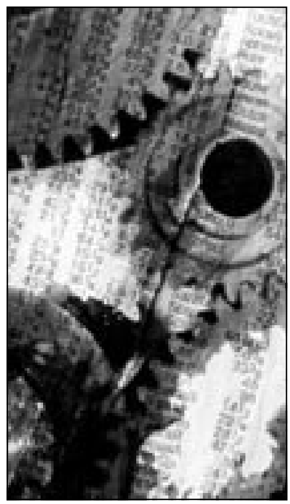
From equation (11) we start by verifying that for $t_i = 0$ we also have that $w_i^{**}(e) = w_i^{*}(e)$, besides from (11) it is easy to see that $\dfrac{w_i^{**}(e)}{dt_i} < 0$ by a backwards shifting effect. That is, the higher the size of the proportional labor tax the lower will be the wage offered to the workers from the export oriented firm.

A non trivial implication of (11) is that even when we consider the costs of labor mobility to explain the optimal wage setting of the exporter firm, we conclude that the elasticity of labor demand is highly inelastic $\eta \to 0$ the equation (11) suggests an optimal wage policy such that $w_i^{**}(e) < w_i^{*}(e)$. In fact as $\eta \to 0$ the ratio of optimal wages $\dfrac{w_i^{**}(e)}{w_i^{*}(e)} \to 0$ implying that the response of the firm to the labor tax is to reduce greatly the wage offered to the workers, since for a highly inelastic labor supply the turn over costs and output's opportunity cost are close to zero due precisely that there is no labor mobility.

On the other hand as labor's supply

[13] Note that in equation (11), $w_i^{*}(e)$ is given (is a constant), so there is no a problem of endogeneity (indetermination).

tends to be perfectly elastic $\eta \rightarrow \infty$ the relative ratio of optimal wages depends in an important manner on α which is the sensitivity of change in labor's turnover in firm *i* for a variation in the difference of wages offered by firms *i* and *j*[14]. In this case $\eta \rightarrow \infty$ can be interpreted as $\partial L_i / \partial w_i \rightarrow -\infty$, which necessarily has an implication about the value of labor's mobility, that is the mobility labor is very elevated since little changes in the wage differentials reduces greatly the current level of workers in the firm. Hence it must be that $-q \frac{\partial Q_i}{\partial w_i} \approx \infty$ and therefore the optimal response of the firm under this condition is to set $w_i^{**}(e) = w_i^{*}(e)$. In other words the optimal response of the exporter firm to the tax on labor under perfect labor mobility is setting $w_i^{**}(e) = w_i^{*}(e)$ due that trying to shift backwards the tax burden will induce an important raise in labor's turnover and output's opportunity costs.



Similarly, for a given labor tax and $\eta > 0$, equation (11) allows us to isolate the effect of labor turnover through the parameter α which measures the response of the quits to wage differentials. For the case in which $\alpha \rightarrow 0$, that is the no labor mobility case, we have that $w_i^{**}(e) < w_i^{*}(e)$ and conclusions derived from the case of the perfect inelastic labor's supply still holds.[15] That is, in this case since the labor turnover and the output's opportunity costs cannot further being reduced by setting $w_i^{**}(e) = w_i^{*}(e)$, the firm optimally decides to reduce the wage to workers.

The model allow us to conclude (from the previously exposed) that

$$lim_{\alpha \rightarrow \infty} \frac{w_i^{**}(e)}{w_i^{*}(e)} = 1,$$

that is when the labor is perfectly mobile the optimal wage offered by the exporter firm after the introduction of the labor tax remains unchanged, $w_i^{**}(e) = w_i^{*}(e)$. In this case if the firm reduces the wage then the increase of both the labor turnover and output's opportunity cost exceeds

[14] Considering a given labor's demand–supply ratio $\left(L^D / L^S\right)$.

[15] This represents the traditional analysis where it is not considered that labor mobility induces costs, resulting in $\frac{w_i^{**}(e)}{w_i^{*}(e)} = 1 \Big/ \left(t_i + \frac{t_i w_i^{*}(e)}{\eta} \right)$

to that of the payroll, therefore the firm internalizes the labor tax as a fall on its profits given by equation (7).

It is worth to make an additional comment about the result that $w_i^{**}(e) \le w_i^{*}(e)$. The underlying reason why the model concludes that the optimal wage under the presence of a tax on the payroll is bounded above by $w_i^{*}(e)$, is because we have assume that the cost of qualification, that the firm offers to the new workers (needed to be hired due to the labor turnover), is not subject to a tax.

However it is of our theoretical interest to suppose a situation where the firm is subject to a tax on the price on qualification for new workers it hires. In this case we have the next lemma.

Lemma. For the case where it is imposed a tax on labor and a tax on qualification denoted by $t_i > 0$, we have that the after tax optimal wage is bounded below by $w_i^{*}(e)$: That is $w_i^{**}(e) \ge w_i^{*}(e)$ if and only if $\frac{t_q}{t_i} \ge \frac{1 + \; w_i^{*}(e)/\eta}{q\,\partial Q_i/\partial L_i}$.

Proof. We start by considering the optimal wage $w_i^{*}(e)$ which is still given by equation (8). Now we take the first order condition under the presence of the labor tax $t_i > 0$ and a tax on the price the firm pays for qualification of the new workers $t_q > 0$. By a similar methodology we used before we obtain:

$$\frac{w_i^{**}(e)}{w_i^{*}(e)} = \frac{\left(1 - \alpha\, q\,\frac{\partial\left(L^D/L^S\right)}{\partial L_i}\right) - \frac{t_q}{w_i^{*}(e)}\left[q\alpha w_j \frac{\partial\left(L^D/L^S\right)}{\partial L_i} + q\alpha\left[\frac{\partial w_j}{\partial L_j}\frac{\partial L_j}{\partial L_i} - \frac{\partial w_i}{\partial L_i}\right]\left(\frac{L^D}{L^S}\right)\right]}{\left[t_i + \frac{t_i w_i^{*}(e)}{\eta}\right] + \left(1 - (1+t_q)q\alpha\,\frac{\partial\left(L^D/L^S\right)}{\partial L_i} - t_q q\alpha\left[\frac{\partial w_j}{\partial L_j}\frac{\partial L_j}{\partial L_i} - \frac{\partial w_i}{\partial L_i}\right]\left(\frac{L^D}{L^S}\right)\right)} \quad \textbf{(L1)}$$

Since $t_q \in (0,1)$, let us assume that $\frac{t_q}{w_i^{*}(e)} \cong 0$ and hence the optimal wage ratio is given by:

$$\frac{w_i^{**}(e)}{w_i^{*}(e)} = \frac{\left(1 - \alpha\, q\,\frac{\partial\left(L^D/L^S\right)}{\partial L_i}\right)}{\left[t_i + \frac{t_i w_i^{*}(e)}{\eta}\right] + \left(1 - (1+t_q)q\alpha\,\frac{\partial\left(L^D/L^S\right)}{\partial L_i} - t_q q\alpha\left[\frac{\partial w_j}{\partial L_j}\frac{\partial L_j}{\partial L_i} - \frac{\partial w_i}{\partial L_i}\right]\left(\frac{L^D}{L^S}\right)\right)} \quad \textbf{(L2)}$$

Which lead us to conclude that $\frac{w_i^{**}(e)}{w_i^{*}(e)} \geq 1$, or equivalently $w_i^{**}(e) \geq w_i^{*}(e)$ if and only if:

$$\frac{t_q}{t_i} \geq \frac{1+\frac{w_i^{*}(e)}{\eta}}{q\alpha\frac{\partial\left(L^D/L^S\right)}{\partial L_i}+q\alpha\left[\frac{\partial w_j}{\partial L_j}\frac{\partial L_j}{\partial L_i}-\frac{\partial w_i}{\partial L_i}\right]\left(\frac{L^D}{L^S}\right)} \qquad \textbf{(L3)}$$

(L3) is equivalent to:

$$\frac{t_q}{t_i} \geq \frac{1+\frac{w_i^{*}(e)}{\eta}}{q\frac{\partial Q_i}{\partial L_i}}$$

which gives the desired result.

Now with the inclusion of the tax on qualification $t_q > 0$ the cost of labor mobility (or equivalently, the cost of having positive vacancies) is strictly higher $\forall\, Q_i > 0$, and the particularity of this shift is that if the firm intends to shift backward the burden of the tax the result is an strictly higher cost of labor turnover since $\partial Q_i / \partial w_i < 0$. Therefore a backward shifting entails a lower wage which in turn results in a raise in labor mobility inducing a higher cost of labor turnover and output's opportunity cost.

Further intuitive conclusions can be derived from (L3); A perfectly inelastic labor supply curve implies that in order we obtain a higher optimal wage as a response of both taxes $t_i > 0$ and $t_q > 0$, the proportion of the tax on workers qualification over the tax on labor should be infinite $\frac{t_q}{t_i} \to \infty$.

One case where $w_i^{**}(e) > w_i^{*}(e)$ because $\frac{t_q}{t_i} \to \infty$ is satisfied, is when we consider simultaneously $t_q > 0 \wedge t_i \approx 0$. As a result of $t_q > 0$ we have that $\forall\, Q_i > 0$ the labor mobility costs is strictly higher, hence $w_i^{*}(e)$ cannot be the cost minimizing choice. At the margin the reduction of labor's mobility and output's costs due to an increase in the wage will dominate its positive effect in the payroll's cost. Therefore a higher wage is an optimal response for a given $\eta > 0$ and $t_q > 0 \wedge t_i \approx 0$.

On the other hand under perfect labor mobility, the optimal wage offered by the exporter firm after the introduction of the labor tax will be higher or at least equal $w_i^*(e)$ to even for a fairly low ratio between the taxes. That is under perfect labor mobility (as $\alpha \to 0$) even for $\frac{t_q}{t_i} \to 0$ we have $w_i^{**}(e) \geq w_i^*(e)$.

5. CONCLUSIONS

We developed a theoretical model which questions whether the backward shifting is an optimal response of an export oriented firm to the establishment of taxes on labor. For an export oriented firm the sales of its production is characterized by an international perfect competitive market and hence the forward shifting is not a choice for the firm. In the model we add an important element, in general ignored, the cost of labor mobility.

As the firm intends to avoid the burden of the tax it reacts by lowering the wage offered to employees, this policy in turn induces that workers move to another job seeking also not to pay the tax burden. This wage policy might be optimal if this process does not involve additional costs.

However when we consider that the workers' reaction to lower wages is high then the current level of labor on the firm will be too low, as a result of backwards shifting, implying that the firm has reduced its production (with a loss of the gross profit equal to the market value of the marginal product of labor). Besides, in the presence of labor's mobility the firm will need to replace part of the labor that quits due to a lower wage. The latter means that the firm will need to qualify the new hired workers. An activity that entails additional costs to the firm.

In the paper it is shown that when the firm is subject *only* to a tax on labor (a payroll tax) its optimal response is to set an after tax wage that is bounded above by the wage that minimizes the costs related to labor before the tax is imposed.[16] In other words in the case where the firm is subject only to tax on labor the optimal response is to shift backwards the burden tax to its employees.

Nevertheless we found that when the firm is subject to both taxes on labor and on qualification, the optimal response of the export oriented firm is to set a wage bounded below by the no tax optimal wage implying that the capital is the factor that bears the payroll tax liability.

That is, since the firm needs to offer qualification to the workers and if this activity is taxed, then the firm is maximizing profits by increasing the wage it pays to employees. This result arises because with the inclusion of the tax on

[16] In this case we consider three costs associated with labor: The payroll cost, the cost related with labor turnover or labor mobility and the opportunity's output cost due labor mobility.

qualification the cost of labor mobility is strictly higher and the particularity of this increased cost is that if the firm tends to shift it backwards it will cause an strictly higher cost of labor turnover since a lower wage will promote labor mobility. Therefore the backward shifting entails a lower wage which in turn results in a raise in labor mobility inducing a higher cost of labor turnover and output's opportunity cost which dominate the fall in the payroll costs due a lower wage. Thus, the firm optimally decides to respond to the qualification and labor taxes by increasing the after tax wage and therefore the capital in this firm will bear the tax burden.

The policy implication from the paper is that a carefully design of the payroll tax composition might increase (decrease) the degree of progressivity of the tax structure once a taste for redistribution has been determined. Indeed, the lemma in the paper provides the ratio of taxes on qualification and on labor that might induce that the payroll taxes be paid primarily by the capital owners (or by the workers) which would increase (decrease) the degree of progressivity of the tax structure.

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