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Long Run Effects of Employment and Payroll Taxes in an Efficiency Wage Model[*]

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Abstract

A long run efficiency wage model with free entry and exit is proposed. It is demonstrated that a balanced-budget substitution of employment taxes for payroll taxes leads to a higher long run equilibrium level of employment.

Keywords: Efficiency wages, long run, employment taxes, payroll taxes, tax equivalence.

JEL: J41, H22.

1. Introduction

In equilibrium models of unemployment, e.g. efficiency wage models, the level of unemployment generally depends on the level of taxes on labor (see e.g. Johnson and Layard (1986) and Pisauro (1991)). Considering labor taxes levied on firms, the tax authorities may choose between employment and payroll taxes where the former is a head tax on the number of employees while the latter is a tax on the cost of labor to firms. Pisauro (1991) has shown in a short run efficiency wage model that the incidence of employment and payroll taxes generally differ and, in particular, that employment taxes lead to less wage restraint than payroll taxes. Extending his model to the long run by allowing for free entry and exit of firms we go one step further and consider whether changes in the composition of labor taxes, balancing the government budget, affect equilibrium unemployment in the long run. Our results reveal that, perhaps somewhat surprisingly given the result

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that payroll taxes lead to more wage restraint than employment taxes, that more extensive use of employment taxes instead of payroll taxes, balancing the government budget, increases the level of employment and decreases unemployment.

2. The Model

The model captures a small open economy consisting of a large number of competitive firms producing a single tradable good whose price is fixed from the world market and normalized at unity. Labor acts as the only productive input.[1] The government provides, in excess of benefits to the unemployed, an exogenously given level of public goods financed through employment and payroll taxes.[2] We use a generalized version of the shirking models in Johnson and Layard (1986), Moene (1995) and Pisauro (1991) where a firm makes a wage offer to workers each period in an infinitely horizon framework. If the wage offer is accepted the workers choose how much effort to provide. Effort cannot be costlessly observed but the firm can, at a cost, monitor the effort of its employees. The firm renews the contract with a worker unless an unsatisfactory level of effort has been observed. The long run or steady-state equilibrium is characterized by free entry and exit of firms to determine the long run equilibrium level of employment.

2.1. Households

Let there be H households in the economy. The representative household maximizes at time t the expected present value of utility, V_t,

$$V_t = E\left(\int_{s=t}^{\infty} e^{-r(s-t)} U_s ds\right), \tag{2.1}$$

where r is the subjective discount rate, E is the expectations operator and U_t is the (instantaneous) utility function of a household[3]

$$U = U(m, 1-e), \tag{2.2}$$

[1] It may seem rather strange to claim long run results in an economy without capital accumulation. It is hard to see, however, how the presence of capital accumulation should influence the choice of the composition of labor taxes, holding the overall tax burden on labor constant. Therefore, the omission of capital as a productive input is merely for simplicity.

[2] Since we only consider balanced-budget tax changes the assumption of exogenously given level of public goods is innocuous.

[3] For simplicity, time subscripts are left out from now on whenever possible. Notice that we implicitly assume that $e = 1$ is the maximum effort that can be provided. For an interior solution $e < 1$ to apply, which we assume throughout the paper, just requires sufficient concavity of the utility function with respect to income, see Pisauro (1991) for further details.

where m is labor income and e is effort.[4] The utility function exhibits the standard properties $\frac{\partial U(m,1-e)}{\partial m} > 0$, $\frac{\partial^2 U(m,1-e)}{\partial m^2} < 0$, $\frac{\partial U(m,1-e)}{\partial(1-e)} > 0$, $\frac{\partial^2 U(m,1-e)}{\partial(1-e)^2} < 0$, and following Pisauro (1991) we assume weak separability between income and leisure, implying that $\frac{\partial^2 U(m,1-e)}{\partial m \partial(1-e)} = 0$. The household chooses effort to maximize the expected present value of utility. Following Moene (1995) we assume that firms can only observe effort through costly monitoring, and if an unsatisfactory level of effort is observed the employment relationship is terminated. The probability of continuation of the relationship, $p = p(e)$, depends positively on the effort provided by the worker, $p'(e) > 0$, but at a decreasing rate, $p''(e) < 0$.[5] If employed the household receives wage income $m = w$, while an unemployed household receives unemployment benefits $m = b$ financed by the government through taxes on labor.

Notice that

$$\frac{dV}{dt} = rE\left(\int_{s=t}^{\infty} e^{-r(s-t)} U_s ds\right) - EU = rV - EU, \tag{2.3}$$

such that by defining V^E (V^U) as the value of V for an employed (unemployed) worker, respectively, we can state the asset equations of an employed and an unemployed worker as[6]

$$rV^E = U(w, 1-e) + (1 - p(e))\left(V^U - V^E\right), \tag{2.4}$$

and

$$rV^U = U(b, 1) + \psi\left(V^E - V^U\right), \tag{2.5}$$

where ψ is the exit probability from unemployment determined in the long run (steady-state) equilibrium by the flow condition that the flows into and out of unemployment are equal. As a consequence, ψ will depend, among other things, positively on aggregate employment, N, $\psi = \psi(N, \cdot)$ with $\psi_N \equiv \frac{\partial \psi(N,\cdot)}{\partial N} > 0$ (see below). It follows implicitly from the specification of the asset equations that a worker who starts out being unemployed receive unemployment benefits, b,

[4] Utility obviously also depends on the level of the publicly provided good, g, but since that level is kept fixed throughout the analysis, g is suppressed in the utility function.

[5] This is obviously a short cut to a full description of the behaviour of firms when effort is only observable at a cost. The full description would involve the amount of resources devoted to monitoring and specification of the wage contract to workers. Completing that description is a topic for future research.

[6] Notice that we implicitly assume that all separations are due to workers being fired when monitored showing too little effort. Exogenous quits could easily be incorporated into the model without affecting the results.

whereafter he obtains a job with probability $\psi(N, \cdot)$. Solving the asset equations for V^E we obtain

$$V^E = \frac{(r + \psi(N, \cdot)) U(w, 1-e) + (1 - p(e)) U(b, 1)}{r (1 - p(e) + r + \psi(N, \cdot))}. \tag{2.6}$$

Maximizing V^E with respect to e we get (after some simple manipulations)

$$\frac{p'(e)(U(w, 1-e) - U(b, 1))}{1 - p(e) + r + \psi(N, \cdot)} - \frac{\partial U(w, 1-e)}{\partial(1-e)} = 0, \tag{2.7}$$

de ning e implicitly as a function of w and N, $e = e(w, N)$. Using 2.7 it is straightforward to show that $e_w(w, N) \equiv \frac{\partial e(w,N)}{\partial w} > 0$, $e_N(w, N) \equiv \frac{\partial e(w,N)}{\partial N} < 0$, $e_{ww}(w, N) \equiv \frac{\partial^2 e(w,N)}{\partial w^2} < 0$ and $e_{wN}(w, N) \equiv \frac{\partial^2 e(w,N)}{\partial w \partial N} < 0$.

2.2. Firms

The production technology is the same in all periods (so time subscripts are left out). Following Johnson and Layard (1986) we assume constant returns to labor in the production function relating output, y, to the input of labor in efficiency units, en

$$y = \theta e n, \tag{2.8}$$

where $\theta > 0$ is the (constant) marginal product of an efficiency unit of labor input. The rm is aware of the household incentive problem regarding the choice of effort, i.e. the rm knows the effort function $e = e(w, N)$. Pro ts are[7]

$$\Pi = \theta e(w, N) n - wn - tn - \tau wn,$$

where t is the employment tax rate and τ is the payroll tax rate. The rm sets wages to maximize pro ts taking into account how effort, e, is affected by the wage offer. The rst-order condition reads

$$\frac{\partial \Pi}{\partial w} = \theta e_w(w, N) - (1 + \tau) = 0. \tag{2.9}$$

Of course, due to the assumption of constant returns to labor we cannot determine the equilibrium level of employment in a single rm, n, but only aggregate employment N (which will be determined by a zero pro t condition, see below).

[7]Notice the difference between aggregate employment, N, and employment in the representative rm, n, and that it is aggregate employment that in uences effort.

2.3. Government

The government collects employment and payroll taxes to cover the provision of the publicly provided good, g, and the expenditures on unemployment benefits, $(H - N)\, b$. Thus, the government budget constraint reads

$$g = \tau w N + t N - (H - N)\, b. \tag{2.10}$$

When changes in taxes are considered g is kept fixed, $dg = 0$, while τ and t are changed simultaneously to produce a constant net tax revenue, $\tau w N + t N - (H - N)\, b$.

3. Equilibrium

Since all firms are equal we consider symmetric equilibria only. As a consequence, all firms offer the same wage and all workers provide the same level of effort, implying that we can treat equation 2.9 as an aggregate equilibrium wage condition. Free entry and exit of firms in the long run allows aggregate employment, N, to be determined by the zero pure profit condition of the representative firm,

$$\Pi = \theta e\,(w, N) - w - t - \tau w = 0. \tag{3.1}$$

For the analysis to be of interest we assume that unemployment prevails in equilibrium, i.e. $N < H$. Finally, to confirm the claim made earlier regarding the dependence of ψ on N, notice that in long run (steady-state) equilibrium the probability of leaving unemployment, ψ, will be determined by the flow condition that the flows into and out of unemployment are equal:

$$(1 - p\,(e))\, N = \psi\,(H - N)\,, \tag{3.2}$$

such that

$$\psi = \psi\,(N, e) = \frac{(1 - p\,(e))\, N}{H - N}, \tag{3.3}$$

with $\frac{\partial \psi(N,e)}{\partial e} = \frac{-p'(e)N}{H-N} < 0$, and $\frac{\partial \psi(N,e)}{\partial N} = \frac{(1-p(e))H}{(H-N)^2} > 0$ as claimed above.

Thus, to determine the long run equilibrium values of w and N we have the two equilibrium conditions

$$\theta e_w\,(w, N) - (1 + \tau) = 0 \tag{3.4}$$

$$\theta e\,(w, N) - w\,(1 + \tau) - t = 0, \tag{3.5}$$

de ning (provided the determinant of the Jacobian is non-zero)[8] equilibrium levels of w and N as functions of the tax rates:

$$w = w(t, \tau) \tag{3.6}$$

$$N = N(t, \tau). \tag{3.7}$$

4. Tax Incidence

The long run equilibrium of the model de nes wages and employment as functions of employment and payroll taxes. The interesting aspect of the model is that the incidence of the two labor taxes differs such that a balanced-budget substitution of one tax for the other generally affects equilibrium employment in the long run. Our main result is stated in the following proposition.

Proposition 4.1. *Employment and payroll taxes are non-equivalent in long run equilibrium. In particular, a balanced-budget substitution of the employment tax for the payroll tax increases employment.*
Proof. *For given amount of the publicly provided good, $dg = 0$, the marginal rate of substitution of the employment tax for the payroll tax is*

$$\left.\frac{d\tau}{dt}\right|_{dg=0} = -\frac{\frac{\partial g}{\partial t}}{\frac{\partial g}{\partial \tau}} = -\frac{N + (w\tau + t + b)\frac{\partial N(t,\tau)}{\partial t} + N\tau\frac{\partial w(t,\tau)}{\partial t}}{wN + (w\tau + t + b)\frac{\partial N(t,\tau)}{\partial \tau} + N\tau\frac{\partial w(t,\tau)}{\partial \tau}}. \tag{4.1}$$

Then, using the equilibrium conditions for w and N, equations 3.6 and 3.7, the effects on employment of a balanced-budget substitution of the employment tax for the payroll tax is

$$\left.\frac{dN}{dt}\right|_{dg=0} = \frac{N\left(w\frac{\partial N(t,\tau)}{\partial t} - \frac{\partial N(t,\tau)}{\partial \tau}\right) + N\tau\left(\frac{\partial N(t,\tau)}{\partial t}\frac{\partial w(t,\tau)}{\partial \tau} - \frac{\partial N(t,\tau)}{\partial \tau}\frac{\partial w(t,\tau)}{\partial t}\right)}{\frac{\partial g}{\partial \tau}}. \tag{4.2}$$

Differentiating the equilibrium conditions 3.4 and 3.5 implicitly and solving for the effects on wages and employment yields

$$\frac{\partial w(t,\tau)}{\partial t} = -\frac{e_{wN}(w,N)}{\theta e_{ww}(w,N)e_N(w,N)} > 0 \tag{4.3}$$

$$\frac{\partial w(t,\tau)}{\partial \tau} = w\frac{\partial w(t,\tau)}{\partial t} + \frac{1}{\theta e_{ww}(w,N)} \gtreqless 0 \tag{4.4}$$

[8] The determinant of the Jacobian is equal to $\theta^2 e_{ww}(w,N)\, e_N(w,N) > 0$.

$$\frac{\partial N(t,\tau)}{\partial t} = \frac{1}{\theta e_N(w,N)} < 0 \tag{4.5}$$

$$\frac{\partial N(t,\tau)}{\partial \tau} = w\frac{\partial N(t,\tau)}{\partial t} < 0, \tag{4.6}$$

implying that

$$\left.\frac{dN}{dt}\right|_{dg=0} = \frac{\frac{N\tau}{\theta e_{ww}(w,N)e_N(w,N)}}{\frac{\partial g}{\partial \tau}} > 0, \tag{4.7}$$

for $\frac{\partial g}{\partial \tau} > 0$, *i.e. when the economy is on the upward sloping part of the net payroll tax Laffer curve.* ■

Notice, that the payroll tax provides better incentives for wage restraint than the employment tax (cf. equation 4.4 where the second term is negative making $\frac{\partial w(t,\tau)}{\partial \tau} < w\frac{\partial w(t,\tau)}{\partial t}$),[9] which could lead to the expectation that more intensive use of payroll taxes instead of employment taxes would increase equilibrium employment. In efficiency wage models, however, wage restraint does not necessarily lead to a high level of employment since effort also depends on wages. From equations 4.5 and 4.6 follows that the employment effects of a unit increase in either of the two taxes are the same, implying that it is in fact the wage moderating effects of the payroll tax leading to an erosion of the payroll tax base that accounts for the superiority of the employment tax in terms of promoting employment. In other words, the marginal rate of substitution of the employment tax for the payroll tax (for given tax revenue) exceeds unity such that for a given increase in the employment tax rate a relatively larger fall in the payroll tax rate is consistent with a balanced government budget. Hence, the level of employment increases.

Another interpretation of the results is available from the recent literature on the incidence of income taxation in labor markets with wage-setting agents where it is generally found that, for a given average tax, the speci cation of tax schedules in uences wages and employment (see e.g. Malcomson and Sartor (1987) for a wage bargaining model and Hoel (1990) for an efficiency wage model). The important implication of wage-setting behaviour in those models is that changes in average or marginal income taxes affect incentives in wage formation very differently, implying that it is the progressiveness of income taxation which matters for wages and employment. A similar interpretation may be given for why employment and payroll taxes affect wage formation differently in our model. Since both taxes are proportional to the level of employment while only payroll taxes depend on the wage rate, the employment tax has a zero marginal tax rate with respect

[9] Pisauro (1991) obtains the same results regarding the effects on wages of changes in employment and payroll taxes in a short run efficiency wage model. He does not, however, consider the effects of simultaneous changes in the two taxes satisfying the government budget constraint.

to wages while the payroll tax has a positive marginal tax rate with respect to wages. Therefore, the incidence of employment and payroll taxes will generally differ in efficiency wage models like ours, but somewhat surprisingly it is the tax that leads to a wage hike that provides the better incentives for job creation.

Finally, our results is to some extent related to those in Albrecht and Vroman (1996) who compare payroll taxation and experience rating in nancing unemployment compensation in an efficiency wage model with heterogenous workers. They conclude, on the basis of numerical solutions to their model, that experience rating where rms contribute to the nance of expenditures on unemployment compensation relative to their contributions to the pool of unemployed, leads to less unemployment than nance of unemployment compensation by a general payroll tax. Although our employment tax is not equivalent to experience rating, especially not in a dynamic context since the employment tax is a tax on a stock while experience rating is a tax on a ow, they are both less dependent on wages than payroll taxation is.

5. Concluding Remarks

We have shown in a shirking efficiency wage model that in the long run employment taxes provide better incentives for job creation than payroll taxes when the same net tax revenue is generated. Since what matters for the non-equivalence of employment and payroll taxes is the wage-setting aspect of the labor market, the non-equivalence part of the result should generalize to other non-competitive labor markets, like unionized labor markets with wage bargaining. However, it is not clear whether the ranking of labor taxes in terms of their effects on employment will generalize to other non-competitive labor markets.

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