

Tax Wedge and Job Distribution in a Directed Search Model

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More Economists agree on that a high tax wedge reduces job creation and output - Prescott (2002, 2004)

International Comparison - OECD

Tax Wedge is defined by

$$\Psi_P = \frac{1 + t_P}{1 - t}$$

where t_P , $P = G, B$, is the payroll tax rate, and t is the income tax rate.

In policy discussion, it is often argued that payroll tax should be replaced by income tax or consumption tax.

However, economists usually say that replacement of payroll tax with income tax is irrelevant.

That is, it does not change employment or output, because the tax wedge is the same.

This Paper

Two Sectors: Good (high productivity) sector and Bad (low productivity) sector, following Acemoglu (2001).

The labor market is frictional.

Search is directed.

There is on-the-job-search from bad to good jobs.

Consider a balanced budget switch from payroll tax to income tax.

- 1 If both the sectors are taxed at a uniform rate, the policy is irrelevant for the distribution of good jobs and bad jobs, or the welfare distribution between workers and firms.
- 2 If the bad sector is taxed at a lower payroll tax rate, and the payroll tax is gradually replaced by the income tax in the good sector,
 - 1 the policy only slightly reduces the tax wedge in the good sector, while it considerably raises it in the bad sector.
 - 2 however, the policy does not affect the distribution of jobs by so much.

There are identical works, of which the population is normalized to one. Unemployed workers enter the labor market and search for jobs.

There are two types of jobs: Good and Bad according to Acemoglu (2001).

Job search is directed.

There is on-the-job search, with which workers switch from the bad job to the good job.

u_G : mass of unemployed workers searching for the good job.

u_B : mass of unemployed workers searching for the bad job.

e_G : mass of workers employed at the good job

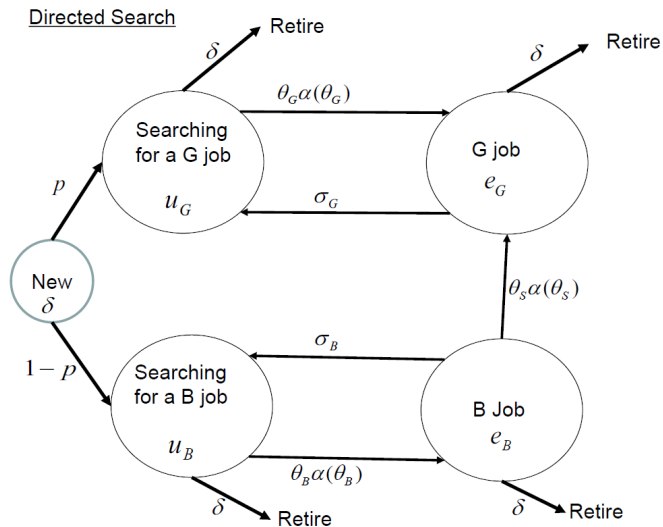
e_B : mass of workers employed at the bad job

R : mass of retired workers, out of the market, die at Poisson rate ϕ .

$$u_G + u_B + e_G + e_B = 1.$$

At each instant, workers retire at Poisson rate δ , and are replaced by new ones, of which a fraction p goes to u_G . (exogenous education)

Transition



Unemployed workers receive benefit b .

Retired workers receive pension h .

Firms pay wage w_i , $i = G, B$, to their employees, and pay payroll tax $t_i w_i$ to the government

Workers receive pre-tax income w_i , $i = G, B$, and pay income tax tw_i .

The government budget constraint:

$$bu + hR = (t_G + t)w_G e_G + (t_B + t)w_B e_B, \quad \text{where } u = u_G + u_B.$$

There are three labor markets, Good, Bad, and On-the-Job Search from Bad to Good jobs.

Search is directed.

θ_i , $i = G, B, S$, is the labor market tightness, which is equal to the ratio of the mass of vacancies to the mass of job searchers.

$\alpha(\theta)$ is the standard matching function.

$$rU_G = b - e + \theta_G \alpha(\theta_G)[W_G - U_G]$$

$$rU_B = b - e + \theta_B \alpha(\theta_B)[W_B - U_B]$$

$$rW_G = (1 - t)w_G + \sigma_G(U_G - W_G)$$

$$rW_B = (1 - t)w_B - e + \theta_S \alpha(\theta_S)[W_G - W_B] + \sigma_B(U_B - W_B)$$

- b is the unemployment benefit. e is the job search cost.
- The discount rate $r = \rho + \delta$: ρ is the time preference rate. δ is the retirement rate.
- A worker employed at a good job receives wages $(1 - t)w_G$ where t is the income tax rate
- A good (bad) job is destroyed by an exogenous shock that comes at Poisson rate σ_G (σ_B).
- $\theta_i \alpha(\theta_i)$, $i = G, B, S$, is the rate at which a worker is employed.

The value U_G for an unemployed worker searching for a good job is written as

$$rU_G = b - e + \theta_G \alpha(\theta_G) [W_G - U_G]$$

where W_G is the value for a worker to work at a good job. b is the unemployment benefit. e is the job search cost.

The discount rate $r = \rho + \delta$: ρ is the time preference rate. δ is the retirement rate.

The value U_B for an unemployed worker searching for a bad job is written as

$$rU_B = b - e + \theta_B \alpha(\theta_B) [W_B - U_B]$$

Once a worker is employed at a good job, his value W_G is written as

$$rW_G = (1 - t)w_G + \sigma_G(U_G - W_G).$$

A worker employed at a good job receives wages $(1 - t)w_G$ where t is the income tax rate and w_G is the pre-tax wage.

A good job is destroyed by an exogenous shock that comes at Poisson rate σ_G .

The value W_B for an on-the-job searcher searching for a good job is written as

$$rW_B = (1 - t)w_B - e + \theta_S \alpha(\theta_S)[W_G - W_B] + \sigma_B(U_B - W_B)$$

where w_B is the pre-tax wage of the bad job, which is destroyed by an exogenous shock that comes at Poisson rate σ_B , as well as by the employee's job search at rate $\theta_S \alpha(\theta_S)$.

Note that $\theta_G \neq \theta_S$ since job search is directed and then the good job market for unemployed workers is separated from the good job market for on-the-job searchers.

$$rV_G = -f + \alpha(\theta_G)[J_G - V_G]$$

$$rV_S = -f + \alpha(\theta_S)[J_G - V_S]$$

$$rV_B = -f + \alpha(\theta_B)[J_B - V_B]$$

$$rJ_G = y_G - (1 + t_G)w_G + \sigma_G(V_G - J_G)$$

$$rJ_B = y_B - (1 + t_B)w_B + \sigma_B(V_B - J_B)$$

- Firms can create a vacancy of the good job by paying cost k , while they can create a vacancy of the bad job for free. f is the cost to hold a vacancy.
- t_G and t_B are the payroll tax rates for the good and bad jobs, respectively.
- (Assumption for simplification) An exogenous shock occurs at Poisson rate δ to force a firm to close its business. Additionally, for a filled job, that shock occurs at the same timing as the employee suddenly retires.

Firms enter the labor market by carrying a vacancy of the good job or the bad job.

The instant product of the good job is higher than that of the bad job, in other words, $y_G > y_B$.

Firms can create a vacancy of the good job by paying cost k , while they can create a vacancy of the bad job for free. The value V_G for a firm carrying a good job vacancy for unemployed workers is written as

$$rV_G = -f + \alpha(\theta_G)[J_G - V_G]$$

where J_G denotes the value of a firm holding a filled good job. f is the cost to hold a vacancy.

Other good firms targets at employees at the bad job.
The value V_S for a firm carrying a good job vacancy for workers on the bad job is written as

$$rV_S = -f + \alpha(\theta_S)[J_G - V_S].$$

Other firms provides vacancies of the bad job. Its value V_B is written as

$$rV_B = -f + \alpha(\theta_B)[J_B - V_B].$$

The value functions of firms with filled jobs, J_G and J_B , are written as follows.

$$rJ_G = y_G - (1 + t_G)w_G + \sigma_G(V_G - J_G)$$

$$rJ_B = y_B - (1 + t_B)w_B + \sigma_B(V_B - J_B)$$

where t_G and t_B are the payroll tax rates for the good and bad jobs, respectively.

(Assumption for simplification) An exogenous shock occurs at Poisson rate δ to force a firm to close its business. For a filled job, that shock occurs at the same timing as the employee suddenly retires.

The three labor market tightness $(\theta_G, \theta_B, \theta_S)$ are determined as follows. First, good firms enter the market until their values equals the investment cost k .

$$V_G = V_S = k. \quad (1)$$

Second, bad firms enter the labor market until their value to create the bad job reaches zero:

$$V_B = 0 \quad (2)$$

Since there are three markets, there could be three wages, which are determined by directed search.

However, we assume that the good firms recruiting employees at the bad jobs will pay the same wage as the good firms recruiting unemployed workers.

Firms carrying a good vacancy attract unemployed workers by committing to pay the highest wage they can pay subject to the constraint that $V_G = k$. This strategy is represented by the tangency condition of the indifferent curves of firms and unemployed workers.

$$\frac{\partial U_G / \partial \theta_G}{\partial U_G / \partial w_G} = \frac{\partial V_G / \partial \theta_G}{\partial V_G / \partial w_G}. \quad (3)$$

Similarly, firms carrying a bad job post a wage such that

$$\frac{\partial U_B / \partial \theta_B}{\partial U_B / \partial w_B} = \frac{\partial V_B / \partial \theta_B}{\partial V_B / \partial w_B}. \quad (4)$$

(3) and (4) are solved for (w_G, w_B) .

Aggregate Welfare

The linear utility implies that the social welfare is equivalent to the sum of the output net of the costs.

$$\Omega = y_G e_G + y_B e_B - e(u_G + u_B) - f(v_G + v_B + v_S)$$

where

$$v_G = \frac{\sigma_G e_G}{\alpha(\theta_G)}, \quad v_B = \frac{\sigma_B e_B}{\alpha(\theta_B)}, \quad v_S = \frac{\sigma_G e_G}{\alpha(\theta_S)}$$

Welfare Distribution

Analysis of welfare distribution across workers and firms is more subtle, if profits are not redistributed from firms to workers. We restrict our attention to the flow welfare again.

The average welfare accrued to workers is defined as

$$\Omega_W = (b - e)(u_G + u_B) + (1 - t)w_G e_G + ((1 - t)w_B - e)e_B + hR$$

The average welfare accrued to firms is defined as

$$\Omega_F = -f(v_G + v_B + v_S) + [y_G - (1 + t_G)w_G]e_G + [y_B - (1 + t_B)w_B]e_B$$

Note that $\Omega = \Omega_W + \Omega_F$.

Replace payroll tax with income tax such that

- 1 (Both sectors are equally taxed) Reduce $t_G = t_B$ and raise t to keep unemployment benefit b and pension benefit h .
- 2 (bad jobs are lower taxed than good jobs) Set $t_B = .1$ and reduce $t_G > .1$ and raise t to keep unemployment benefit b and pension benefit h .

Parameters (no structural estimation)

$$\begin{aligned}r &= .05, \quad \delta = .024, \quad \phi = .04, \quad p = .3, \\a &= 2, \quad c = -.4, \quad \sigma_G = .1, \quad \sigma_B = \sigma_S = .2, \\y_G &= 40, \quad y_B = 20, \quad b = 8, \quad h = 20, \\e &= 1, \quad f = 3, \quad q = 4, \quad k = 15\end{aligned}$$

Both sectors are equally taxed 1

| | | | | | |
|------------|------------|------------|------------|------------|---------------|
| t_G | .19 | .20 | .22 | .24 | payroll tax ↓ |
| t_B | .19 | .20 | .22 | .24 | payroll tax ↓ |
| t | .194 | .188 | .174 | .160 | income tax ↑ |
| w_G | 32.34 | 32.07 | 31.54 | 31.03 | no big change |
| w_B | 12.94 | 12.83 | 12.62 | 12.42 | no big change |
| θ_G | 12.07 | 12.07 | 12.07 | 12.07 | no change |
| θ_B | 14.30 | 14.30 | 14.30 | 14.30 | no change |
| θ_S | .22 | .22 | .22 | .22 | no change |
| u | .014 | .014 | .014 | .014 | no change |
| u_G | .012 | .012 | .012 | .012 | no change |
| u_B | .002 | .002 | .002 | .002 | no change |
| e_G | .966 | .966 | .966 | .966 | no change |
| e_B | .020 | .020 | .020 | .020 | no change |
| R | .600 | .600 | .600 | .600 | no change |

Table: Both Sectors are equally taxed 1

Both sectors are equally taxed 2

| | | | | | |
|------------|------------|------------|------------|------------|-------------------|
| t_G | .19 | .20 | .22 | .24 | payroll tax ↓ |
| t_B | .19 | .20 | .22 | .24 | payroll tax ↓ |
| t | .194 | .188 | .174 | .160 | income tax ↑ |
| w_G | 32.34 | 32.07 | 31.54 | 31.03 | no big change |
| w_B | 12.94 | 12.83 | 12.62 | 12.42 | no big change |
| θ_G | 12.07 | 12.07 | 12.07 | 12.07 | no change |
| θ_B | 14.30 | 14.30 | 14.30 | 14.30 | no change |
| θ_S | .22 | .22 | .22 | .22 | no change |
| Ω | 38.52 | 38.52 | 38.52 | 38.52 | no change |
| Ω_G | 37.46 | 37.46 | 37.46 | 37.46 | no change |
| Ω_B | 1.06 | 1.06 | 1.06 | 1.06 | no change |
| Ψ_G | 1.47 | 1.47 | 1.47 | 1.47 | matches OECD data |
| Ψ_B | 1.47 | 1.47 | 1.47 | 1.47 | matches OECD data |

Table: Both Sectors are equally taxed 2

Bad jobs are taxed at a low rate 1

| | | | | | | |
|------------|------------|------------|------------|------------|------------|----------------------|
| t_G | .14 | .18 | .20 | .26 | .28 | payroll tax ↓ |
| t_B | .1 | .1 | .1 | .1 | .1 | payroll tax constant |
| t | .22 | .20 | .18 | .14 | .13 | income tax ↑ |
| w_G | 33.76 | 32.61 | 32.07 | 30.54 | 30.06 | gradually rises |
| w_B | 14.06 | 14.11 | 14.14 | 14.22 | 14.24 | no big change |
| θ_G | 12.07 | 12.07 | 12.06 | 12.06 | 12.06 | no big change |
| θ_B | 13.81 | 13.36 | 13.14 | 12.54 | 12.35 | no big change |
| θ_S | .22 | .22 | .22 | .22 | .22 | no big change |
| u | .014 | .014 | .014 | .014 | .014 | no change |
| u_G | .012 | .012 | .012 | .012 | .012 | no change |
| u_B | .002 | .002 | .002 | .002 | .002 | no change |
| e_G | .966 | .966 | .966 | .966 | .966 | no change |
| e_B | .020 | .020 | .020 | .020 | .020 | no change |
| R | .600 | .600 | .600 | .600 | .600 | no change |

Table: Bad jobs are taxed at a low rate 1

Bad jobs are taxed at a low rate 2

| | | | | | | |
|------------|------------|------------|------------|------------|------------|----------------------|
| t_G | .14 | .18 | .20 | .26 | .28 | payroll tax ↓ |
| t_B | .1 | .1 | .1 | .1 | .1 | payroll tax constant |
| t | .22 | .20 | .18 | .14 | .13 | income tax ↑ |
| w_G | 33.76 | 32.61 | 32.07 | 30.54 | 30.06 | gradually rises |
| w_B | 14.06 | 14.11 | 14.14 | 14.22 | 14.24 | no big change |
| θ_G | 12.07 | 12.07 | 12.06 | 12.06 | 12.06 | no big change |
| θ_B | 13.81 | 13.36 | 13.14 | 12.54 | 12.35 | no big change |
| θ_S | .22 | .22 | .22 | .22 | .22 | no big change |
| Ω | 38.52 | 38.52 | 38.52 | 38.51 | 38.51 | slightly rises |
| Ω_W | 37.46 | 37.46 | 37.46 | 37.45 | 37.45 | slightly rises |
| Ω_F | .106 | 1.06 | 1.06 | 1.06 | 1.05 | slightly rises |
| Ψ_G | 1.47 | 1.47 | 1.47 | 1.47 | 1.47 | slightly declines |
| Ψ_B | 1.42 | 1.37 | 1.35 | 1.29 | 1.27 | rises |







Table: Bad jobs are taxed at a low rate 2






Results (Summary)

- 1 If both sectors are equally taxed, replacing payroll tax with income tax under the constant transfer policy is neutral in the sense that it does not affect the job distribution (T1) or the tax wedge (T2).
- 2 If the bad sector is taxed at a lower rate, reducing the payroll tax rate and raising the income tax rate in the good sector,
 - 1 slightly reduces the tax wedge in the good sector, and considerably increases the tax wedge in the bad sector (T3),
 - 2 while it does not affect by so much the job distribution or the labor market tightness (T4).

- 1 There might be multiple equilibria.
- 2 In this model, the replacement of payroll tax with income tax changes the tax wedges, while it does not affect the job distribution by so much, Are there any evidences?
- 3 Employment protection should be considered simultaneously as in Blanchard and Tirole (2005).

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