Commuting, congestion and the taxation of work trips

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Background literature

- Optimal taxation and externalities (Sandmo 1975), Bovenberg-Goulder (AER 1996), Cremer-Gahvari-Ladoux (JPubEc 1998))
- Bargaining and (environmental) externality taxation (Bayundir-Uppman and Raith (EER 2003), Schöb (2005))
- Congestion taxes and competitive labour markets: Mayeres-Proost (JPubEcs 1997), Parry-Bento (ScanJEcs 2001), Van Dender (ScanJEcs 2003)
- Bargaining models and congestion: De Borger (2009), De Borger and Wuyts (2009)

Motivation

- Commuting is a large fraction of peak-period transport demand
- Congestion and congestion tolls are likely to affect labour market outcomes
- How should work and non-work trips be taxed?
- Does the structure of the labour market affect labour market responses to congestion and congestion tolls?
- Does the structure of the labour market affect optimal congestion policies?

Overview of the rest of the lecture

- Competitive labour markets
  - Taxing labour and transport trips
- Bargaining models
  - Transport taxes, congestion and union preferences
  - Subsidize commuting?
  - Extensions: telecommuting
- Some illustrative numerical results
- Conclusions

Part I: Competitive labour markets

- **Assumptions simplest version of the model (Parry-Bento (SJE (2001))**
  - **Wage is determined on competitive labour market; exogenous to the individual**
  - **All trips are commuting trips: peak period transport conditions**
  - **Perfect complimentarity commuting and labour supply**
  - **Two transport modes: congested road and uncongested public transport (e.g., metro)**
  - **No formal spatial dimension (e.g., Borck-Wrede (JUE (2005))**
  - **No distributive concerns**

Structure of the model I

- **Utility defined on consumption good (C), leisure (N), and road (R) and public transport (P) use**

$$U = u(C, N) + T(R, P),$$

- **Days of (fixed hours) labour supply (L) equals commuting round trips**

$$L = R + P.$$

- **Time constraint**

$$\bar{L} = N + L + \pi R + \phi P,$$

- **Public transport is uncongested; time per trip ϕ fixed**
- **Road congestion function**

$$\pi = \pi(R),$$

Structure of the model II

- Government levies taxes on labour and commuting by road, adn it provides lump sum transfer
- Commuting by public transport remains untaxed
- Budget constraint individual

$$C + \tau R = (1 - t)L + G$$

- Government budget constraint

$$tL + \tau R = G$$

Behavior consumers

- **Treat congestion as exogenous**
- **Maximizing behavior implies generalized costs of road and public transport are equal**

$$\pi\frac{u_N}{u_C}-\frac{T_R}{u_C}+\tau=\phi\frac{u_N}{u_C}-\frac{T_P}{u_C}$$

- **Demand and labour supply functions**

$$R=R(\tau,\ t,\ G,\ \pi)\quad P=P(\tau,\ t,\ G,\ \pi)\quad L=L(\tau,\ t,\ G,\ \pi)$$

Welfare effect of increase in congestion toll financed by labour tax I

- **Indirect utility**

$$V(\tau, t, G, \pi) = \max_{\{C,N,R,P\}} u(C, N) + T(R, P) + \lambda\{G + (1-t)L - C - \tau R\}$$
$$+ \gamma\{\bar{L} - (1+\pi)R - (1+\phi)P - N\},$$

- **Utility change of congestion toll recycled via labour tax**

$$\frac{dV}{d\tau} = \frac{\partial V}{\partial \tau} + \frac{\partial V}{\partial t}\frac{dt}{d\tau} + \frac{\partial V}{\partial \pi}\pi'\frac{dR}{d\tau}$$

- **Differentiate government budget restriction**

$$\frac{dt}{d\tau} = -\frac{R + \tau\dfrac{dR}{d\tau} + t\dfrac{dL}{d\tau}}{L} < 0$$

Welfare effect of tax reform

- **Welfare effect can be written as (using envelope and government budget constraint)**

$$\left\{\pi' R \frac{u_N}{u_C} - \tau\right\}\left\{-\frac{dR}{d\tau}\right\} + t\frac{dL}{d\tau}$$

- **Trades off distortions on road transport (deviation toll and marginal external cost) and labour markets (labour tax)**

Employment effects of congestion toll I

- **Change in labour supply**

$$\frac{dL}{d\tau} = \overset{-}{\frac{\partial L}{\partial \tau}} + \left\{ \overset{+}{\frac{\partial L}{\partial t}} \frac{dt}{d\tau} \right\} + \left\{ \frac{\partial L}{\partial \pi} \overset{+}{\pi'} \frac{dR}{d\tau} \right\}$$

- **Direct effect reduces return to working relative to leisure**
- **Tax recycling effect raises employment**
- **Lower congestion reduces time cost of going to work and raises labour supply**

Employment effects of congestion toll II

- **Using government budget restriction and substituting we find:**

$$\frac{dL}{d\tau} = \frac{-\left\{\frac{\partial L}{\partial t}\overset{+}{\frac{dR}{d\tau}}\frac{\tau}{L}\right\} + \left\{\frac{\partial L}{\partial \pi}\overset{+}{\pi'}\frac{dR}{d\tau}\right\}}{1 + \frac{t}{L}\frac{\partial L}{\partial t}}$$

- **In absence of congestion, employment effect plausibly negative**
- **Congestion has opposite effect, implying more favorable employment effects**
- **Numerical analysis suggests effects may be positive**

Employment effects of different recycling instruments

- **Lump sum transfer**

$$\frac{dL}{d\tau}=\overset{-}{\frac{\partial L}{\partial \tau}}+\left\{\overset{-}{\frac{\partial L}{\partial G}\frac{dG}{d\tau}}\right\}+\left\{\overset{+}{\frac{\partial L}{\partial \pi}\pi'\frac{dR}{d\tau}}\right\}$$

- **Less favorable employment effects: recycling effect plausibly negative**
- **Public transport subsidies**

$$\frac{dL}{d\tau}=\overset{-}{\frac{\partial L}{\partial \tau}}+\left\{\overset{+}{\frac{\partial L}{\partial s}\frac{ds}{d\tau}}\right\}+\left\{\overset{+}{\frac{\partial L}{\partial \pi}\pi'\frac{dR}{d\tau}}\right\}$$

- **Recycling effect positive but (assuming equal congestion effects) smaller than for labour tax recycling**

Optimal taxation

- **Optimal congestion toll equals marginal external cost**

$$\tau^* = \pi' R u_N / u_C$$

- **Based on particular assumptions**
  - **Zero tax on public transport**
  - **Specific separability**
  - **Implied assumption of wage elasticities of road and public transport**

Optimal taxation in a model with multiple trip purposes

- **Consumer cares about consumption (0), leisure (N), leisure and commuting trips by road (1,3), leisure and commuting trips by public transport (2,4)**

$$u = U(q_0, q_1, q_2, N) + T(q_3, q_4),$$

- **Constraints**

$$(1 - t_L)L + S = q_0 + \sum_{i=1}^{4} p_i q_i \quad [\lambda]$$

$$\overline{L} = N + L + \sum_{i=1}^{4} a q_i \quad [\gamma]$$

- **Perfect complimentarity** $L = q_3 + q_4$

Prices and congestion

- **Transport prices**

$$p_i = c_{car} + t_i \qquad (i = 1, 3)$$

$$p_i = t_i \qquad (i = 2, 4)$$

  - **Car use: resource cost plus tax**
  - **Public transport use: fare**

- **Congestion**

$$a = a(F)$$

$$F = \sum_{i=1}^{4} \alpha_i q_i \qquad \alpha_1 = \alpha_3 = 1 \text{ and } (\alpha_2 = \alpha_4) < 1$$

The optimal tax problem

- **Max indirect utility of typical individual s.t. government budget restriction**

$$\Im = V(t_L; t_i, i=1,\ldots,4; a; S) + \mu\left(\sum_{i=1}^{4} t_i q_i + t_L L - \sum_{i=2,4} c_{bus} q_i - S\right).$$

Optimal (differentiated) tax rules

- **Optimal transport taxes satisfy:**

$$\frac{t_i + \delta_{Li} t_L}{p_i} = \underbrace{\theta \frac{1}{\varepsilon_{ii}}}_{\text{Ramsey}} \underbrace{- \frac{1}{p_i} \sum_{\substack{j=1 \\ j \neq i}}^{4} \frac{\varepsilon_{ji}}{\varepsilon_{ii}} \frac{q_j}{q_i} \left(t_j + \delta_{Lj} t_L - \delta_{pj} c_{bus} - \frac{\gamma}{\mu} \alpha_j d' F \right)}_{\text{Trip interaction}}$$

$$+ \underbrace{\frac{\gamma}{\mu} \frac{d' F}{p_i}}_{\text{Pigou}}, \quad i = 1, \ldots, 4,$$

$\delta_{Li} = 1$ for $i = 3, 4$

$\delta_{bus,\ i} = 1$ for $i = 2, 4$

$$\theta = (1 - \mu/\lambda)/(\mu/\lambda)$$

Interpretation

- Tax indeterminacy for commuting (3,4)
- External cost, Ramsey, trip interaction terms
- Trip interaction reflect deviations of taxes from external cost in other transport services

Zero cross elasticities between leisure and commuting

- **Tax rule car commuting (idem for bus)**

$$\frac{t_3 + t_L}{p_3} = \underbrace{\left[\frac{\varepsilon_{44}}{\varepsilon_{33}\varepsilon_{44} - \varepsilon_{43}\varepsilon_{34}} - \frac{p_4 q_4}{p_3 q_3}\frac{\varepsilon_{43}}{\varepsilon_{33}\varepsilon_{44} - \varepsilon_{43}\varepsilon_{34}}\right]}_{R_3}\theta + \frac{\gamma}{\mu}\frac{d'F}{p_3}$$

- **Ramsey weights related to elasticity labour supply (w is weight)**

$$\frac{1}{\varepsilon_{LL}} = wR_3 + (1-w)R_4$$

- **Ramsey weights more important when low elasticity of labour supply**
- **Tax commuting less when taxing it would strongly affect labour supply**

Zero cross elasticities between transport modes

- **Tax rule car commuting (idem bus):**

$$\frac{t_3 + t_L}{p_3} = \left[\frac{1}{\varepsilon_{33}}\right]\theta + \frac{\gamma}{\mu}\frac{d'F}{p_3}$$

- **Standard Ramsey rule corrected for commuting labour supply complimentarity**

Optimal (uniform) tax rules

- **No tax differentiation between commuting and leisure travel**
- **Optimal taxes satisfy (zero cross elasticities transport):**

$$t_L = \theta \frac{p_L}{\varepsilon_{LL}} - \frac{\partial q_3}{\partial t_L}\left(t_{car} - \frac{\gamma}{\mu} d' F\right) - \frac{\partial q_4}{\partial t_L}\left(t_{bus} - c_{bus} - \frac{\gamma}{\mu}\alpha_{bus} d' F\right)$$

$$t_{car} = \frac{1}{\frac{\partial q_1}{\partial t_{car}} + \frac{\partial q_3}{\partial t_{car}}}\left(\theta(q_1 + q_3) - t_L \frac{\partial q_3}{\partial t_L}\right) + \frac{\gamma}{\mu} d' F$$

$$t_{bus} = \frac{1}{\frac{\partial q_2}{\partial t_{bus}} + \frac{\partial q_4}{\partial t_{bus}}}\left(\theta(q_2 + q_4) - t_L \frac{\partial q_4}{\partial t_L}\right) + \frac{\gamma}{\mu}\alpha_{bus} d' F + c_{bus}.$$

- **Note that marginal external cost pricing does not solve the system**

Interpretation

- Trade off between trying to reduce commuting toll (in order not to reduce labour supply too much) and trying to shift the tax burden to leisure traffic
- Tax indeterminacy obviously resolved

Numerical model

- Apply for standard 20km commuting trip
- Linear congestion function
- Value of time in reference 7.65 euro/hour

Results

	(1) Initial situation	(2) Optimal uniform taxes at reference labour tax ($t_L = 40\%$)	(3) Optimal differentiation at reference labour tax ($t_L = 40\%$)	(4) Optimal differentiation and optimal labour tax ($t_L = 32.5\%$)
Welfare index	1	1.000189	1.001299	1.004208
Transport tax (Euro/trip)				
(1) Leisure car trips	4.240	4.840	7.407	16.285
(2) Leisure bus trips	0.527	0	1.034	8.823
(3) Commuting car trips	4.240	4.840	0	5.457
(4) Commuting bus trips	0.527	0	0	0
Trip demand				
Total trip demand index	1	1.000	0.965	0.900
% commuting trips	53.0%	52.8%	56.3%	62.9%
Modal split (share of car trips)				
Leisure	75.0%	74.0%	73.5%	74.5%
Commuting	67.0%	58.8%	80.1%	63.3%
All trips	70.6%	66.0%	77.2%	67.5%
Taxes/marginal external congestion costs				
(1) Leisure car trips	0.617	0.700	1.078	2.302
(2) Leisure bus trips	1.533	0	2.983	24.950
(3) Commuting car trips	0.617	0.700	0	0.772
(4) Commuting bus trips	1.533	0	0	0

Interpretation I

- **Optimal uniform taxes at reference labour tax**
  - **High reference labour tax: transport taxes below MEC**
  - **Small welfare effects**
- **Optimal differentiated transport taxes at reference labour tax**
  - **Leisure trips taxed at more than MEC, commuting untaxed**

Interpretation II

- **Tax indeterminacy implies optimal labour tax-commuting taxes cannot be determined**
- **Look at tax structure where bus commuting remains untaxed (labour tax is 32.5%)**
- **Commuting car trips now taxed**

Implications

- **Countries with high labour taxes should tax peak period passenger transport below marginal external cost**
- **Countries with high labour taxes should ‘subsidize’ commuting: lower tolls on commuters versus non-commuting**
- **Large welfare effects of non-differentiation**
- **Do not subsidize commuting at current low tolls**

Part II: Optimal taxation of work trips in a wage bargaining model

- **Assumptions**
- **Theoretical model**
- **Congestion, road tolls and wage bargaining outcomes**
- **Optimal taxation**
- **The role of union ‘preferences’**

Assumptions of the basic model I

- **Two types of households: “employed” and “not employed”**
- **All workers are union members, represented by a single union**
- **The employed work for firm producing output at exogenous world price**
- **Labour market outcomes are the result of (right-to-manage) bargaining between firm and union.**

Assumptions of the basic model II

- **Perfect complementarity between employment and commuting**
  - **Working times fixed**
  - **Each working day requires roundtrip commute**
- **Following Parry-Bento-Van Dender, the model reflects average peak period transport conditions over an extended period of time**
  - **The employed demand both commuting and non-commuting transport**
  - **People not employed only demand non-commuting transport**

Assumptions of the basic model III

- Preferences quasi-linear
- All transport takes place on a single link
- Government faces an exogenous budget constraint
- Main tax instruments
  - Labour tax
  - Uniform transport tax on all trip purposes

Labour market participation and union membership

- Population normalized at *1*
- A fraction *m* participates on the labour market, (*1-m*) does not participate at all (discourage workers, retired, etc.)
- Employment is given by *L* ($0<L<m$), unemployment is ($m-L$)
- All labour market participants are unionized; union membership is then *m*

Behavior of households I

- **The employed care about a general numeraire consumption good (C), commuting (c) and non-commuting (n) transport, and leisure (l)**
- **Each day of work requires one round trip commuting**
- **Problem is**

$$\underset{C^e, T_n^e, l^e}{Max} \quad C^e + u^e(T_n^e, \bar{T}_c^e, \ell^e)$$

$$C^e + (1+\tau_T)T_n^e = \left[w - \tau_L \right] - (1+\tau_T)\bar{T}_c^e + G$$

$$l^e + aT_n^e + (1+a)\bar{T}_c^e = R$$

- **All trips expressed in terms of a commuting trip**

Behavior of employed households II

- **Indirect utility employed**

$$V^e(w-\tau_L, \tau_T, a, G)$$

- **Note**

$$\frac{\partial V^e}{\partial \tau_L} = -1 < 0, \quad \frac{\partial V^e}{\partial \tau_T} = -(\overline{T}_c^e + T_n^e) < 0, \frac{\partial V^e}{\partial a} = -\theta^e(\overline{T}_c^e + T_n^e) < 0$$

- **Value of time denoted** θ^e
- **People not working care about the consumption good, leisure and non-commuting transport**
- **Yields indirect utility:**

$$V^u(\tau_T, a, G) \qquad \frac{\partial V^u}{\partial \tau_T} = -T^u < 0, \quad \frac{\partial V^u}{\partial a} = -\theta^u T^u < 0$$

Congestion

- **Congestion function *a(T)***

$$a' > 0, \quad a'' > 0$$

- **Depends on total transport demand**

$$T = L(\overline{T}_c^e + T_n^e) + (1 - L)T^u$$

Union preferences

- **Conditional on taxes, congestion etc., union preferences depend on wages and employment**
- **Union utility**

$$\Omega(w, L; \tau_L, \tau_T, a)$$

- **Scarce empirical evidence suggests unions care about congestion and congestion taxes**
  - **Discussion of London charging scheme by union leaders**
  - **Debate on New York City congestion pricing by unions (NY Times, March 2007)**
  - **Union Conference on congestion and road pricing (Brussels, May 2007; Rome, March 2008)**

The firm

- Labour is the only input
- Profit

$$\pi(w,L) = f(L) - wL; \quad f' > 0, f'' < 0$$

- Profit maximizing behavior at exogenous world output price normalized at 1

Bargaining

- **Right to manage bargaining between union and firm**
  - **Bargaining over wage**
  - **Conditional on negotiated wage, the firm autonomously sets employment**
- **Bargaining outcomes obtained as solution to**

$$\underset{w}{Max} \quad \mu \ln\left(\Omega(w, L; \tau_L, \tau_T, a)\right) + (1-\mu)\ln\left(\pi(w, L)\right); \qquad L = L^d(w)$$

  - **Union power** μ
  - **Labour demand is the solution of** $w = f'(L)$

Bargaining outcomes I

- **Negotiated wages and resulting employment depend on transport parameters**

$$w(\tau_L, \tau_T, a), \quad L(\tau_L, \tau_T, a)$$

- **For a variety of 'plausible' union utility functions, the labour tax, the transport tax and congestion all raise wages and reduce employment**
- **Example**

$$\Omega = \left[LV^e(.) \right]^{\beta} \left[(m-L)V^u(.) \right]^{1-\beta}$$

Bargaining outcomes II

- **Will a more powerfull union be able to transmit a given tax or congestion increase into higher wages?**
- **Answer is ambiguous and depends on characteristics of the production function**
  - **Isoelastic (Cobb-Douglas): more powerful union satisfied with lower wage increase**
  - **Other cases: use higher power to get larger wage increase**

The optimal tax problem

- **Welfare function captures expected well-being of employed and those not employed, and firm profits**
- **Government is budget constrained: tax revenues pay for fixed lump sum transfer**
- **Problem**

$$\underset{\tau_L, \tau_T}{Max} \quad LV^e(w-\tau_L, \tau_T, a, \alpha, G) + (1-L)V^u(\tau_T, a, G) + \left[f(L) - wL \right]$$

$$\text{s.t.} \qquad \tau_T T + \tau_L L = G \qquad (\gamma)$$

Derivation optimal taxes

- **First order conditions**

$$\frac{dL}{d\tau_L}\left\{V^e - V^u + \gamma\tau_L\right\} + \frac{dT}{d\tau_L}\left\{\gamma\tau_T - MEC\right\} + L(\gamma - 1) = 0$$

$$\frac{dL}{d\tau_T}\left\{V^e - V^u + \gamma\tau_L\right\} + \frac{dT}{d\tau_T}\left\{\gamma\tau_T - MEC\right\} + T(\gamma - 1) = 0$$

- **Where**

$$MEC = -a'\left[L\frac{\partial V^e}{\partial a} + (1-L)\frac{\partial V^e}{\partial a}\right] = a'\left[L\left(\theta^e(\bar{T}^e_c + T^e_n)\right) + (1-L)\theta^u T^u\right]$$

- **This is marginal external congestion cost; weighted average of welfare loss of employed and people not employed**

Taxes and long run total transport demand

- **Impact of labour and transport tax**

$$\frac{dT}{d\tau_L} = \frac{1}{1-\rho}\left[(T^e - T^u)\frac{\partial L}{\partial \tau_L}\right]$$

$$\frac{dT}{d\tau_T} = \frac{1}{1-\rho}\left[(S) + (T^e - T^u)\frac{\partial L}{\partial \tau_T}\right]$$

where $T^e = \overline{T}_c^e + T_n^e$

$$S = L\frac{\partial T_n^e}{\partial \tau_T} + (1-L)\frac{\partial T^u}{\partial \tau_T} < 0$$

$$\rho = L\frac{\partial T_n^e}{\partial a}a' + (1-L)\frac{\partial T^u}{\partial a}a' + (T^e - T^u)\frac{\partial L}{\partial a}a'$$

Taxes and long run employment

- **Impact of labour and transport tax**

$$\frac{dL}{d\tau_L} = \frac{1-\rho_t}{1-\rho}\left\{\frac{\partial L}{\partial \tau_L}\right\} \qquad \rho_t = L\frac{\partial T_n^e}{\partial a} + (1-L)\frac{\partial T^u}{\partial a}$$

$$\frac{dL}{d\tau_T} = \frac{1}{1-\rho}\left\{[1-\rho_t]\frac{\partial L}{\partial \tau_T} + [S]\frac{\partial L}{\partial a}a'\right\}$$

- **Long-run employment effects differ from direct impact due to congestion effects**

Optimal transport tax I

$$\tau_T = \frac{MEC}{\gamma} + \left\{ \frac{(1-\gamma)}{\gamma} \frac{(1-\rho_t)}{[S]} \right\} T - \left\{ \frac{(1-\gamma)}{\gamma} \frac{(1-\rho_t)}{[S]} \right\} \left\{ \left[L \frac{\frac{\partial L}{\partial \tau_T}}{\frac{\partial L}{\partial \tau_L}} \right] - \left[\frac{1-\gamma}{\gamma} \right] \left\{ L \frac{\frac{\partial L}{\partial a} a'}{\frac{\partial L}{\partial \tau_L}} \right\} \right\}$$

- **Four clearly identifiable terms: Pigou, Ramsey, (relative) employment effect transport tax and congestion**
- **Larger wage effects of transport taxes reduce optimal tax**
- **Opposite holds for congestion itself**

Optimal transport tax II

- Tax can vary dramatically depending on union preferences with respect to employment and congestion
- If congestion does not matter to the union but transport prices do then the tax is structurally below Ramsey
- If the opposite holds then the tax structurally above Ramsey

Optimal labour tax

$$\tau_L = -\left(\frac{V^e - V^u}{\gamma}\right) - \left(\frac{\gamma - 1}{\gamma}\right)\left\{\frac{L}{\frac{\partial L}{\partial \tau_L}} + \frac{(T^e - T^u)(L\frac{\partial L}{\partial \tau_T} - T\frac{\partial L}{\partial \tau_L})}{\frac{\partial L}{\partial \tau_L}[S]}\right\}$$

- **Corrects for the distortion due to wage bargaining: tax negative with lump sum tax available**
- **Corrects for relative effects transport and labour taxes on employment**

Role of union preferences I

- General results are not surprising: labour market effects matter in expected sense
- Bargaining framework implies that tax rules strongly depend on union preferences
- Consider specific union utility function

$$\Omega = \left[L V^{e}(w - \tau_L, \tau_T, a) \right]^{\beta} \left[(m - L) V^{u}(\tau_T, a) \right]^{1-\beta}$$

- Implies that the union 'accepts' worker preferences with respect to transport taxes and congestion

Role of union preferences II

- **Specification implies that following relations hold:**

$$\frac{\partial w}{\partial \tau_T} = (\bar{T}_c^e + T_n^e)\frac{\partial w}{\partial \tau_L}; \qquad \frac{\partial L}{\partial \tau_T} = (\bar{T}_c^e + T_n^e)\frac{\partial L}{\partial \tau_L}$$

$$\frac{\partial w}{\partial a} = \theta^e(\bar{T}_c^e + T_n^e)\frac{\partial w}{\partial \tau_L}; \qquad \frac{\partial L}{\partial a} = \theta^e(\bar{T}_c^e + T_n^e)\frac{\partial L}{\partial \tau_L}$$

- **Relative wage effects of labour and transport taxes (congestion) reflect their relative marginal indirect utilities for workers**
- **Only transport demand of the employed matters for the relative impact of labour and transport taxes on negotiated wage**

Role of union preferences III

- **Using in general optimal transport tax rule we find:**

$$\tau_T = MEC - \left(\frac{\gamma-1}{\gamma}\right)\left[\frac{(1-\rho_t)}{(S)} + \theta^u a'\right]\left((1-L)T^u\right)$$

- **Optimal tax equals *MEC* if all demand comes from people employed**
- **Note difference with models of competitive labour markets (Van Dender 2003)**
- **Reason**

Role of union preferences IV

- **In principle, optimal tax can be > or <MEC depending on time values of users that do not work (pensioners, unemployed)**
- **Two issues at stake**
  - **Tax shifting of employed to broader tax base (tax>MEC): labour tax paid by employed only, transport tax by all users**
  - **People not employed suffer from congestion and are not compensated through wage adjustments (tax<MEC)**

Role of union preferences V

- **Do unions care about congestion and congestion taxes?**
  - **Suppose union cares much less about congestion taxes than its members do**
    - **Optimal transport tax above MEC, even if all demand comes from employed only**
    - **Intuition: small employment effects**
  - **Suppose union does not care about congestion**
    - **Reduce optimal transport tax**

Role of union preferences VI

- **Let** $$\Omega = L^{\delta}\hat{w}, \quad \hat{w} = w - \tau_L - \varepsilon\tau_T - \sigma a$$
- **Parameters reflect importance of transport tax and congestion relative to labour tax from union's perspective**
- **Optimal transport tax rule (zero demand people not working)**

$$\tau_T = MEC - \left(\frac{1-\gamma}{\gamma}\right)\left\{\left[\delta L a' - MEC\right] + \left[L(\varepsilon - T^e\right]\left(\frac{1-\rho_t}{(S)}\right)\right\}$$

- **Low valuation congestion: low transport tax**
- **Low valuation transport tax: high transport tax**

Tax differentiation I

- **Adapt model on two accounts:**
  - **Differentiate taxes on commuting, non-commuting** τ_c, τ_n
  - **Relax assumption of perfect complementarity commuting-work**
- **Optimal tax rules for initial specification of union preferences**
- **Different countries have very different policies: US, Canada etc. versus Germany, France, Sweden, etc.**

Tax differentiation II

- **Standard view on commuting subsidies (Borck-Wrede (JUE (2005, 2008))**
  - **Depends to large extent on relative flexibility labour versus housing markets**
  - **Flexible housing markets: no reason to subsidize commuting**
  - **Rigid housing markets, flexible labour markets: subsidies can be justified**

Tax differentiation III

- **Optimal tax rules**

$$\tau_c = MEC + \left(\frac{1-\gamma}{\gamma}\right)(1-L)\theta^u T^u a'$$

$$\tau_n = MEC + \left(\frac{1-\gamma}{\gamma}\right)\left[\frac{1}{(S)} + \theta^u a'\right]\left((1-L)T^u\right)$$

- **Subsidize commuting?**
  - **Tax commuting below external cost**
  - **Tax less than leisure traffic**

$$\tau_n - \tau_c = \left(\frac{1-\gamma}{\gamma}\right)\left[\frac{(1-L)T^u}{[S]}\right] \geq 0$$

Extensions I: Spatial or temporal differentiation

- **Model assumed all transport uses same link at same time**
- **Suppose non-commuting uses different link or travels at different time. We then find:**

$$\tau_c = MEC$$

$$\tau_n = \left(\frac{1-\gamma}{\gamma}\right)\frac{T_n}{S}$$

- **Commuters pay external cost, non-commuters contribute to financing**

Extensions II: multiple transport modes

- **Suppose there is an uncongested alternative (rail) apart from car travel**
- **Assume all transport demand is commuting, so with car transport only tax would equal *MEC***
- **Let taxes be denoted**

$$\tau_{car}, \tau_{rail}$$

Multiple transport modes

- **Tax rules (Z<0)**

$$\tau_{car} = MEC + \left(\frac{1-\gamma}{\gamma}\right)\left\{\frac{[B]}{[K]}\left[-(L+T_{rail}Z)\frac{\partial T_{rail}}{\partial \tau_{car}} + T_{rail}Z\frac{\partial T_{car}}{\partial \tau_{car}}\right]\right\}$$

$$\tau_{rail} = \left(\frac{1-\gamma}{\gamma}\right)\frac{[B]}{[K]}\left\{L\frac{\partial T_{car}}{\partial \tau_{car}}\right\}$$

$$B = \tau_{\pi}\frac{\partial w}{\partial a}a'Z(T_{car} - T_{rail})\frac{\partial T_{car}}{\partial \tau_{rail}}$$

$$K = (L+T_{rail}Z)\left(\frac{\partial T_{car}}{\partial \tau_{car}}\frac{\partial T_{rail}}{\partial \tau_{rail}} - \frac{\partial T_{car}}{\partial \tau_{rail}}\frac{\partial T_{rail}}{\partial \tau_{car}}\right)$$

- **If car demand exceeds rail demand and car and rail are substitutes, then B<0, K>0**

Optimal rail tax

- **If congestion raises wages and reduces employment, this is argument to subsidize rail**

$$\tau_{rail} = \left(\frac{1-\gamma}{\gamma}\right)\frac{[B]}{[K]}\left\{L\frac{\partial T_{car}}{\partial \tau_{car}}\right\} < 0$$

- **Doing so reduces congestion and raises employment**
- **Rail subsidy despite the availability of an optimal car tax**

Optimal road tax

- **If labour market effects of congestion are small, then** $\tau_{car} < MEC$
- **If effects are large, then** $\tau_{car} > MEC$
- **So:**
  - **If road demand exceeds rail demand, if the modes are substitutes and if congestion strongly affects the labour market, then subsidize rail but not car (tax>MEC)**
  - **Similar conditions but small labour market effects of congestion, then subsidize rail and tax road below MEC**

Extensions III: allow telecommuting

- Allow people to work at home, but let there be productivity differences
- Bargaining: more efficient telecommuting reduces wages and raises employment
  - Makes union members better off, hence reducing wage claims
- Telecommuting does not affect optimal tax structure, but does affect optimal taxes
    - It reduces congestion at given employment
    - It raises employment, hence congestion

Conclusions I

- **The structure of the labour market does matter for optimal congestion taxes**
- **Uner plausible conditions, both congestion itself and congestion tolls will affect negotiated outcomes on the labour market**
- **Uniform transport taxes depend on the effect of transport taxes (-) and congestion (+) on negotiated wages**

Conclusions II

- **The optimal uniform transport tax directly depends on the share of road users that do not work**
- **If taxes can be differentiated, commuting ‘subsidies’ are justified if at least some demand comes from people inactive on the labour market and their time values are limited**
  - **Tax commuters below external cost**
  - **Higher tax on non-commuters**
- **Role of union preferences is crucial**
- **Important to learn more about union attitudes towards congestion and its solutions**

Part III: Numerical application

- Compare bargaining and competitive labour market structure in a simple model with telecommuting
- Bargaining Right to Manage versus Nash
- There is only one mode (car)
- Taxes can be differentiated or uniform
- Calibration with Belgian data

Results I

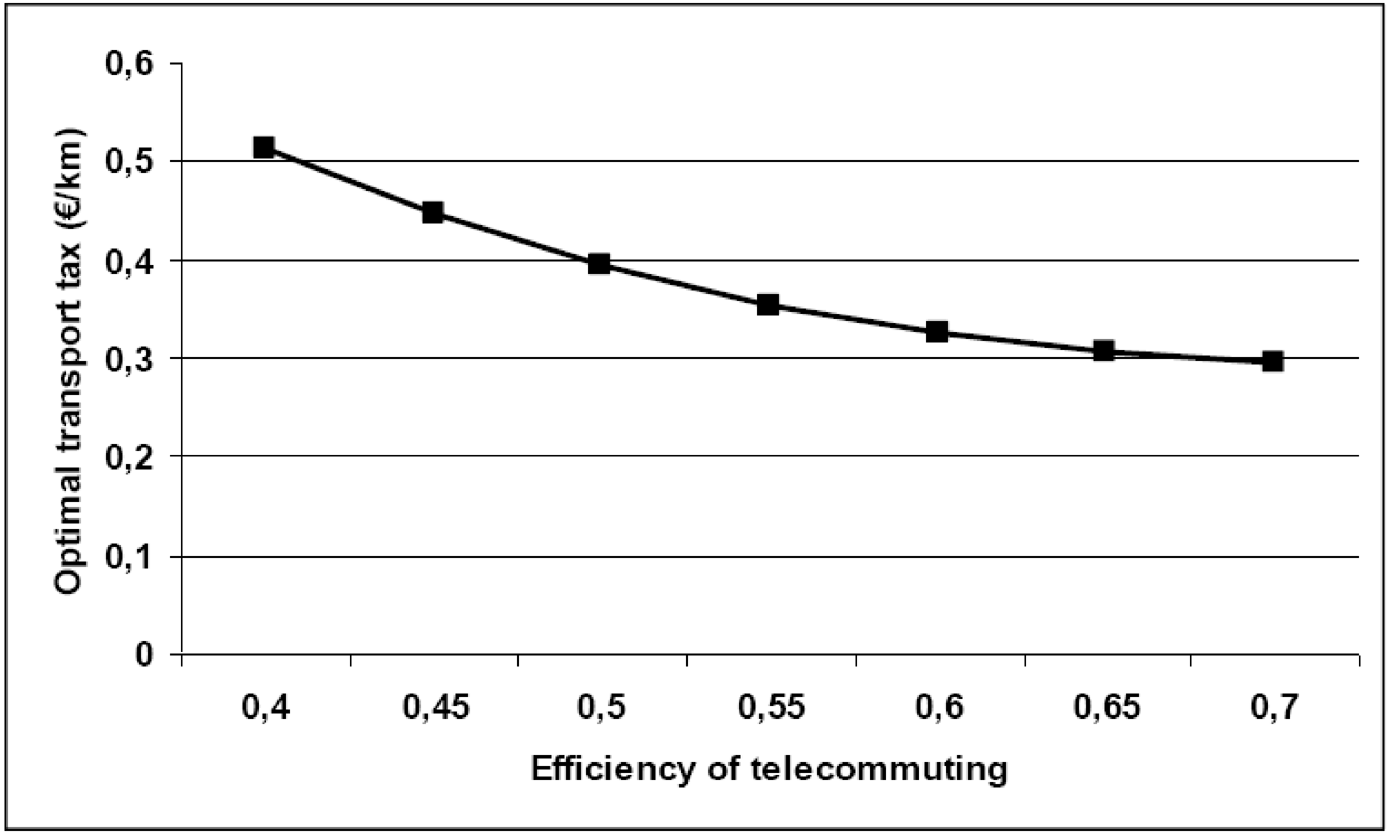
	Competition			Bargaining I	
	Initial situation (1)	Uniform (2)	Differentiated (3)	Uniform (4)	Differentiated (5)
Employment	3.510.088	3.541.867	3.547.700	3.545.048	3.545.048
Wage	130	128,059	127,708	127,972	127,972
Labour tax	52	35,964	36,831	38,184	38,184
Commuting transport tax	0,062	0,394	0,345	0,348	0,348
Non-commuting transport tax	0,062	0,394	0,465	0,348	0,348
MEC	0,767	0,357	0,358	0,348	0,348
Total traffic	187,054	169,365	169,402	168,780	168,780
Commuting traffic	133,014 (71,11%)	125,370 (74,02%)	127,181 (75,08%)	123,022 (72,89%)	123,022 (72,89%)
Non-commuting traffic	54,040 (28,89%)	43,996 (25,98%)	42,221 (24,92%)	45,758 (27,11%)	45,758 (27,11%)
Average speed	38,798	53,442	53,412	53,910	53,910
Total days of homework	369.483	815.246	736.332	938.989	938.989

Employment	Number of full time jobs
Wage	€/day
Labour tax	€/day
Commuting transport tax	€/km
Non-commuting transport tax	€/km
MEC	€/km
Total traffic	million vehicle kilometres
Commuting traffic	million vehicle kilometres (the share of commuting traffic in total traffic is given between brackets)
Non-commuting traffic	million vehicle kilometres (the share of non-commuting traffic in total traffic is given between brackets)
Average speed	km/hr
Total days of homework	Number of (8 hour) days that are worked at home

Results II

- Higher tolls under competitive labour markets
- Small difference between different bargaining models
- Substantial differentiation commuting versus non-commuting

Results III: varying telecommuting efficiency



Does the structure of the labour market matter?

- Competitive models: Tax effects on labour supply depend on consumer preferences
- Bargaining model: effects taxes on bargaining outcomes driven by union preferences
- Two issues:
  - Is the difference quantitatively important?
  - What do we know about union attitudes towards transport issues?