Multi-tier tax competition on Gasoline

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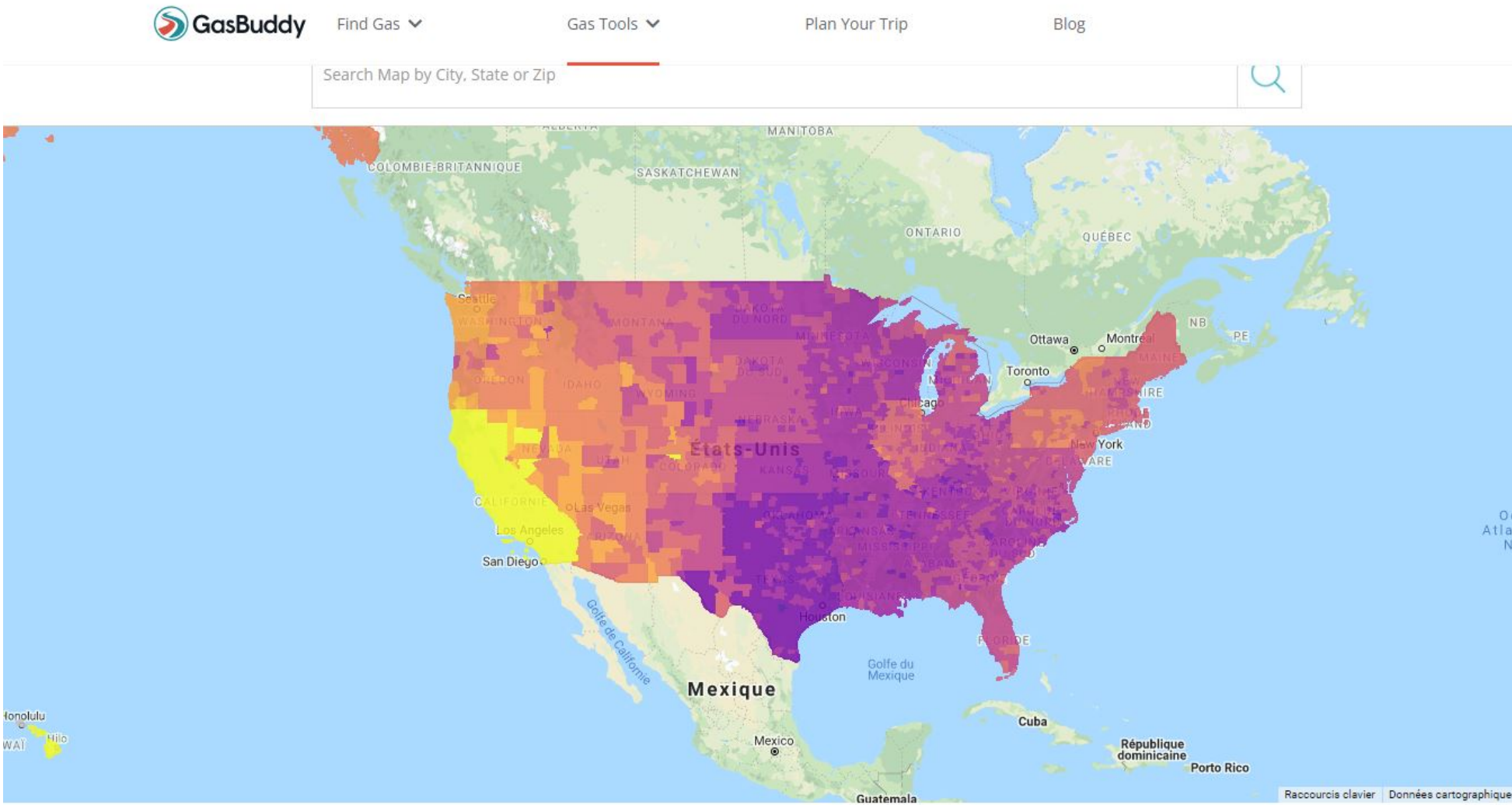
Motivation

Gasoline price and taxation features

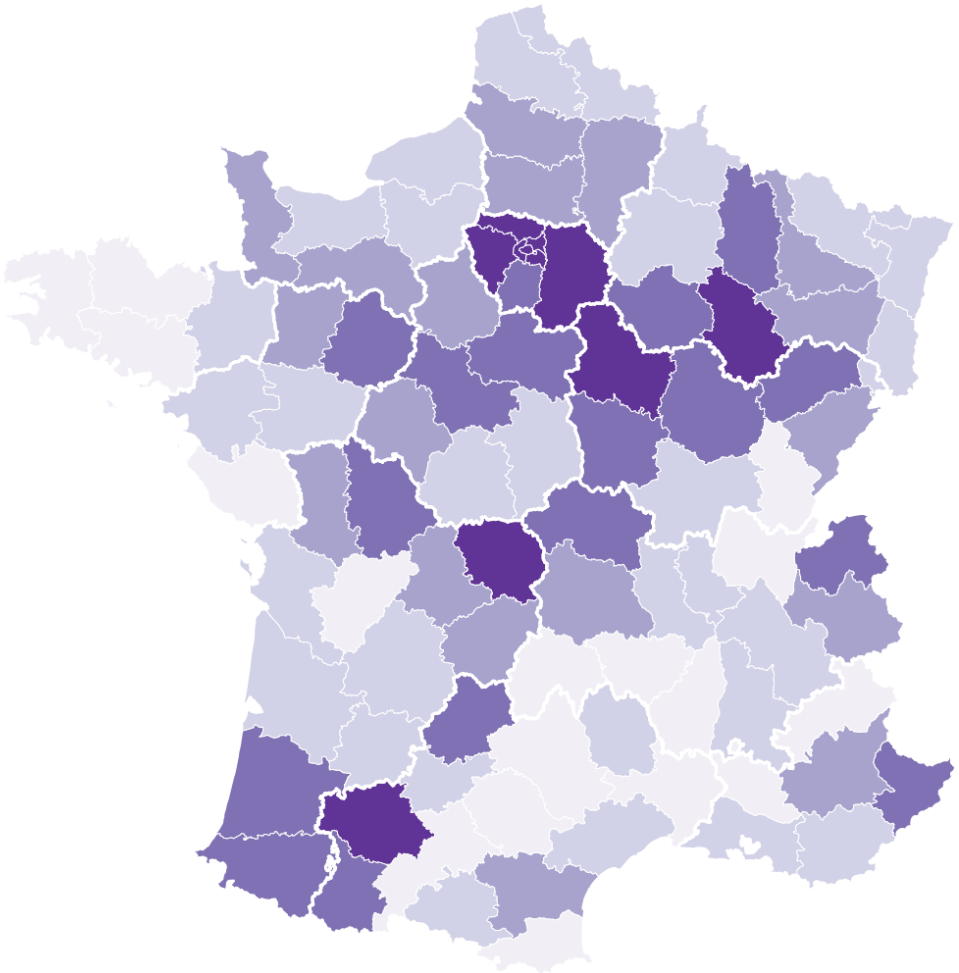
- disparities of prices between countries, regions and "départements" + transparency (development of web sites)

Gasoline price in the US



See what gas prices are around the country at a glance. Areas are color coded according to their price for the average price for regular unleaded gasoline.

Gasoline price in France



Prix au 14 octobre 2021

Actualité : Prix de vente moyens nationaux des produits pétroliers - base de données DGEC (Cliquez ici)

Rechercher des points de vente de carburants

Choix des carburants

- ☐ B7 Gazole
- ☐ E5 SP98
- ☐ E10 SP95-E10
- ☐ E5 SP95
- ☐ LPG GPLc
- ☐ E85 E85

Localisation

Par département

33 - Gironde

Par commune ou un code postal

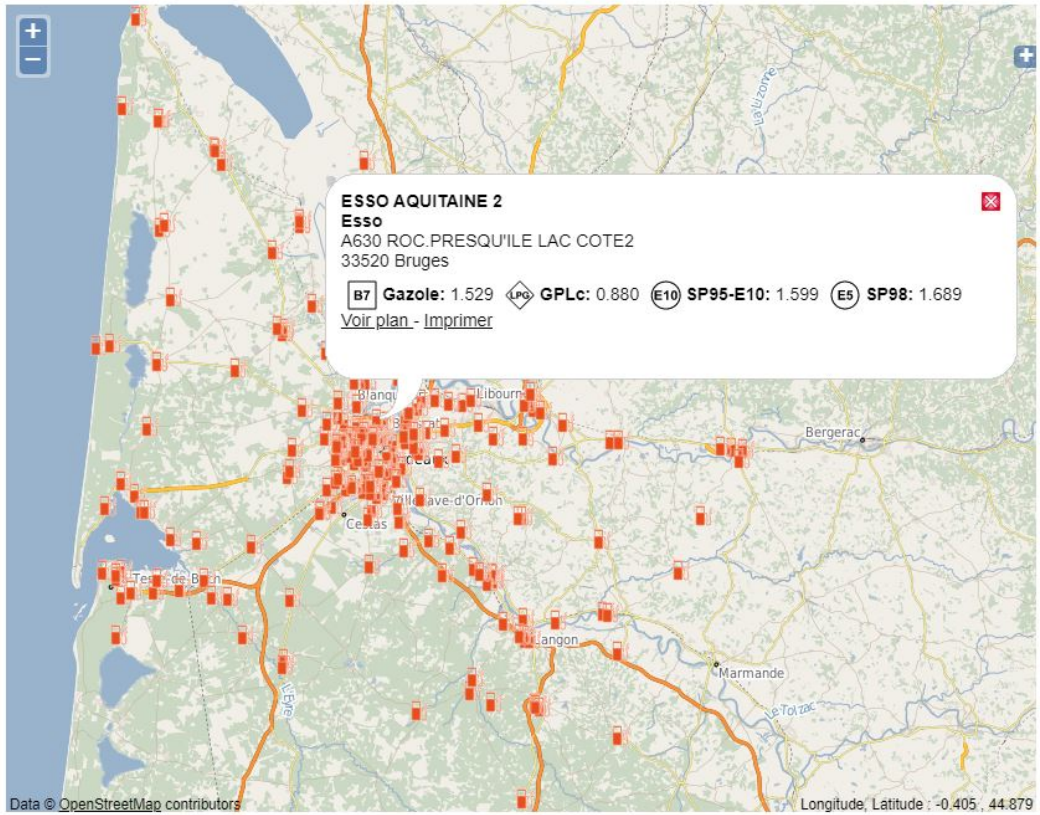
Par exemple 'Toulouse' ou '33200'

Choisissez un type d'enseigne

Toutes les enseignes

Choisissez un ou plusieurs services

Voir la liste des stations



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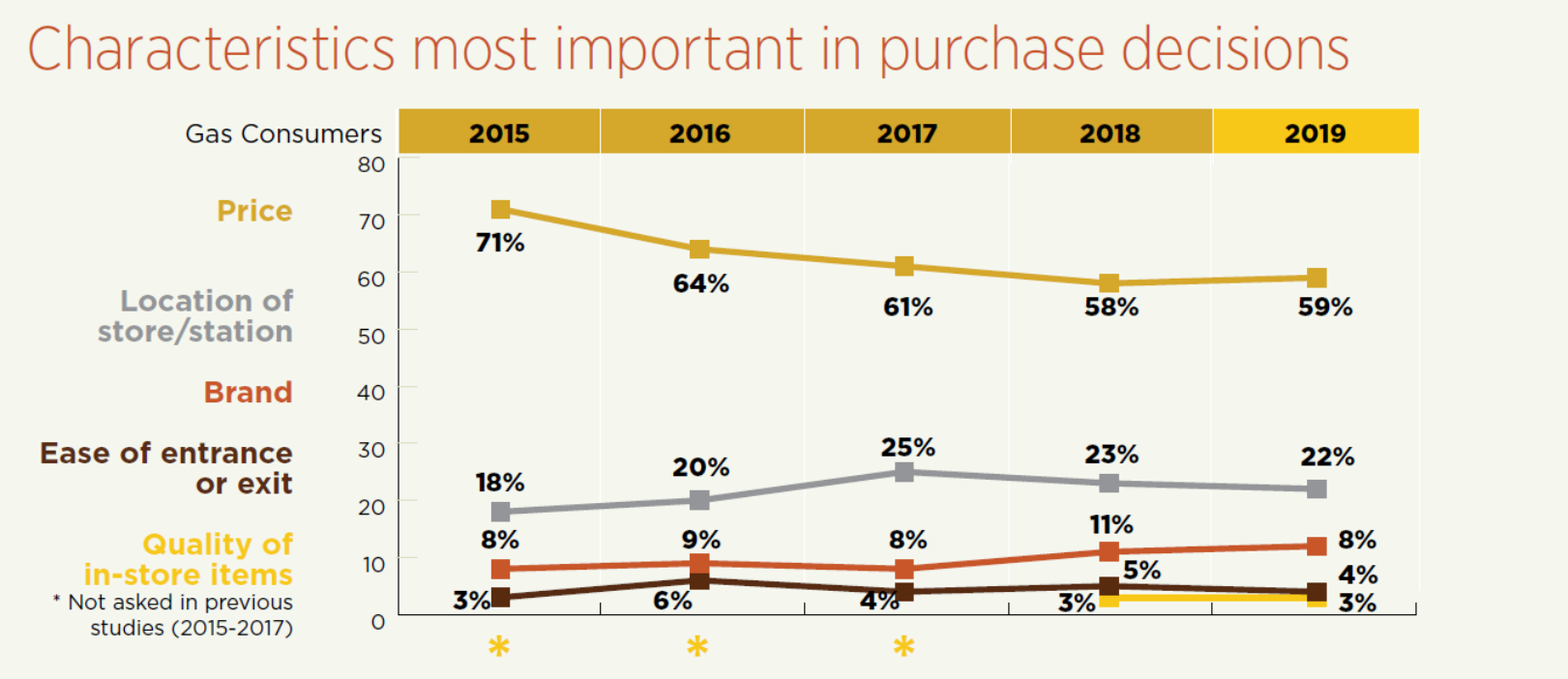
- no consensus in the literature about the measure of price elasticity of gasoline demand

Gasoline purchase decision



Behavior at the Pump, NACS Report 2019

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- gazoline/fuel taxation : easiest and cheapest form of automative taxation at local level...

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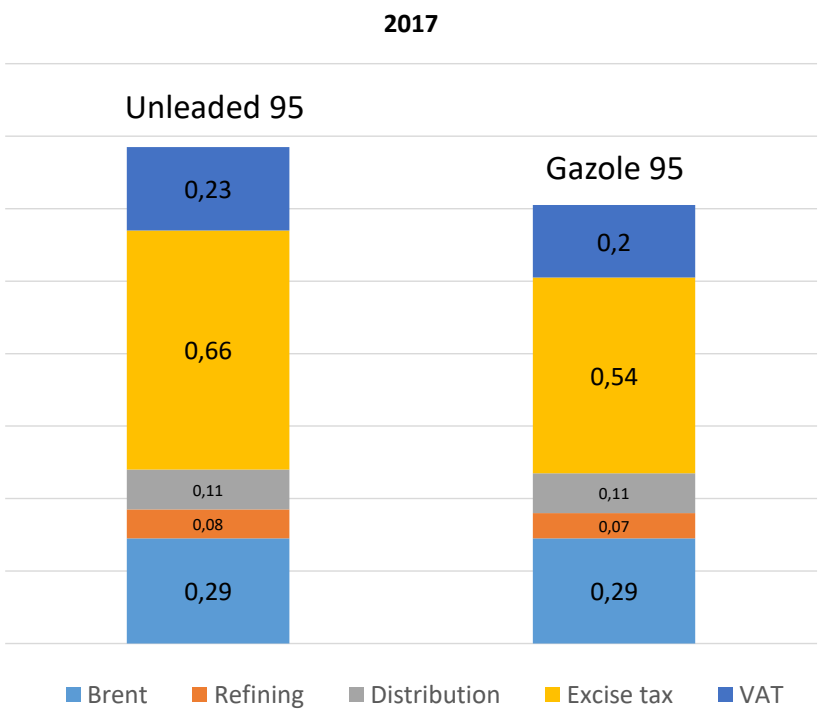
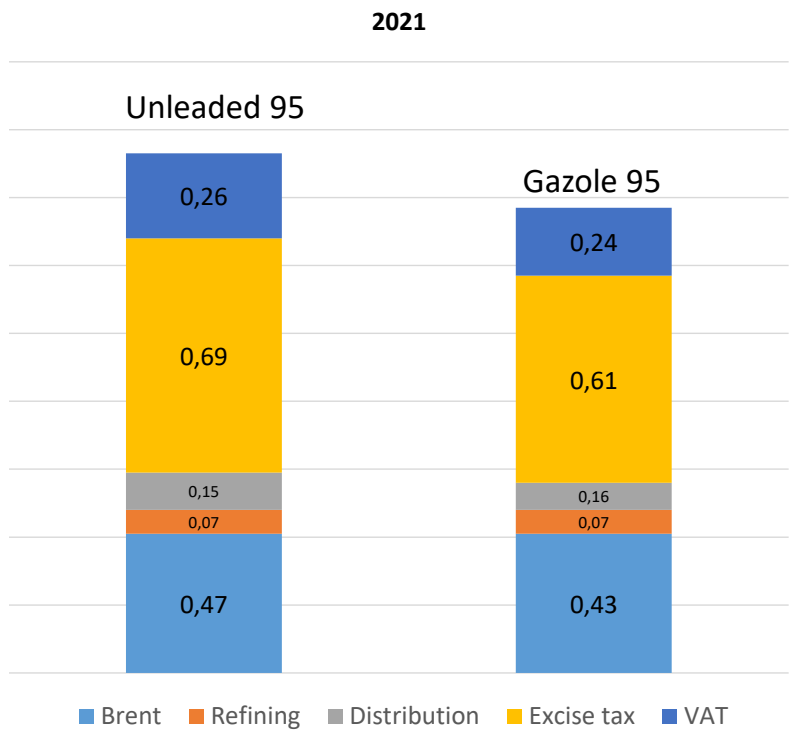
- ....but indeed, complex : horizontal + vertical
- ...and regressive (but less than carbon tax (Teixido and Verde 2017))

Price of gasoline at the pump (France)





% of taxes :	65%	61%	61,4%	61%
	1,39 €/l	1,21 €/l	1,59 €/l	1,44 €/l

Price of gasoline at the pump (France)

Some insights :

- Taxes : 60% of the gazoline price
- Almost 35 billions of euros
- More than 20 billions for the central Gvt
- 6 billions euros for Regions (20% of their revenue)
- 6 billions euros for départements (6% of their revenue)
- From 2011 to 2016 : Regions had possibility to determine their own TICPE share according to two brackets (< 0.025 euros/l)
- From 2016 : Central gvt redistributes a portion of TICPE revenue according to the revenues generated in the region.

Our approach

- Is gasoline tax a good instrument for local governments ?
- Should local government intervene more in gasoline tax setting ?

Better understanding of the gasoline tax system through a general theorerical model with :

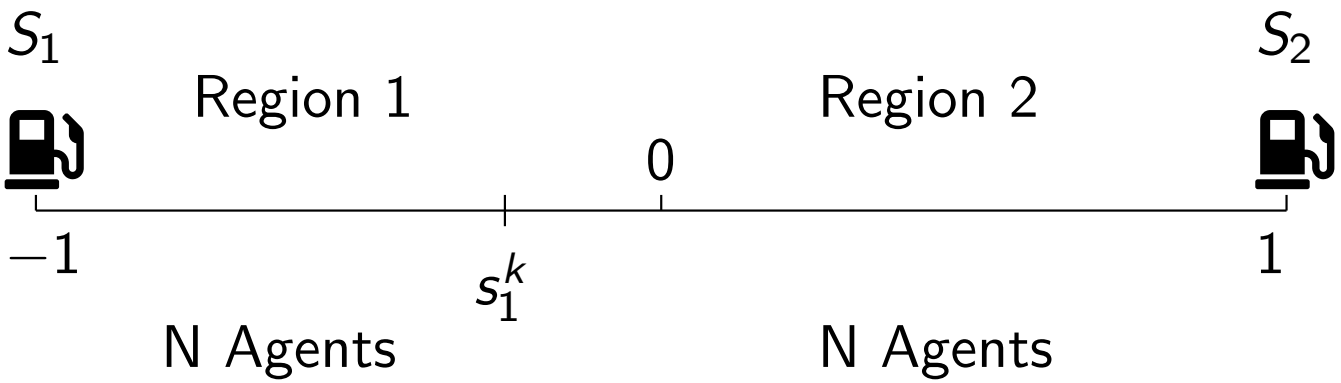
- horizontal fiscal competition
- vertical interactions
- a specific price elasticity of demand

Literature

- "cross border shopping" : Keen and Kanbur (AER 1993)
- fiscal federalism with vertical and horizontal interactions : Oates 1972, Keen 1998, Boadway 2001
- tax reaction functions Vrijburg and de Mooij (ITAX 2012), Graziosi (ITAX 2015, WP 2016)
- Devereux and al (JPubE 2007) (no VAT + transport costs)

The Model (1)

- 2 regions
- N agents in each region ($N = 1$)
- agents uniformly distributed on $[-1, 1]$



The Model (2)

- gasoline price at the pump : $P_i = q_i(1+\theta)$
  with $q_i = p_i + t_i + T$ price without VAT
- Agents consume 2 goods : c_i and x_i
- quasi linear utility function : $c_i + u(x_i)$
- budget constraint :

$\overline{y}$ $\rightarrow$ $c_k^i(1+\theta)$: numeraire good expenditures

$\rightarrow$ $x_k^j P_j$: gazoline purchases

$\rightarrow$ $(\delta + \alpha P_j)\left|s_k^i - S_j\right|$: transport costs

Gasoline Demand / Choice of the gasoline station

Consumer choice leads :

$$\left.\begin{array}{l} q_j \nearrow \Longrightarrow x^j \searrow \\ t_j \nearrow \Longrightarrow x^j \searrow \\ T \nearrow \Longrightarrow x^j \searrow \end{array}\right\} \text{same amount}$$

$$\theta \nearrow \Longrightarrow x^j \text{ unchanged}$$

θ applies either on gazoline and numeraire good $\Longrightarrow$ no arbitrage based on VAT.

Choice of the station to refuel

Agent k chooses S_1 iff $V_k^1 > V_k^2$

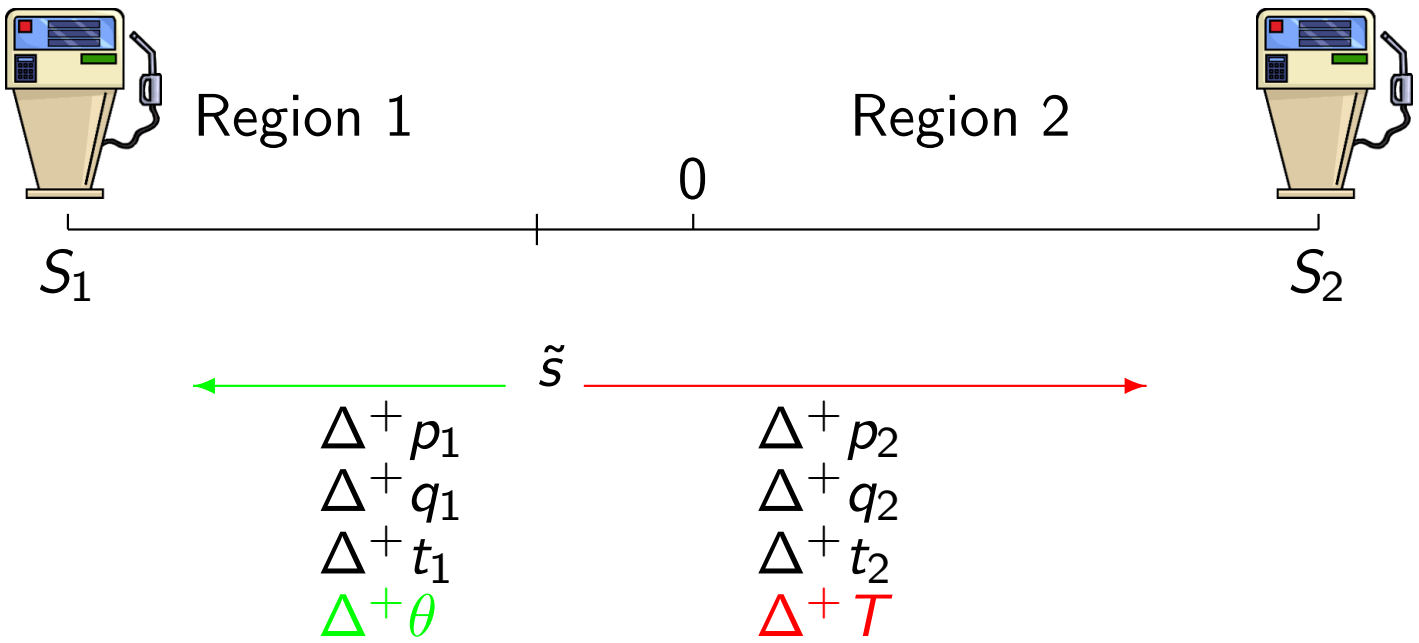
$$V_k^j \equiv c_i + u(x^j).$$

$\widetilde{s}$: consumer who is indifferent between bying in 1 or 2

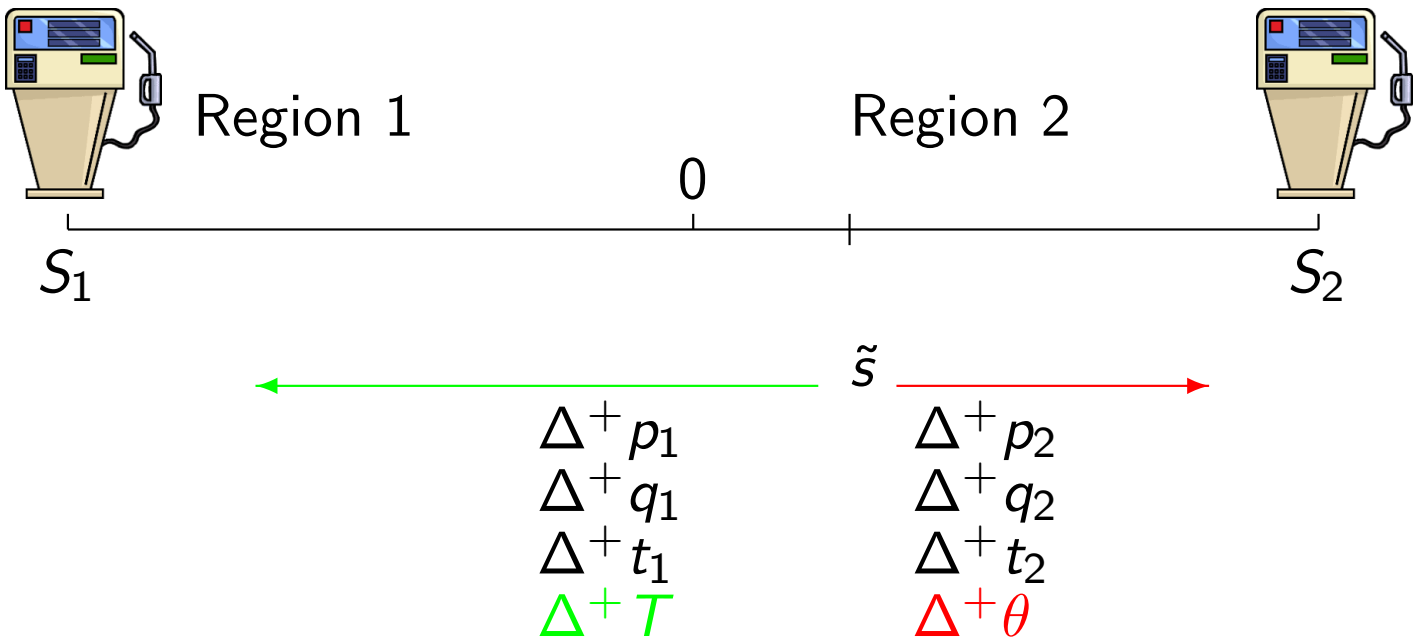
$$\widetilde{s} = \frac{u(x^1) - (x^1 + \alpha)\, q_1 - \left(u(x^2) - (x^2 + \alpha)\, q_2\right)}{\rho}.$$

ρ is the **transportation cost** :
increases with T and t_i (through prices included taxes) ;
decreases with θ : reduces the psychological cost relative to the monetary one.

$q_1 > q_2$


Region 1
Region 2
0
S_1
S_2
$\tilde{s}$
$\Delta^+ p_1$
$\Delta^+ q_1$
$\Delta^+ t_1$
$\Delta^+ \theta$
$\Delta^+ p_2$
$\Delta^+ q_2$
$\Delta^+ t_2$
$\Delta^+ T$

$q_1 < q_2$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$\Delta^+ q_2$
$\Delta^+ t_2$
$\Delta^+ \theta$

Tax choice

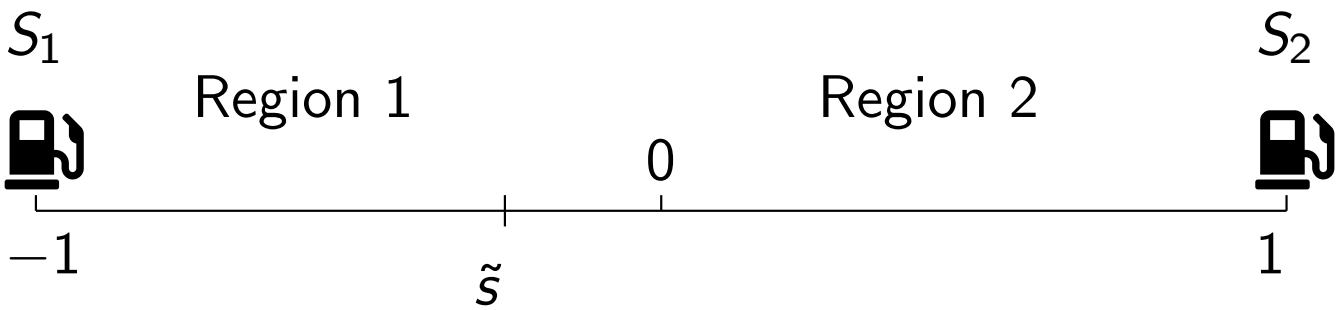
- Governments are Leviathan
- Local governments
  - choose t_i
  - to maximize tax revenue : $r_i = t_i \times$ local tax base
- Federal government
  - chooses T and θ
  - to maximize tax revenue : $R = \theta C + \sum_{i=1}^{2} (\theta q_i + T) X_i$

Local taxes choice / non cooperative choice (Nash)

$$\text{Local tax base} = x_i s_i(q_i, q_j, \theta)$$

s_i : number of shoppers in i.
Can be evaluated from the "threshold" shopper :

$$s_1 = 1 + \tilde{s} \quad \text{and} \quad s_2 = 1 - \tilde{s}$$



Local taxes reaction functions (1)

The optimal local excise tax depends on :

- gazoline demand elasticity to the tax per shopper.
- mobility elasticity to the tax ($\tilde{s}$) : number of shoppers.

Both elasticities are negative.

From the local government choice

$$t_j \nearrow \Longrightarrow t^i \nearrow$$

$$\theta \nearrow \Longrightarrow t_i \searrow$$

$$T \nearrow \Longrightarrow t_i \text{ unclear}$$

Specific cases :

i) inelastic demand $\frac{\partial t_i}{\partial T} > 0$

ii) iso-elastic demand $\frac{\partial t_i}{\partial T} > 0$

Local taxes reaction functions (2)

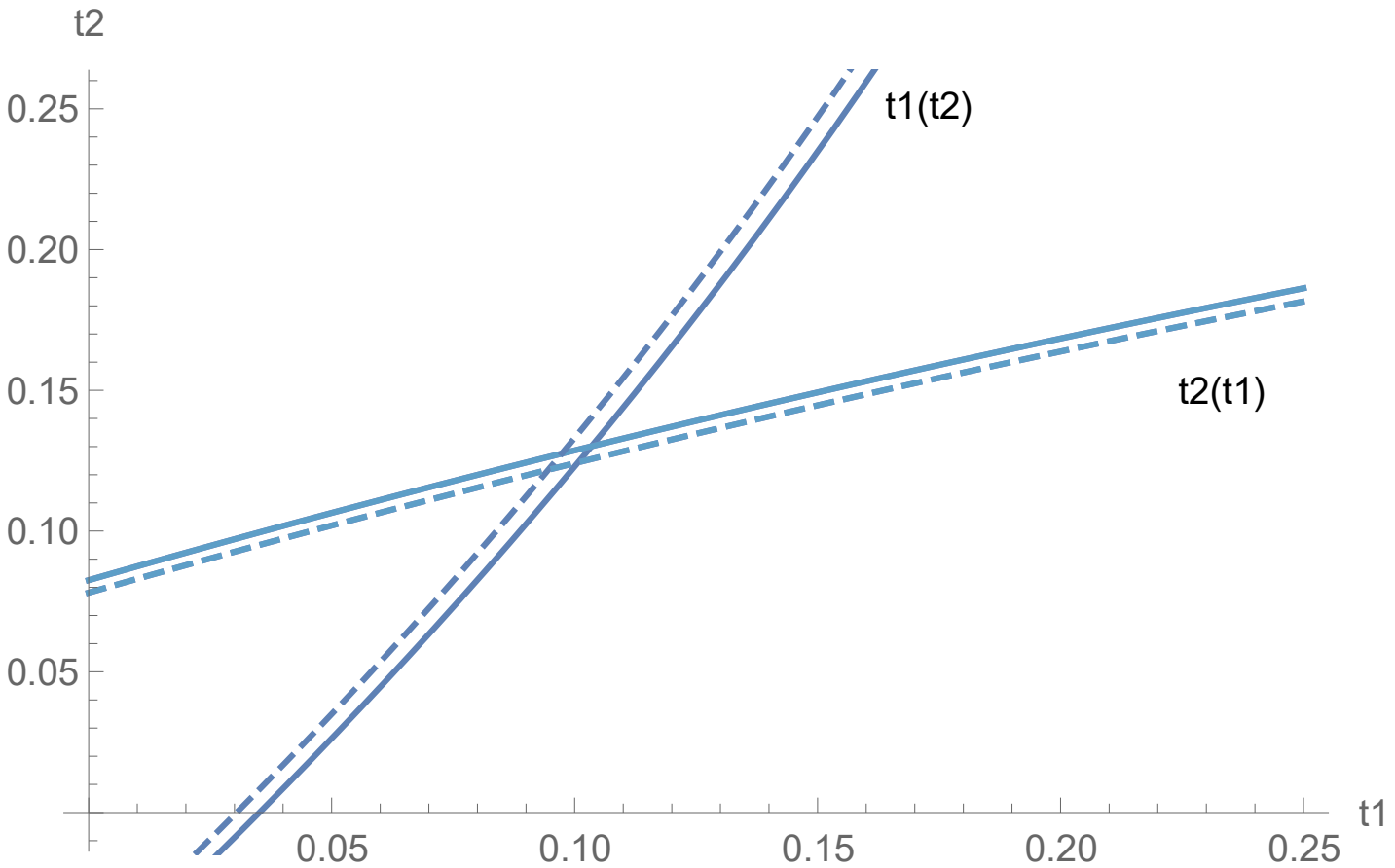


Figure – Effect of a rise in θ (from $\theta = 0.2$ to $\theta = 0.35$) with $p_1 = 0.55$ and $p_2 = 0.5$

Local taxes reaction functions (3)

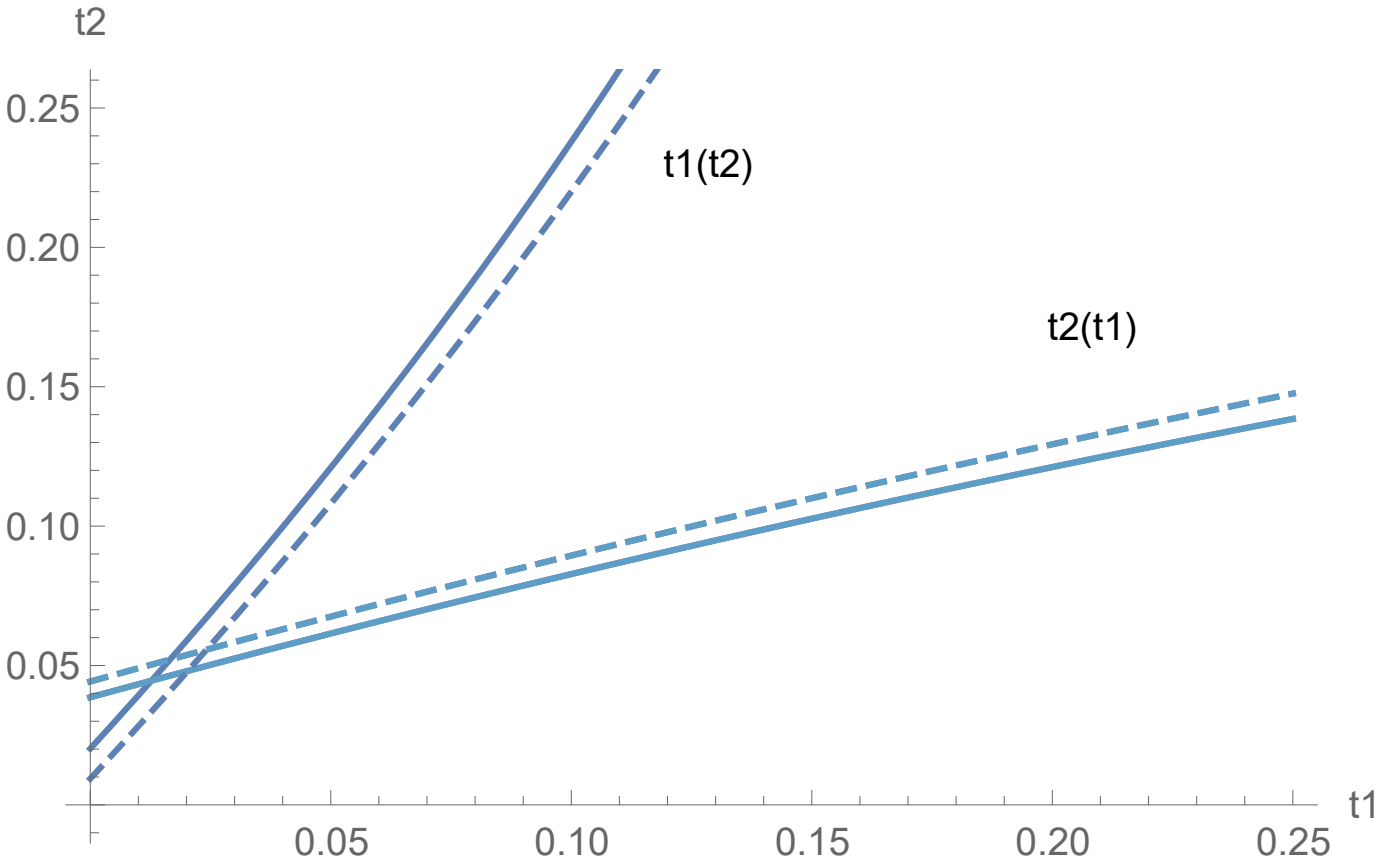


Figure – Effect of a rise in T (from $T = 0.63$ to $T = 0.8$) with $p_1 = 0.55$ and $p_2 = 0.5$

Federal gvt/ non cooperative choice (Nash)

Federal government maximizes his tax revenue :

- VAT on numeraire good
- VAT on gazoline expenditures (net of tax)
- Excise tax per unit of gazoline consumption
- VAT on excise taxes (fed and local)

detailed program

Warning : numeraire goods are the residual consumptions after deducing gazoline expenses from income $\Longrightarrow$ they depend on local taxes.

Federal taxes reaction functions - symmetric regions

From the central government choice, **symmetric regions** :

$$T \nearrow \Longrightarrow \theta \searrow$$

$$\theta \nearrow \Longrightarrow T \searrow$$

$$t_i \nearrow \Longrightarrow T \searrow$$

$$t_i \nearrow \Longrightarrow \theta \searrow$$

but introducing **asymmetry** ($p_1 \neq p_2$), we can observe :

$$T \nearrow \Longrightarrow \theta \nearrow \text{ and } \theta \nearrow \Longrightarrow T \nearrow$$

Nash versus Social Planner

- Social planner maximizes the sum of the objective :

$$SP = R\left(t_1, t_2, T, \theta\right) + r_1\left(t_1, t_2, T, \theta\right) + r_2\left(t_1, t_2, T, \theta\right)$$

  with the set of instruments $\left(t_1, t_2, T, \theta\right)$

- SP=Benchmark

- First best that internalizes externalities

Externalities

i) local taxes imply positive externalities at the horizontal level and negative externalities at the vertical level : $t_i \nearrow \Longrightarrow r_j \nearrow$ and $t_i \nearrow \Longrightarrow R \searrow$

ii) The federal tax T (excise tax) implies negative externalities at the local level : $T \nearrow \Longrightarrow r_1 + r_2 \searrow$

iii) VAT has no effect on local governments' revenues : $\theta \nearrow \Longrightarrow r_1 + r_2$ unchanged

Nash versus Social planner

Nash versus Social Planner

Let us fix t_1 and t_2

$$T^{SP} < T^{N}$$

$$\theta^{SP} \lessgtr \theta^{N}$$

Let us fix θ and T

$t_i^{SP} < t_i^{N}$ if vertical externalities dominate horizontal externalities, and

$$r_i^{SP} < r_i^{N}$$

$\Longrightarrow$ Surprising in a tax competition framework

Sequential game : Centralized leadership

Sequential game : federal gvt has a **leadership** position

Centralized leadership vs Nash

For $\varepsilon_x > -1$ and $\frac{\partial t_i}{\partial T} > 0$

- $\theta^{CL} > \theta^N$
- $T^{CL} < T^N$
- $t_i^{CL} < t_i^N$
- $r_i^{CL} < r_i^N$

- $\Longrightarrow$ centralized leadership equilibrium is detrimental for the local government revenues.
- But local tax lower than at the Nash equi (as SP solution)

Conclusion

- Fiscal tools from the different tiers of governments are interdependent :
  - the federal reaction functions to local taxes changes are of opposite signs
  - excise taxes are strategic complements
- Price elasticity of demand plays a crucial role
- Sequence of decision of the taxes matters.
- Local excise tax : a good instrument for local governments ?
  not sure : the optimal solution suggests low local rates ; instrument with a low room for manoeuvre.

Thank you for your attention !

Federal taxes choice / non cooperative choice (Nash)

Federal government maximizes his tax revenue :

$$R\left(t_1, t_2, T, \theta\right) = \theta C + \sum_{i=1}^{2} \left(\theta q_i + T\right) X_i$$

and C depends on the local tax choices since

$$C\left(t_1, t_2, T, \theta\right) = \int_{-1}^{\widetilde{s}} c^1 ds + \int_{\widetilde{s}}^{1} c^2 ds$$

with c^1 and c^2 are the residual consumptions after deducting gazoline expenses from income (xhich depend on local taxes). return