Some challenges in accounting for the size of government

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Coincidentally, 30 years ago this year. . .

- Allan Meltzer & Scott Richard's "A rational theory of the size of government" (*Journal of Political Economy*, October 1981)
- Template for (almost) all subsequent work
- Main ingredients:
  - Size of government = transfers/redistribution/size of "welfare state" (not revisiting Hobbes, Plato, *etc.*)
  - Minimal politics—vague majoritarianism (median voter)
  - Equilibrium policies represent preferred points of decisive agent
  - Key trade-off: more government, smaller pie to redistribute

Much progress, many challenges

- A large literature has developed since then: much progress
- I'm going to emphasize some difficulties, though
  - Mainly in accounting for cross-country differences in composition of taxes
  - *cf.* Peter Lindert, *Growing Public* (Cambridge University Press, 2004)
- My bias is toward macro-political economy models, calibratable, quantitative
- Still, I'll try some methods more common to theoretical political science than to macro
  - Uncovered set, essential set

Roadmap of talk

Meltzer-Richard: A parametric example

- Two types of agents, with preferences over consumption and leisure
$$U(c_i, l_i) = \log(c_i) + \psi \log(l_i)$$
- Agents differ in labor productivity, $e_L < e_H$,
- Leisure is time not spent working, $l_i = 1 - n_i$, and type-i agent supplies effective labor $e_i n_i$.
- Labor income, $we_i n_i$ taxed at flat rate τ. All agents receive an identical transfer T. This gives a budget constraint
$$(1 - \tau)we_i n_i + T = c$$
- Important constraint is $n_i \geq 0$, equivalently $l_i \leq 1$

Meltzer-Richard: A parametric example

- Technology is simple, linear in effective labor:

$$C = wN$$

where

$$N = \sum_i p_i e_i n_i$$

and p_i is type i's share of population.

- Government simply collects tax revenue, redistributes

$$T = \tau wN$$

Essential tensions

- Subsitute T from government's budget constraint into agent's budget constraint to get

$$we_i n_i + \tau[wN - we_i n_i] = c$$

- Only agent with below-average earnings (type e_L) gains from redistribution. Type e_H would prefer $\tau = 0$.
- Does type e_L want $\tau = 1$? No—because tax is distortionary (higher τ, lower N), this is not a pure redistribution game.
- It's only because taxes distort economic activity that we have any hope of finding interior political equilibria (or political equilibria at all, if we increase the number of agent types).

Calibrating & solving

- Could solve model algebraically, but—even though this is clearly a toy model—I still like to calibrate, get quantitative solutions
- The model only has two items to calibrate: preference parameter ψ and type distribution $\{p_i, e_i\}$. The technology parameter w just sets units, doesn't matter otherwise.
- ψ governs agents' allocation of time between leisure and market work. If we had a representative agent, $\psi = 2$ would give $n = 1/3$, so let's use that.

Calibrating & solving

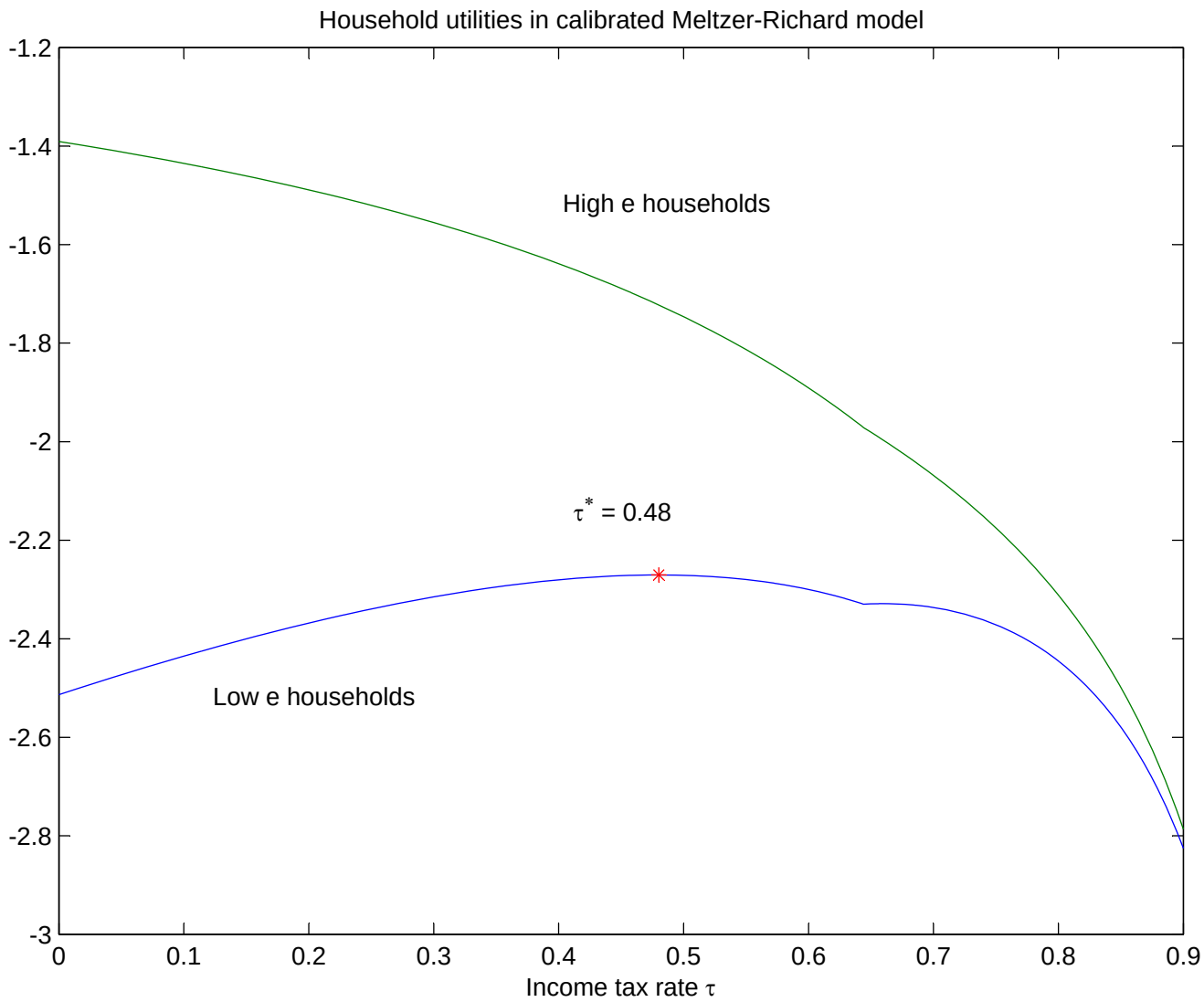
- For the types' shares of the population, $50-50$ does us no good. Since we do observe non-zero taxes, let's make the e_L type the majority, $p_L = 0.6$, and $p_H = 0.4$.
- Then, can set e_L and e_H to match some facts—in particular, Katz-Autor estimate of standard deviation of log real wages.
- This plus $\sum_i p_i e_i = 1$ gives

$$(e_L, e_H) = (0.547, 1.980)$$

or

$$e_H/e_L \approxeq 3.1$$

What do we find? Way too much government



Extensions of Meltzer-Richard

- Many extensions of basic model have expanded our understanding of the determinants of the size of government
- Krusell & Rios-Rull (*AER*, 1999): Extends Meltzer-Richard to neoclassical growth model
  - Heterogeneity in initial capital holdings and labor productivity
  - Single tax instrument, median voter
  - Markov equilibrium, $\tau_{t+1} = \Psi(A_t, \tau_t)$, $A_{t+1} = H(A_t, \tau_t)$
  - What does steady state of the mapping look like? Calibrated to US data, gives about the right size of government, $\approxeq$ 7% of GDP

Extensions of Meltzer-Richard

- Krusell, Quadrini, Rios-Rull (*JME*, 1996): Comparing income tax systems to consumption tax systems
  - Consumption tax systems $\Rightarrow$ bigger government
  - Switch from income tax to consumption tax may make everyone worse off
  - When both types of taxes allowed (they assume one decisive agent type), consumption tax rate is positive & income tax rate is negative
  - Negative income tax rate undoes some of the distortion associated with the high consumption tax rate

Extensions of Meltzer-Richard

- Hassler, Rodriguez Mora, Storesletten & Zilibotti (*AER*, 2003): Survival of the welfare state paper
  - Agents can investment in improving their labor productivity ('education')
  - Redistribution reduces incentive to invest $\Rightarrow$ greater demand for redistribution
  - Makes welfare state persistent
  - OLG framework with two-period-lived agents; median voter; Markov equilibrium; theoretical
- Hassler, Krusell, Storesletten & Zilibotti (*JME*, 2005): Dynamics of government
  - Similar structure to HRSZ
  - Under probabilistic voting, welfare state does not survive in steady state

The challenge posed by cross-country comparisons

- Why is US social spending not more like, say, Norway?
- Can we have a successful theory of the size of government that does not explain cross-country differences in the size of welfare states?
- Composition of financing seems important for cross-country comparisons
  - E.g., consumption taxes in Norway 26%, versus US 6%.
  - Peter Lindert's *Growing Public*: Nordic welfare states are very big, but they're financed very efficiently

Tax rates for 20 OECD countries (Carey & Rabesona, 2002)

	Consumption	Labor income	Capital income
US	6.4	23.4	27.3
Japan	6.4	24.1	27.9
Switzerland	9.3	30.9	27.1
Australia	12.1	20.9	30.7
Germany	13.4	35.0	21.2
Canada	13.9	29.6	36.8
Italy	13.9	37.7	31.0
Spain	14.5	30.7	20.0
Belgium	15.0	41.3	32.7
France	15.1	40.5	33.2

Tax rates for 20 OECD countries (Carey & Rabesona, 2002)

	Consumption	Labor income	Capital income
Greece	15.5	34.9	12.9
UK	15.7	22.6	34.0
Korea	15.8	9.9	16.7
Austria	16.2	39.6	24.3
Netherlands	18.0	36.4	32.7
Finland	18.7	45.0	26.0
Sweden	19.8	49.6	35.7
Portugal	19.9	23.9	17.6
Denmark	20.6	39.9	39.5
Norway	25.7	36.2	24.7
Mean	**15.3**	**32.6**	**27.6**

A model with three types of taxes

- Households pay three types of taxes, on capital income, labor income, and consumption
- Very simple model, two-sector AK (a la Rebelo, *JPE* 1999)
- Equilibria given constant tax rates have no transitional dynamics, and households' relative positions in wealth/income distribution constant.
- Solve for BGE given constant taxes, take households' utilities over constant tax rates, $V_i(\tau)$, as inputs to political decision

A model with three types of taxes

- Political decision once-and-for-all at date zero
  - Clearly a simplification
  - But, given linear structure of model, if you make same decision again at a later date, you'd get the same result
- See how much we can say just deciding over constant tax rates
- Consider several different solution concepts
  - Probabilistic voting
  - Pareto set, uncovered set, essential set
- **This is very much work-in-progress**

Households

- Standard preferences over consumption and leisure:

$$U = \sum_{t=0}^{\infty} \frac{[c_{i,t}(1-n_{i,t})^{\psi}]^{1-\sigma}}{1-\sigma}$$

- Sequence of budget constraints:

$$(1-\tau_k)r_t k_{i,t} + (1-\tau_n)w_t e_i n_{i,t} + T_t = (1+\tau_c)c_{i,t} + q_t[k_{i,t+1} - (1-\delta)k_{i,t}]$$

- Nonnegativity constraint on hours worked: $n_{i,t} \geq 0$
- Household types distinguished by values of (e_i, s_i), where $s_i = k_{i,0}/K_0$, which will also equal $k_{i,t}/K_t$ in BGE. Let I denote the set of types.

Firms

- CRTS, indeterminate number of firms
- Produce consumption good using Cobb-Douglas technology, using capital and effective labor:

$$Z_t = (\eta_t K_t)^{\alpha} N_t^{1-\alpha}$$

- Produce new capital (gross investment) with a linear technology:

$$X_t = A(1-\eta_t)K_t$$

- Maximize profits, which are zero in equilibrium:

$$Z_t + q_t X_t - w_t N_t - r_t K_t$$

Government

- Collects tax revenue, uses for redistribution and to pay for exogenous government consumption, G_t
- Consumption tax is incredibly efficient; hard to avoid unrealistically high values in any political equilibrium.
- I'm going to cheat a little and make government relatively less adept at translating consumption tax collections into usable revenues (compared to factor income taxes).
  - Some of the collected consumption tax is going to be lost in the process

$$T_t + G_t = \tau_k r_t K_t + \tau_n w_t N_t + (1 - \theta)\tau_c C_t$$

Resource constraints

- Demand for effective labor equals its supply

$$N_t = \sum_{i \in I} p_i e_i n_{i,t}$$

- Capital producing sector's output equals household demand for new capital:

$$X_t = \sum_{i \in I} p_i [k_{i,t+1} - (1 - \delta) k_{i,t}]$$

- Consumption good output equals private + public consumption:

$$Z_t = \sum_{i \in I} p_i c_{i,t} + G_t + \theta \tau_c \sum_{i \in I} p_i c_{i,t}$$

Balanced growth equilibrium given constant taxes

- Assume government consumption is a constant fraction of consumption good output: $G_t = \lambda Z_t$
- Can show there is a BGE where households choose constant labor effort n_i, household's shares of aggregate capital stock are constant at $k_{i,t}/K_t = s_i$, and the firm chooses a constant fraction η of capital to allocate to producing the consumption good.
- Capital stock grows at rate $1 + \gamma_k = A(1 - \eta^*) + 1 - \delta$, everyone's consumption grows at rate $1 + \gamma_k = (1 + \gamma_k)^{\alpha}$, price of capital q_t falls at rate $1 + \gamma_q = (1 + \gamma_k)^{\alpha - 1}$.
- The after-tax return on new capital is constant, and:

$$\frac{(1 - \tau_k) r_{t+1} + q_{t+1}(1 - \delta)}{q_t} = (1 + \gamma_q)[(1 - \tau_k)A + 1 - \delta]$$

Balanced growth equilibrium given constant taxes

- The BGE consumption growth rate is sensitive to τ_k—which should help narrow range of possible τ_k's in any political equilibrium:

$$1 + \gamma_c = [\beta(1 - \tau_k)A + 1 - \delta]^{\alpha/(1-\alpha(1-\sigma))}$$

- Calibrating, solving for BGE at given tax vector $\tau = (\tau_k, \tau_n, \tau_c)$ yields lifetime utilities for each household type—which can then be used as preferences over alternative policies:

$$\{V_i(\tau) : i \in I\}$$

- Can also calculate size of government T/Y at every τ.

Calibration

- I calibrate the model as if in a BGE with constant tax rates given by Table 1 data for US:

$$\bar{\tau} = (\bar{\tau}_k, \bar{\tau}_n, \bar{\tau}_c) = (.273, .234, .064)$$

- Calibrate EIS (0.5) and depreciation rate (10%) directly.
- Also, θ, share of τ_c collections 'lost', set directly: $\theta = 0.1$.

Calibration

- Other taste, technology parameters α, A, ψ, λ and β set to match several targets:

Quantity	**Target**
Private consumption share of output	65%
Government consumption (G) share of output	20%
Labor's share of national income	60%
Fraction of time endowment spent working	30%
Consumption growth rate	2% per year

Calibration

- Remaining parameters govern distribution of household types
- Four types: $I = \{(e_L, s_L), (e_L, s_H), (e_H, s_L), (e_H, s_H)\}$
- $\text{Mean}(e) = \text{Mean}(s) = 1$
- $\text{Fraction}(e = e_L) = \text{Fraction}(s = s_L) = 6/10$
- $\{s_L, s_H\}$ such that bottom 60% of wealth distribution own 7% of capital stock (Budria Rodriguez et al., *Minneapolis Fed Review*)

Calibration

- $\{e_L, e_H\}$ chosen to give std. dev. of log real wages equal to 0.55 (Katz & Autor, *Handbook of Labor*)
- Correlation between e and s is 0.46 (Budria Rodriguez et al.)
- No type constitutes a majority, though (e_L, s_L) comes close—47%.
- Note wealth distribution much more unequal than earnings ability: $e_H/e_L \approxeq 3$, $s_H/s_L \approxeq 20$.

Calibration

- When we get to political equilibria, we'll also discretize the set of alternatives, $\tau = (\tau_k, \tau_n, \tau_c)$.
- Some methods are computationally intensive—only feasible on coarser grid. Others (like probabilistic voting), we can get away with a finer grid.

Probabilistic voting

- Often used in cases of multi-dimensional issue space (Lindbeck & Weibull, *Public Choice* 1987, is one example).
- Assumes issues other than τ affect household preferences over candidates.
- E.g., utility that household-type $i = (e_i, s_i)$ gets from candidate A winning could be

$$V_i(\tau_A) + \xi_A$$

- Household h votes for A over B if

$$V_i(\tau_A) + \xi_A > V_i(\tau_B) + \xi_B$$

or

$$V_i(\tau_A) - V_i(\tau_B) > \xi_B - \xi_A$$

Probabilistic voting

- Candidates treat $\xi_B - \xi_A$ as random variable with some distribution—e.g., logistic—so A's perceived expected # of votes, given B's platform τ_B:

$$\sum_{i \in I} p_i \left(\frac{\exp[V_i(\tau_A)]}{\exp[V_i(\tau_A)] + \exp[V_i(\tau_B)]} \right)$$

- Gives rise to nice normal-form game between A and B.
- Can calculate symmetric Nash equilibria

The Pareto Set

- The Pareto set is the set of alternatives τ for which there is no τ' that is *unanimously* preferred to τ. That is,

$$P = \{\tau : \nexists \tau' \text{ with } V(\tau'; e, s) > V(\tau; e, s) \, \forall (e, s)\}$$

- Useful if distortionary effects are large—i.e., alternative tax rates have big effects on size of pie to be redistributed.
- If so, could give narrow range of outcomes we might expect to observe, or at least narrow range down to a manageable number, to which we could apply further refinements (like covering).

The Uncovered Set

- A bit complicated to describe
- Begin with majority preference relation, $\succ$:

$$\tau \succ \tau' \iff \sum \{p(e,s) : V(\tau; e, s) > V(\tau'; e, s)\} > \frac{1}{2}$$

- In our model calibration, $\succ$ is asymmetric and antireflexive (it's a dominance relation), and moreover complete (so it's actually a tournament relation).

Definition

τ_j **covers** τ_i if and only if $\tau_j \succ \tau_i$ and $\tau_i \succ \tau_h$ implies $\tau_j \succ \tau_h$. That is, τ_j beats τ_i and beats any other alternative that τ_i beats.

The Uncovered Set

- We can then define the uncovered set as follows:

Definition

The uncovered set is the set of tax rates τ that are not covered by any τ'.

- Intuition on why this is relevant/useful: A candidate who plays a covered alternative in two-party competition is playing a dominated strategy.
- If I play τ that's covered by some τ', there's no circumstance (*i.e.*, no choice by my opponent) where I wouldn't have been better off playing τ' instead—τ' beats τ and does at least as well against everything else.

The Essential Set

- Defined by B. Dutta and J.-F. Laslier (*Social Choice and Welfare*, 1999).
- Set of alternatives played with positive probability in mixed-strategy Nash equilibrium of two-candidate tournament game induced by the majority-voting dominance relation.
- Candidates simultaneously announce alternatives. If 1 chooses τ_i, 2 chooses τ_j, payoffs to candidate 1 are:

$$\begin{array}{lll} +1 & \text{if} & \tau_i P \tau_j, \\ -1 & \text{if} & \tau_j P \tau_i, \end{array}$$

  and zero in the event of a tie (which can't happen in our case).
- F. Brandt & F. Fischer show one can compute the essential set as the solution to a particular linear programming problem (*Mathematical Social Sciences*, 2008).

The relationship between the concepts

- Probabilistic voting is, of course, in its own world—no guarantees that equilibria bear any particluar relation to P, U or E
- Other three solution sets can be ordered by inclusion
- We have the following relationship between the Pareto set, uncovered set and essential set:

$$E \subseteq U \subseteq P$$

- Suggests computation strategy: first find P, then look inside it for U and E

Probabilistic voting: Cautionary findings

- What's our basis for assuming *additive* uncertainty? (As in, *e.g.*, Hassler, Krusell, Storesletten and Zilibotti, *JME*'05, dynamics of welfare state paper.)
- What if i's utility from victory by A is

$$\exp(\xi_A) V_i(\tau_A)$$

  (with ξ_A still logistic)?
- Then, A's expected support is

$$\sum_{i \in I} p_i \left(\frac{V_i(\tau_A)}{V_i(\tau_A) + V_i(\tau_B)} \right)$$

Probabilistic voting: Cautionary findings

- It'd be nice if this didn't make a difference, but it does.
- Here's the additive equilibrium

$$\tau^*_{\text{Add}} = (\tau^*_k, \tau^*_n, \tau^*_c)_{\text{Add}} = (.04, .42, .00)$$

- And here's the multiplicative equilibrium

$$\tau^*_{\text{Mult}} = (\tau^*_k, \tau^*_n, \tau^*_c)_{\text{Mult}} = (.32, .30, .31)$$

Probabilistic voting: Cautionary findings

- Well, maybe they at least agree on the 'size of government'? It turns out, no:

$$(T/Y)_{\text{Add}} = 0.1\%$$
$$(T/Y)_{\text{Mult}} = 29.3\%$$

- Additive is essentially using taxes just to pay what's required for G, multiplicative is doing Scandanavian-scale redistribution

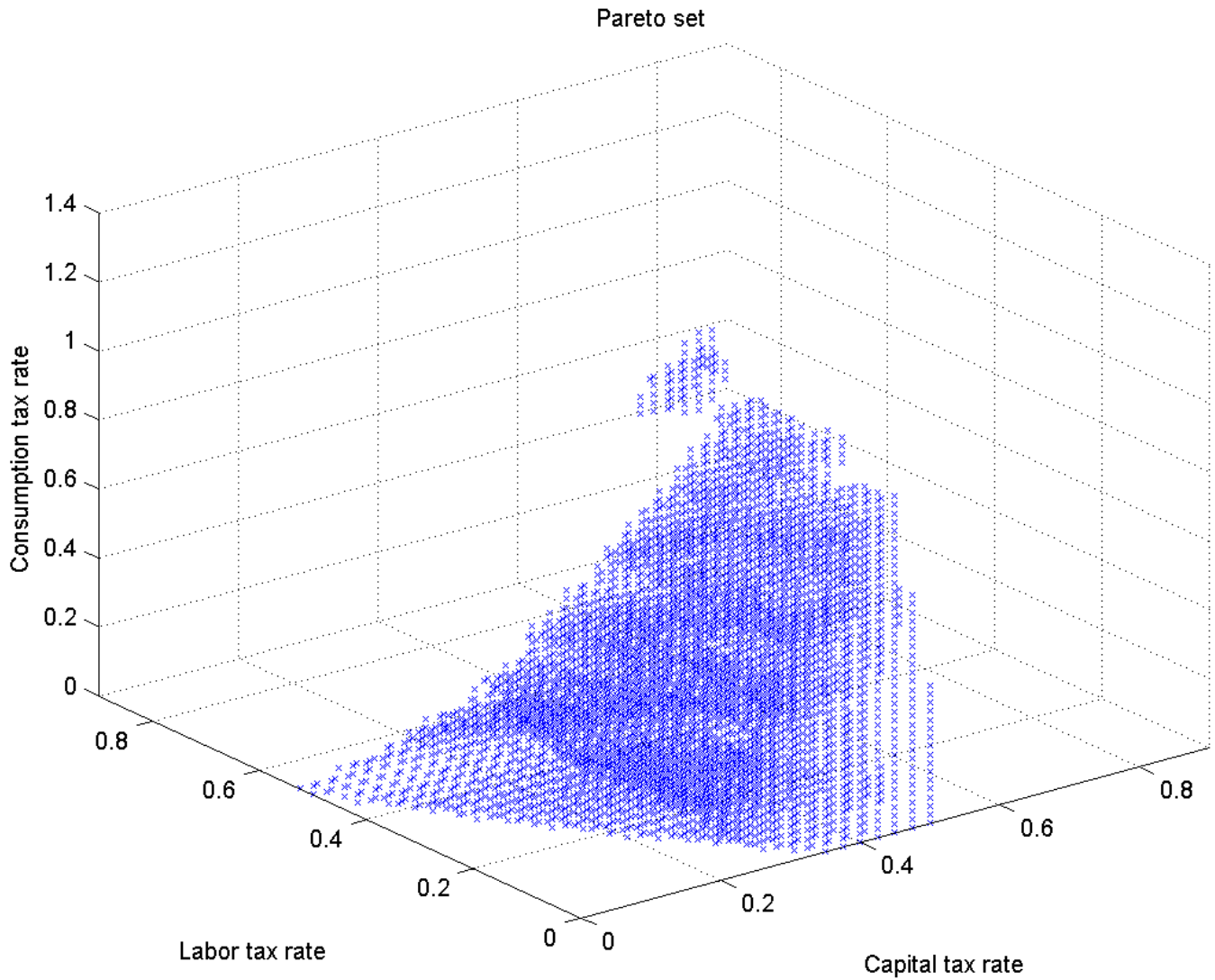
Probabilistic voting: What's going on?

- Can show that the two PV equilibria correspond to two different SWF-maximization problems
- One is utilitarian: $SWF = \sum p_i V_i$
- One adds some curvature: $SWF = \sum p_i \log(V_i)$
- Latter gives, in effect, more weight to poorer agents in FOC
- Lesson: need to be careful using probabilistic voting

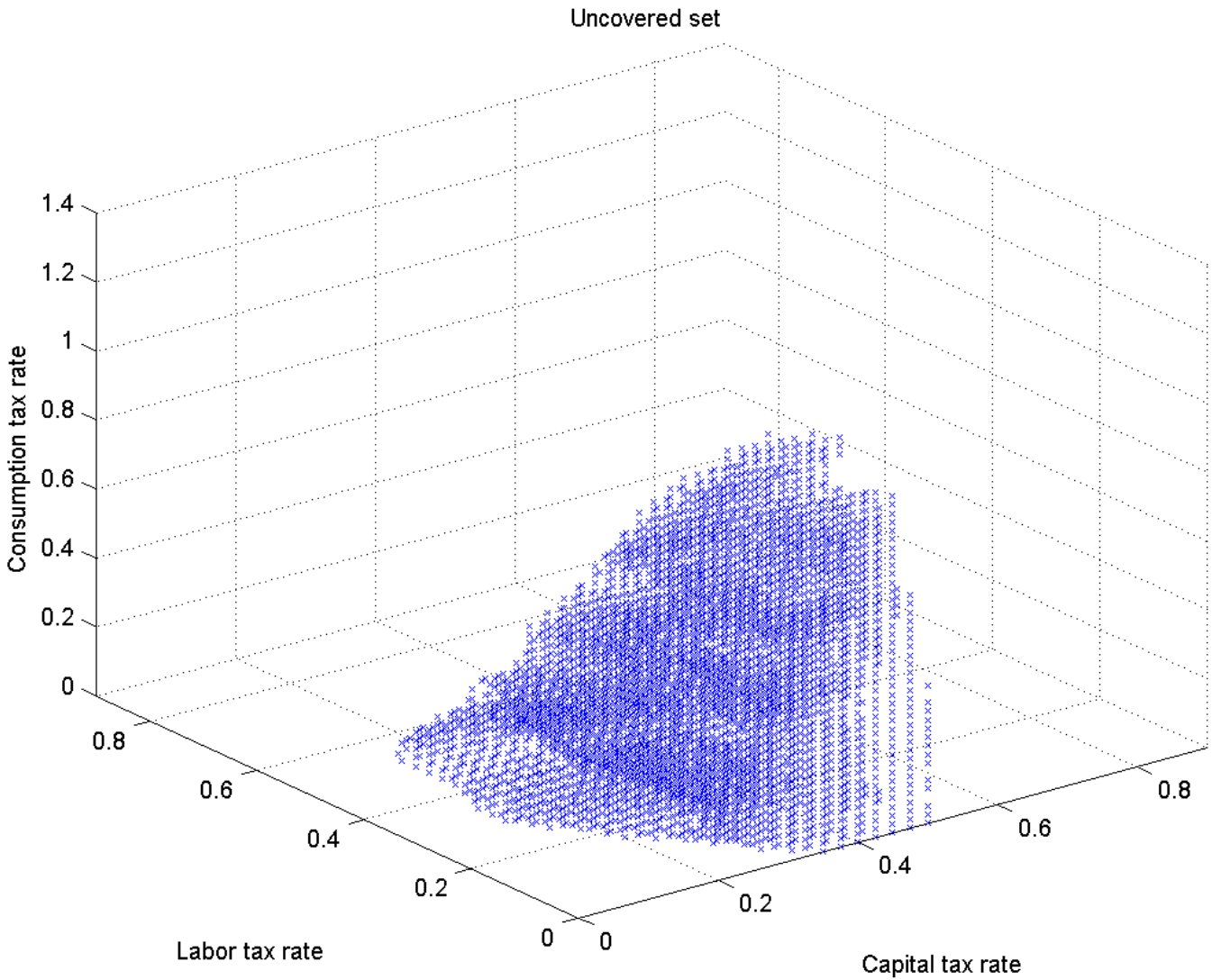
Pareto set & uncovered set: Small, yet big

- Can only calculate P and U on fairly coarse grid: τ_k and τ_n range from 0% to 90% in increments of 2.5%, τ_c goes from 0% to 140% in increments of 2.5%
- That's still over 78,000 alternatives, and we need to do a lot of pairwise comparisons
- Resulting Pareto set—tax vectors that don't have unanimously preferred alternatives—is 'small' in some sense: just 6.2% of entire issue space.
- Uncovered set slightly smaller: about 5.6% of issue space
- But they're big relative to the OECD data

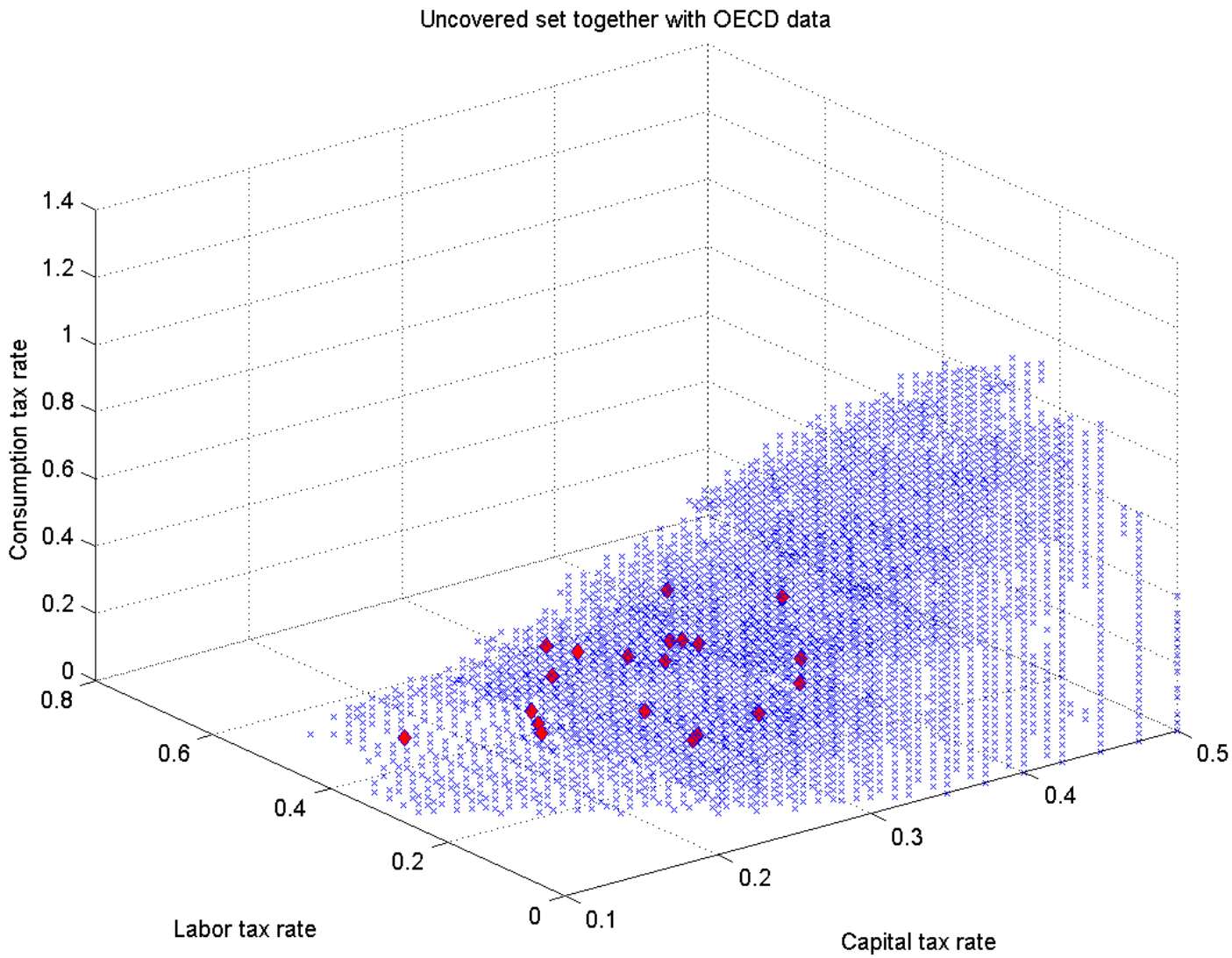
The Pareto set



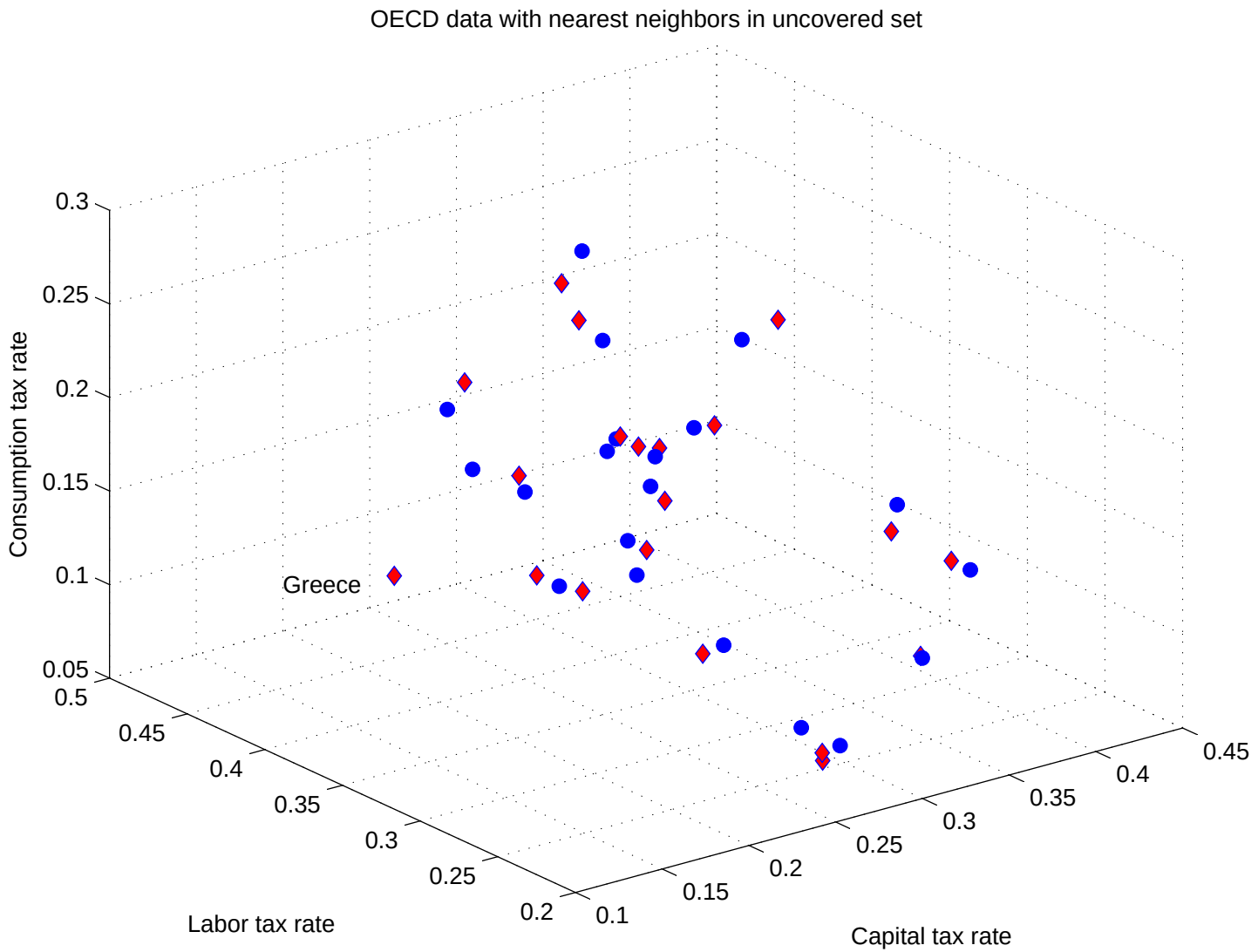
The uncovered set: Only slightly smaller,



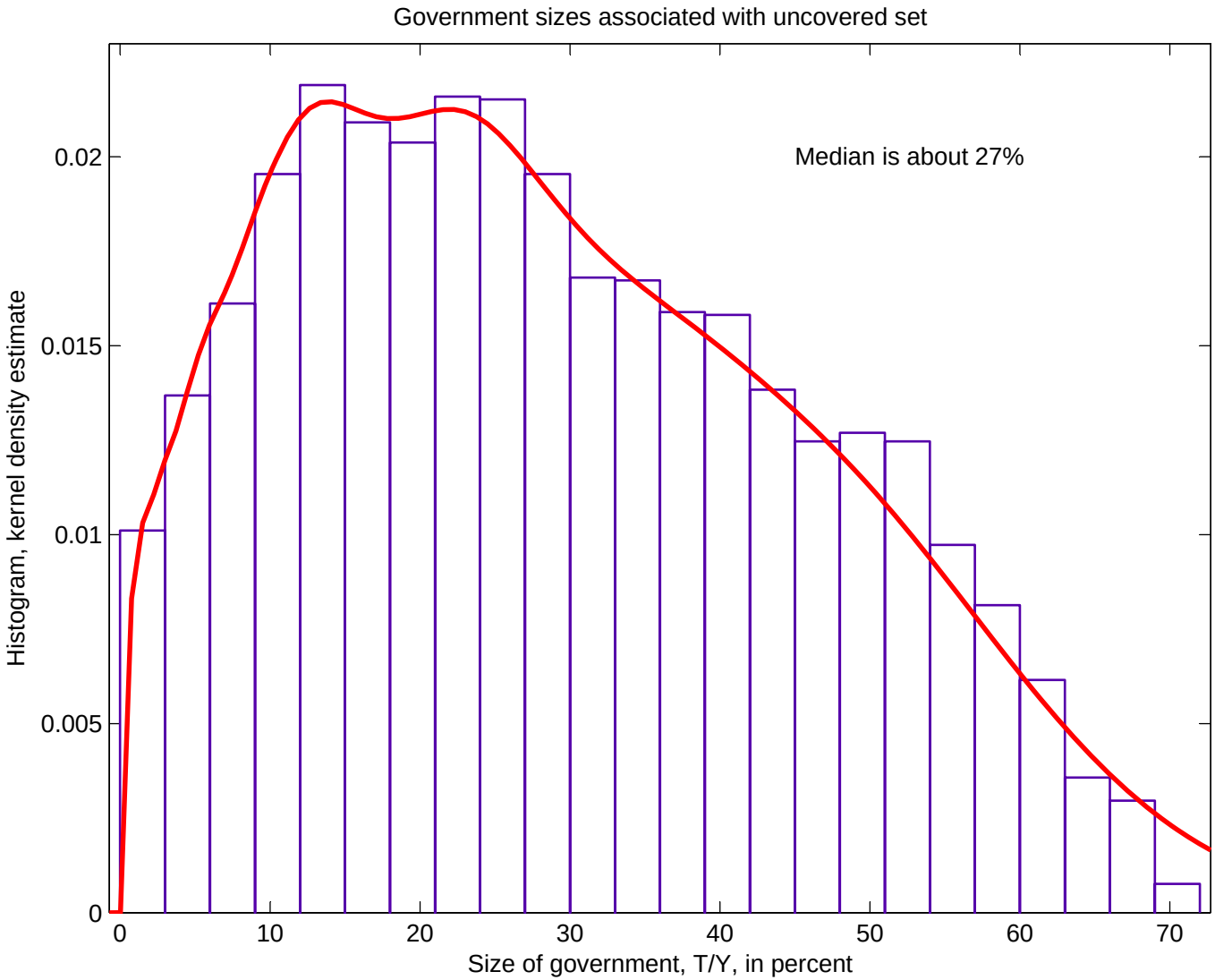
The uncovered set: a cloud around the OECD data



The uncovered set & OECD data: Only Greece is an outlier



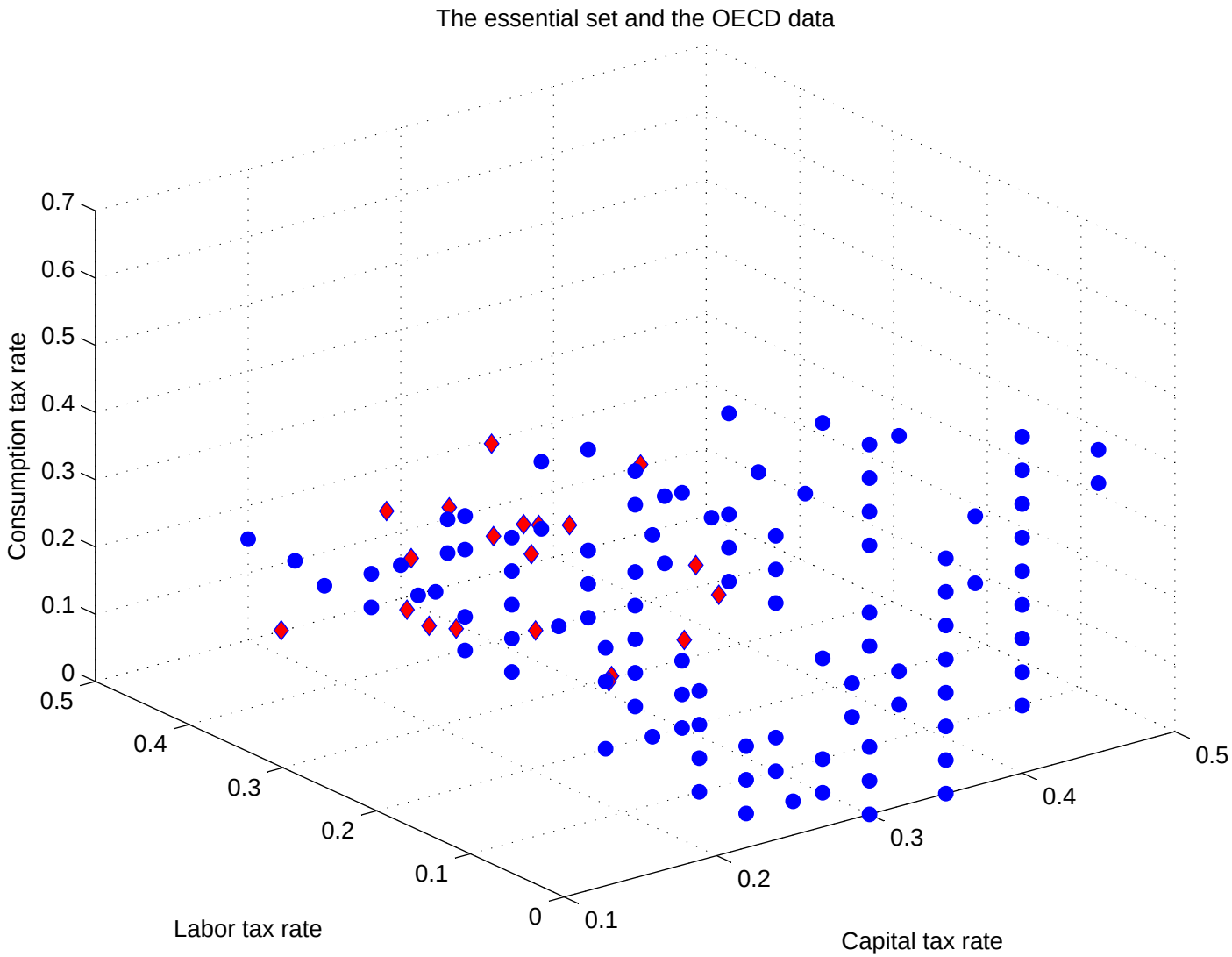
The uncovered set is consistent with a wide range of government sizes



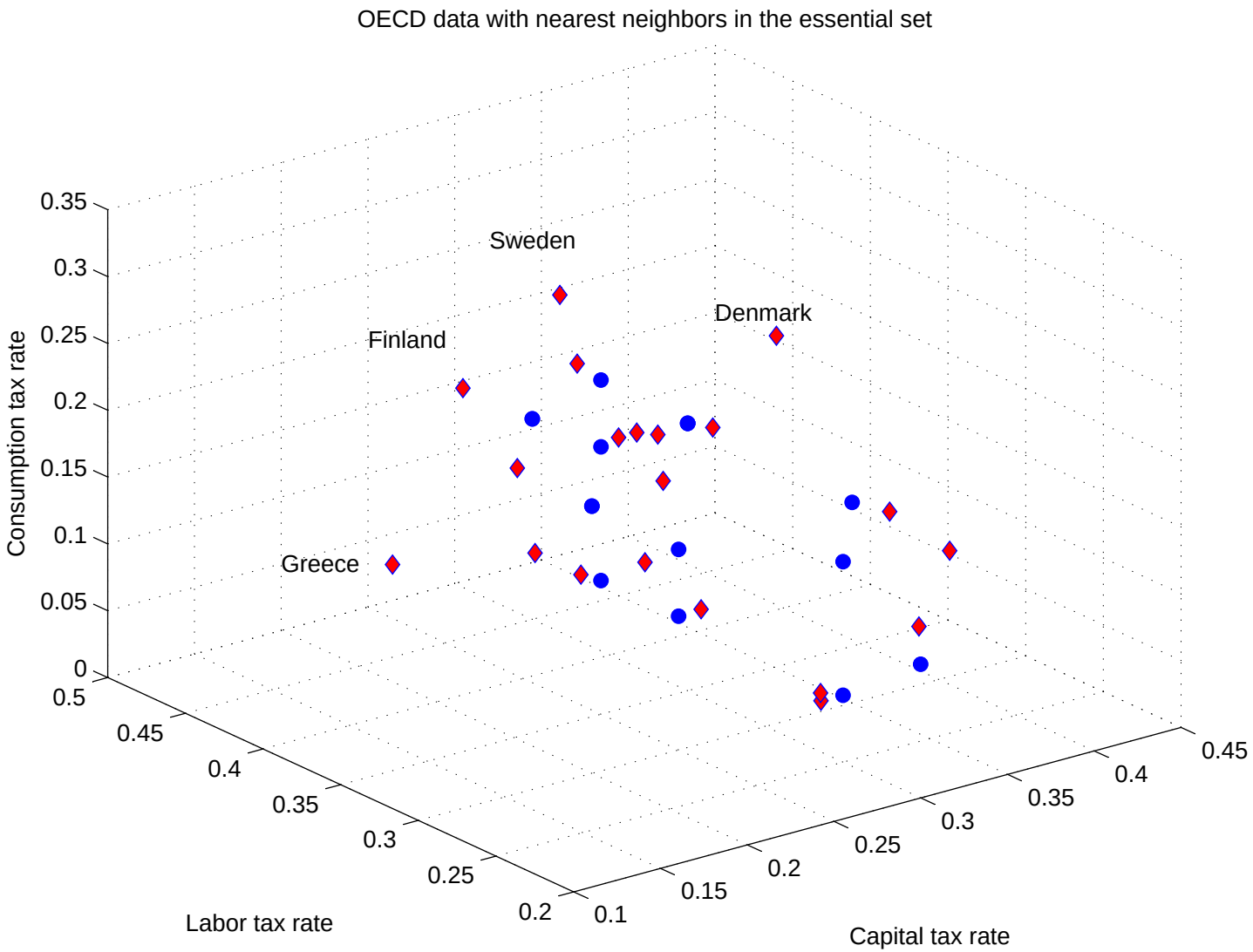
The essential set

- I had to cheat a bit here: even working just inside U, still have 4,384 alternatives
- Makes for a linear programming problem that's way too big
- What did I do? Project the uncovered set U onto a coarser grid (5% steps), gives 811 alternatives
- Solve LP problem on that coarser set
- Yields 103 alternatives that are played with positive probability in mixed-strategy equilibrium

The essential set & the OECD data



The OECD data and closest neighbors in E: there are a few outliers



Taking the OECD data as set of alternatives

- What if we just make the issue space the 20 tax vectors from the Carey-Rabesona data?
- The Pareto set is all 20 countries
- Probabilistic voting outcomes

$$(\tau_k^*, \tau_n^*, \tau_c^*)_{\text{Add}} = (12.9\%, 34.9\%, 15.5\%)$$
$$(\tau_k^*, \tau_n^*, \tau_c^*)_{\text{Mult}} = (32.7\%, 36.4\%, 18\%)$$

—Greece and Netherlands

Taking the OECD data as set of alternatives

- The uncovered set consists of 12 countries, the essential set 9 countries:

Uncovered set	Essential set
US	US
Switzerland	Switzerland
Australia	Australia
Canada	Canada
Italy	Spain
Spain	Korea
France	Austria
UK	Netherlands
Korea	Finland
Austria	
Netherlands	
Finland	

Conclusions/What next?

- Somewhat depressing results—majoritarian methods can rule out a lot, just not enough
- To apply probabilistic voting, one needs to think hard about the form
  - Is there a form that encompasses both additive & multiplicative cases (say, dependent on value of some parameter)
  - How would one calibrate it? What data to bring to bear?
- Could simplify population structure—make some household type decisive ($p_i > \frac{1}{2}$).
  - Seems like a cheap way out, though
- Get more serious about describing the political institutions?