

# A Simpler Theory of Optimal Capital Taxation

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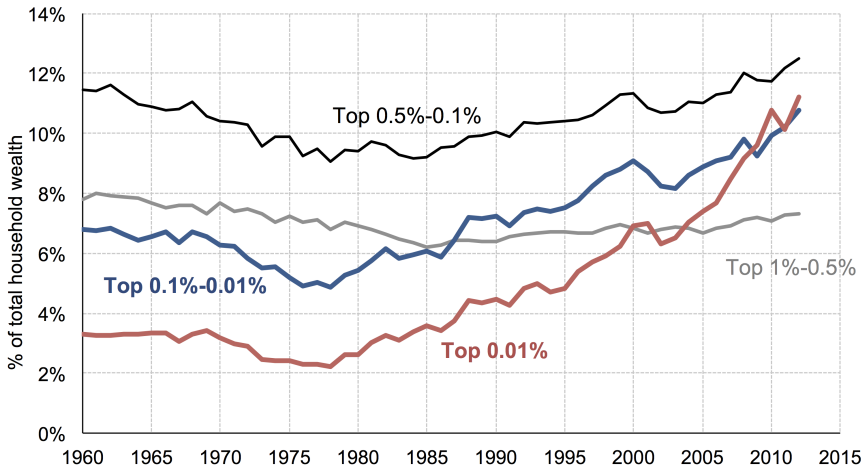
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# Taxation of Capital is First-Order Issue Given Wealth Inequality and Its Global Rise (U.S. Series here)



Source: Saez and Zucman (2015)

# The Need for a Simpler Model for Optimal Capital Taxation

1) Public debate centers around a **simple equity-efficiency tradeoff**:

How concentrated is capital? How does capital react to taxation?

2) Econ literature: disparate models and results (individual preferences, shocks, govt objective, policy tools)

Connect 1) and 2) by deriving robust optimal capital tax formulas in terms of estimable elasticities and distributional parameters

⇒ optimal K tax theory looks like optimal L tax theory.

Centered around equity-efficiency trade-off.

Highlights main forces + policy implications for K tax (often obscured).

## Goals and Contributions

1) Start with dynamic model with linear utility for consumption and concave utility for wealth.

⇒ Transitional dynamics instantaneous ⇒ Simple, tractable theory.

*Put simplicity to use:* new formulas for policy-relevant cases (nonlinear tax, cross-effects, shifting, consumption tax, ..) and normative considerations.

2) Generalize to model with concave utility ⇒ Same optimal K tax formulas apply, with *appropriately defined elasticity of the tax base*.

Qualitatively: Lessons and intuitions from simpler model still valid.

Quantitatively: Sluggish adjustments reflected in elasticity.

The faster K adjustments, the closer to simpler model.

3) Numerically explore optimal taxation using U.S. IRS data.

## Related Literature

### Key Results on K Taxation :

*Neoclassical:* Judd (1985), Chamley (1986), Straub and Werning (2015).

*Incomplete markets:* Aiyagari (1995), Farhi (2010).

*NDPF/ Inverse Euler Equation:* Kocherlakota (2005), Golosov, Tsyvinski, Werning (2006), Golosov and Tsyvinski (2006), Farhi and Werning (2012), Abraham, Koehne, Pavoni (2014), Scheuer and Wolitzky (2016).

**Quantitative Models:** Conesa, Kitao and Krueger (2008), Chen, Guvenen, Kambourov, Kuruscu, Ocampo (2016).

**Estate Taxation:** Farhi and Werning (2008), Piketty and Saez (2013), De Nardi and Yang (2015).

**Isomorphism to labor taxation:** Farhi and Werning (2013) applied to Estate taxation.

**Sufficient Stats in Dynamic Models:** Golosov, Tsyvinski, Werquin (2014), Badel and Huggett (2016).

# Outline

- 1 A Simpler Model of Capital Taxation
- 2 Putting the Model to Use: Topics
- 3 Numerical Application to the U.S.
- 4 Generalized Model

# A Simpler Model of Capital Taxation

## A Simpler Model of Capital Taxation

For exposition: Exogenous and uniform labor income  $z$

Heterogeneous discount rate  $\delta_i$  (assume  $\delta_i > r$ )

Exogenous and uniform rate of return  $r$  on wealth  $k$ , income:  $rk$

Time invariant tax  $T_K(rk)$

Initial wealth  $k_i^{init}$ , exogenous.

Individual  $i$  has instantaneous utility  $u_i(c, k) = c + a_i(k)$

linear in consumption  $c$  and increasing and concave in wealth  $k$ .

Maximizes:

$$U_i = \delta_i \cdot \int_{t=0}^{\infty} [c_i(t) + a_i(k_i(t))] e^{-\delta_i t}$$

$$\text{s.t. } \frac{dk_i(t)}{dt} = rk_i(t) - T_K(rk_i(t)) + z_i(t) - c_i(t)$$

## Solving the Individual's Maximization Problem

$$U_i = \delta_i \cdot \int_{t=0}^{\infty} [c_i(t) + a_i(k_i(t))] e^{-\delta_i t}$$

$$\text{s.t. } \frac{dk_i(t)}{dt} = rk_i(t) - T_K(rk_i(t)) + z_i(t) - c_i(t)$$

$$\text{Hamiltonian: } c_i(t) + a_i(k_i(t)) + \lambda_i(t) \cdot [rk_i(t) - T_K(rk_i(t)) + z_i(t) - c_i(t)]$$

$$\text{FOC in } c_i(t) : \quad \lambda_i(t) = 1 \Rightarrow \text{constant multiplier}$$

$$\text{FOC in } k_i(t) : \quad a'_i(k_i(t)) + \lambda_i(t) \cdot r \cdot (1 - T'_K) = -\frac{d\lambda_i(t)}{dt} + \delta_i \cdot \lambda_i(t)$$

$$\Rightarrow a'_i(k_i(t)) = \delta_i - \bar{r} \quad \text{where} \quad \bar{r} = r \cdot (1 - T'_K)$$

## Steady State

Utility for wealth puts limit on impatience to consume ( $\delta_i > \bar{r}$ )

MU for wealth  $a'_i(k) = \delta_i - \bar{r} =$  value lost in delaying consumption

Wealth accumulation depends on heterogeneous preferences  $a_i(\cdot)$ ,  $\delta_i$ , and net-of-tax return  $\bar{r}$  (substitution effects, no income effects)

$\Rightarrow$  Heterogeneity in (non-degenerate) steady-state wealth.

At time 0: jump from  $k_i^{init}$  to  $k_i(t)$  (consumption quantum Dirac jump):

$$U_i = \underbrace{rk_i(t) - T_K(rk_i(t)) + z_i(t)}_{c_i(t)} + a_i(k_i(t)) + \delta_i \cdot (k_i^{init} - k_i(t))$$

Dynamic model equivalent to a static model:

$$U_i = c_i + a_i(k_i) + \delta_i \cdot (k_i^{init} - k_i) \quad \text{with} \quad c_i = rk_i - T_K(rk_i) + z_i$$

Announced vs. unannounced tax reforms have same effect.

## Wealth in the Utility

Technical reason: to smooth otherwise degenerate steady state ( $\delta_i = \delta = \bar{r}$ )

Possible, but more complicated is uncertainty (in paper).

Entrepreneurship: “cost” of managing wealth,  $-h_i(k)$  (return  $r_i > \delta_i$ ).

Wealth brings non-consumption utility flows: Weber’s “*spirit of capitalism*.”

Keynes (1919, 1931) “*love of money as a possession*”, “*the virtue of the cake [savings] was that it was never to be consumed.*”

Social status (measure of ability, performance, success)

Power and political influence.

Philanthropy and moral recognition.

Empirical evidence in favor of wealth in the utility:

Carroll (2000): helps explain top wealth holdings.

## Isomorphism with Static Labor Taxation Model

$$U_i = c_i + a_i(k_i) + \delta_i \cdot (k_i^{init} - k_i) \quad \text{with} \quad c_i = rk_i - T_K(rk_i) + z_i$$

is mathematically isomorphic to static labor income model:

$$U_i = c_i - h_i(z_i) \quad \text{with} \quad c_i = z_i - T_L(z_i)$$

Optimal K tax analysis isomorphic to optimal L income tax theory.

Differences of degree rather than of kind, quantitative differences.

Key differences (e.g.: uncertainty, shocks to productivity vs. taste) reflected in estimable elasticities.

In general model, slow adjustment will be reflected in lower elasticity.

Bypasses transitional dynamics, greatly simplifies K tax analysis

Like labor supply decisions (not instantaneous, e.g. human capital investment).

# Government Optimization

Government sets a time invariant budget balanced  $T_K(\cdot)$  to maximize its social objective

$$\int_i g_i \cdot U_i(c_i, k_i) di \quad \text{with } g_i \geq 0 \quad \text{social marginal welfare weight}$$

Optimal  $T_K(\cdot)$  depends on three key ingredients:

- (1) **Social preferences:**  $g_i$  = value of \$1 extra given to  $i$  ( $\int_i g_i = 1$ ).
- (2) **Efficiency costs:** Elasticity  $e_K = (\bar{r}/k) \cdot (dk/d\bar{r})$  measures how wealth  $k$  responds to  $\bar{r} = r \cdot (1 - T'_K)$
- (3) **Distribution of capital income:**  $H_K(rk)$  (for nonlinear tax).

## Optimal Linear Capital Taxation at rate $\tau_K$

$k^m(\bar{r}) \equiv \int_i k_i di$  average wealth (depends on  $\bar{r}$  with elasticity  $e_K$ ).

Revenues  $\tau_K k^m(\bar{r})$  rebated lump-sum.

$\tau_K$  maximizes  $SWF = \int_i g_i \cdot U_i(c_i, k_i) di$  with

$$U_i = \underbrace{rk_i \cdot (1 - \tau_K) + \tau_K \cdot rk^m(\bar{r})}_{c_i} + z_i + a_i(k_i) + \delta_i \cdot (k_i^{init} - k_i)$$

Standard optimal tax derivation (using envelope thm for  $k_i$ ):

$$\frac{dSWF}{d\tau_K} = rk^m \cdot \underbrace{\int_i g_i \cdot \left(1 - \frac{k_i}{k^m}\right)}_{\text{Mechanical Revenue net of Welfare Effect}} - rk^m \cdot \underbrace{\frac{\tau_K}{1 - \tau_K} \cdot e_K}_{\text{Behavioral Effect}}$$

Optimal  $\tau_K$  such that  $dSWF / d\tau_K = 0$ .

## Optimal Linear Capital Tax $\tau_K$

$$\tau_K = \frac{1 - \bar{g}_K}{1 - \bar{g}_K + e_K} \quad \text{with} \quad \bar{g}_K = \frac{\int_i g_i \cdot k_i}{\int_i k_i} \quad \text{and} \quad e_K = \frac{\bar{r}}{k^m} \cdot \frac{dk^m}{d\bar{r}} > 0$$

Zero capital tax result:  $\tau_K = 0$  only if:

$\bar{g}_K = 1$  (no inequality in  $rk$ , or no redistributive concerns  $g_i \equiv 1$ ), or

$e_K = \infty$ .

$\tau_K > 0$  as long as  $g_i$  decreasing in  $k_i$ , or wealth concentrated among low  $g_i$  agents.

$\tau_K = 1/(1 + e_K)$  is revenue-maximizing in Rawlsian case:  $g_i = 0$  if  $k_i > 0$ .

Top revenue maximizing rate:  $\tau_K = 1/(1 + a_K^{top} \cdot e_K^{top})$  with  $a_K^{top}$  the Pareto tail parameter for top bracket.

## Optimal Nonlinear Capital Tax

$$T'_K(rk) = \frac{1 - \bar{G}_K(rk)}{1 - \bar{G}_K(rk) + \alpha_K(rk) \cdot e_K(rk)}$$

- 1)  $\bar{G}_K(rk) \equiv \frac{\int_{\{i: rk_i \geq rk\}} g_i d_i}{P(rk_i \geq rk) \int_i g_i d_i}$  is the average  $g_i$  above capital income level  $rk$
- 2)  $\alpha_K(rk)$  the local Pareto parameter of capital income distribution
- 3)  $e_K(rk)$  the local elasticity of  $k$  wrt to  $1 - T'_K(rk)$  at income level  $rk$

Capital income is very concentrated (top 1% capital income earners have 60%+ of total capital income)

⇒ Asymptotic formula:

$T'_K(\infty) = (1 - G_K(\infty)) / (1 - G_K(\infty) + \alpha_K(\infty) \cdot e_K(\infty))$  relevant for most of the tax base

# Putting the Model to Use: Topics

# Equity Considerations: The Ant and the Grasshopper



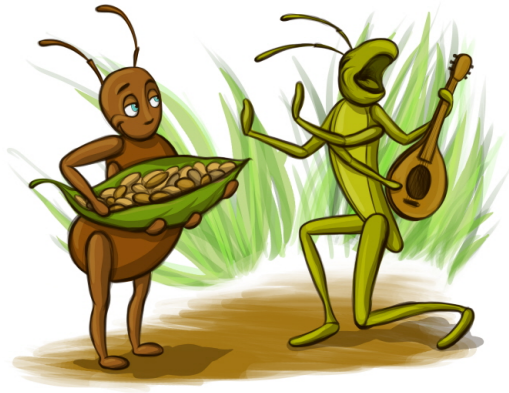
Credit: Adelya Tumasyeva

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# Equity Considerations for Capital Taxation

## (1) Inequality in wealth deemed fair and wealth is not a tag

Equality of opportunity argument: grasshopper had same savings opportunities as ant, conditional on labor earnings.

Capital accumulated by sacrificing consumption, why punish saving behavior.

What if ant had higher work (grain harvesting) ability? → role for nonlinear labor income tax.

→  $g_i$  independent of and uncorrelated with  $k_i$  →  $\tau_K = 0$ .

# Equity Considerations for Capital Taxation

## (2) Inequality in wealth viewed as unfair

High wealth comes from higher patience  $\delta_i$  or higher valuation of wealth  $a_i$  – unfair heterogeneity, like earnings ability.

or parental wealth ( $k_i^{init}$ ) – ant's parents left extra grain.

or higher returns  $r_i$  (luck) – ant speculated on grain-forward derivatives.

→  $g_i$  decreasing in  $k_i \rightarrow \tau_K > 0$ .

# Equity Considerations for Capital Taxation

## (3) Wealth as a tag

May or may not care about  $k$  per se ( $g_i$  may not depend on  $k_i$  directly).

But wealth may be tag for aspects that enter  $g_i$  negatively: parental background (see Saez-Stantcheva), ability.

Having more grain means more likely to come from rich family.

$\bar{G}_K(rk)$  is representation index of agents from poor background at income  $rk$ .

$\rightarrow \text{corr}(g_i, k_i) < 0 \rightarrow \tau_K > 0.$

## Adding in Labor Income Responses & Labor Taxation

Add in choice of labor income, with potentially arbitrary heterogeneity in disutility  $h_i(z)$ .

$$U_i = rk_i + z_i - T(rk_i + z_i) + a_i(k_i) + \delta_i \cdot (k_i^{init} - k_i) - h_i(z_i)$$

$$T'_L(z) = \frac{1 - \bar{G}_L(z)}{1 - \bar{G}_L(z) + \alpha_L(z) \cdot e_L(z)}$$

- 1)  $\bar{G}_L(z) \equiv \frac{\int_{\{i: z_i \geq z\}} g_i d_i}{P(z_i \geq z) \int_i g_i d_i}$  is the average  $g_i$  above labor income level  $z$
- 2)  $\alpha_L(z)$  the local Pareto parameter of capital income distribution
- 3)  $e_L(z)$  the local elasticity of  $k$  wrt to  $\bar{r}$  at income level  $rk$

Separable labor and capital taxes each set according to Mirrlees (1971) and Saez (2001) formulas.

## Joint Preferences in Capital and Labor and Cross-Elasticities

Agent's dynamic problem is again equivalent to maximizing:

$$U_i = c_i + v_i(k_i, z_i) + \delta_i(k_i^{init} - k_i) \quad \text{with} \quad c_i = \bar{r}k_i + z_i - T_L(z_i)$$

Choice  $(c, k, z)$  is such that:

$$v_{iz}(k_i, z_i) = 1 - T_L'(z_i), \quad v_{ik}(k_i, z_i) = \delta_i - \bar{r}, \quad c_i = \bar{r}k_i + z_i - T_L(z_i)$$

Optimal capital tax (at any, possibly non-optimal  $\tau_L$ ):

$$\tau_K = \frac{1 - \bar{g}_K - \tau_L \frac{z^m}{k^m} e_{Z,(1-\tau_K)}}{1 - \bar{g}_K + e_K}$$

$$\text{with} \quad \bar{g}_K = \frac{\int_i k_i g_i}{k^m}, \quad e_{Z,(1-\tau_K)} = \frac{dz^m}{d(1-\tau_K)} \frac{(1-\tau_K)}{z^m}$$

## Comprehensive nonlinear income taxation $T(rk + z)$

Govt uses solely comprehensive taxation  $T(y)$  with  $y_i \equiv rk_i + z_i$

$$U_i = rk_i + z_i - T(rk_i + z_i) + a_i(k_i) + \delta_i \cdot (k_i^{init} - k_i) - h_i(z_i)$$

Standard Mirrlees' formula applies to comprehensive income tax problem

$$T'(y) = \frac{1 - \bar{G}_Y(y)}{1 - \bar{G}_Y(y) + \alpha_Y(y) \cdot e_Y(y)}$$

with  $\bar{G}_Y(y) \equiv \frac{\int_{\{i: y_i \geq y\}} g_i d_i}{P(y_i \geq y) \int_i g_i d_i}$

$\alpha_Y(y)$  local Pareto parameter for  $y$  distribution,

$e_Y(y)$  local elasticity of  $y$  with respect to  $1 - T'$ .

## Tax shifting and Comprehensive Taxation

Suppose individual  $i$  can shift  $x$  dollars from labor income to capital income at utility cost  $d_i(x)$

Reported labor income  $z_L$  and capital income  $z_K$  are elastic to tax differential  $\tau_L - \tau_K$

If shifting elasticity is infinite, then  $\tau_L = \tau_K$  is optimal

If shifting elasticity is finite, then optimal  $\tau_L, \tau_K$  closer than they would be absent any shifting

If shifting elasticity is large then  $e_K$  can appear large, but wrong to set  $\tau_K$  at  $1/(1 + e_K)$  in that case

# Heterogeneous Returns

**Heterogeneous returns**  $r_i$  important in practice:

Same sufficient stats formula, but replace:

$$\bar{g} = \frac{\int_i g_i \cdot r_i k_i}{\int_i r_i k_i} \quad \text{and} \quad e_K = \frac{(1 - \tau_K)}{\int_i r_i k_i} \cdot \frac{d \int_i r_i k_i}{d(1 - \tau_K)}$$

Values of  $e_K$  (responsiveness of  $k$  to taxes) and  $\bar{g}_K$  (social judgement about capital income) could be affected.

## Different Types of Capital Assets

Could have  $\neq$  elasticities (housing vs. financial assets)

Different social judgments or distributional characteristics  $\bar{g}_K^j$ .

Formulas hold asset by asset, determined by:  $\bar{g}_K^j$ ,  $e_K^j$ , and cross-elasticities  $e_{K^s, (1-\tau_K^j)}$ .

$$\tau_K^j = \frac{1 - \bar{g}_K^j}{1 - \bar{g}_K^j + e_K^j}$$

$$\bar{g}_K^j = \frac{\int_i g_i \cdot k_i^j}{\int_i k_i^j}, \quad e_K^j = \frac{\bar{r}^j}{k^{m,j}} \cdot \frac{dk^{m,j}}{d\bar{r}^j} > 0, \quad e_{K^s, (1-\tau_K^j)} = \frac{\bar{r}^j}{k^{m,s}} \cdot \frac{dk^{m,s}}{d\bar{r}^j}$$

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$$\tau_K^j = \frac{1 - \bar{g}_K^j - \sum_{s \neq j} \tau_K^s \frac{k^{m,s}}{k^{m,j}} e_{K^s, (1-\tau_K^j)}}{1 - \bar{g}_K^j + e_K^j}$$

$$\bar{g}_K^j = \frac{\int_i g_i \cdot k_i^j}{\int_i k_i^j}, \quad e_K^j = \frac{\bar{r}^j}{k^{m,j}} \cdot \frac{dk^{m,j}}{d\bar{r}^j} > 0, \quad e_{K^s, (1-\tau_K^j)} = \frac{\bar{r}^j}{k^{m,s}} \cdot \frac{dk^{m,s}}{d\bar{r}^j}$$

## Consumption taxation: The Policy Debate

Can a consumption tax be better than a wealth tax and more progressive than a tax on labor income?

Bill Gates: *“Imagine three types of wealthy people. One guy is putting his capital into building his business. Then there’s a woman who’s giving most of her wealth to charity. A third person is mostly consuming, spending a lot of money on things like a yacht and plane. While it’s true that the wealth of all three people is contributing to inequality, I would argue that the first two are delivering more value to society than the third. I wish Piketty had made this distinction, because it has important policy implications.”*

## Consumption Taxation in our Model

Consider linear consumption tax at (inclusive) tax rate  $\tau_C$  so that:

$$\frac{dk_i(t)}{dt} = r(1 - \tau_K)k_i(t) + z_i(t) - T_L(z_i(t)) - c_i(t)/(1 - \tau_C)$$

Agents care about real wealth  $k^r = k \cdot (1 - \tau_C)$ .

Even with wealth-in-utility,  $\tau_C$  equivalent labor tax + tax on initial wealth (Kaplow, 1994, Auerbach, 2009).

Thought experiment: equal labor income.

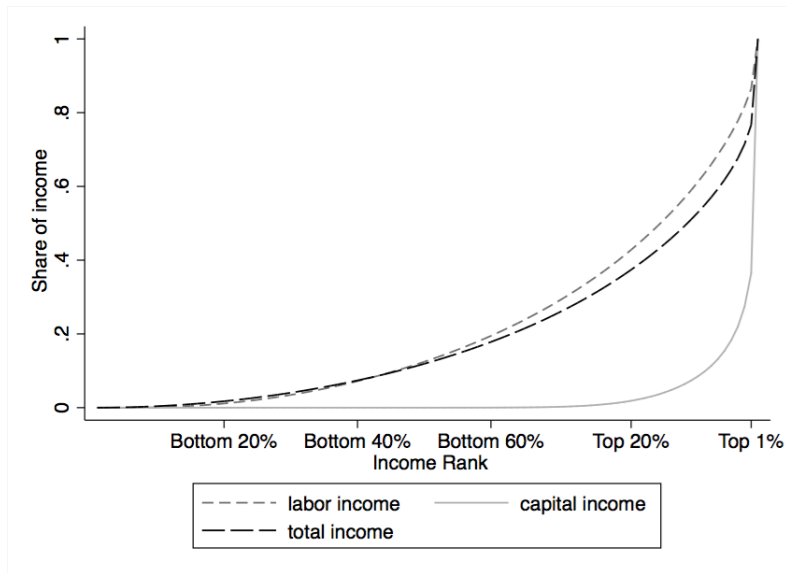
With  $\tau_C$ , wealthy look like pay more taxes, but paid less when accumulated more nominal wealth. Real wealth inequality unaffected.

With 2-dim heterogeneity: labor tax not sufficient (Atkinson-Stiglitz).

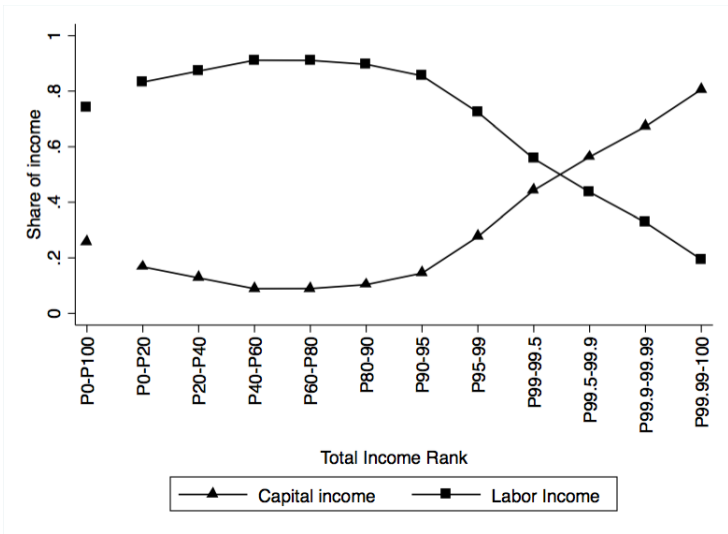
$\Rightarrow \tau_C$  cannot address steady-state capital income inequality

# Numerical Application to the U.S.

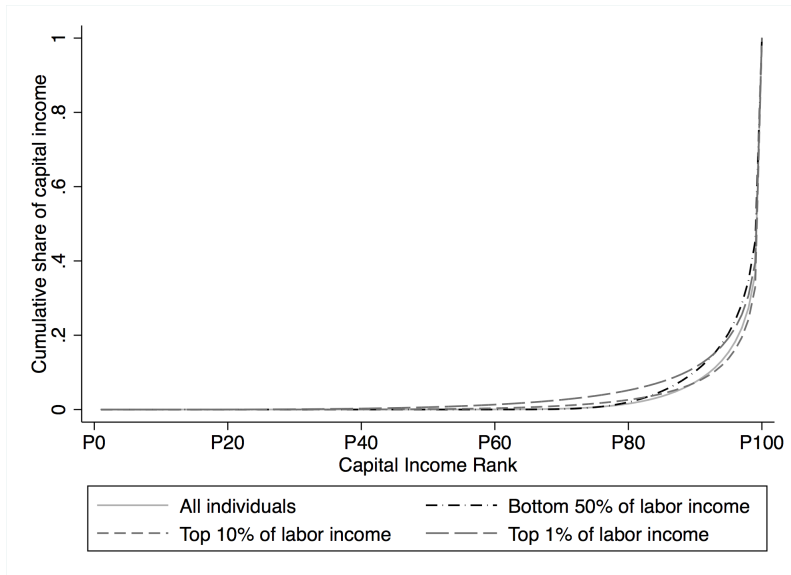
# Fact 1: K income more unequally distributed than L income



## Fact 2: At the top, total income is mostly capital income



### Fact 3: Two-dimensional heterogeneity, inequality in K income even conditional on L income



## Methodology for Computing Optimal Tax Rates

Suppose constant elasticity of labor, capital, and total income ( $e_L, e_K, e_Y$ ) and that choice at zero tax represents preference type:  $(\theta_i, \eta_i)$ .

Based on the IRS micro data, use pairs  $(z_i, rk_i)$  to invert individual choices to obtain  $(\theta_i, \eta_i)$ .

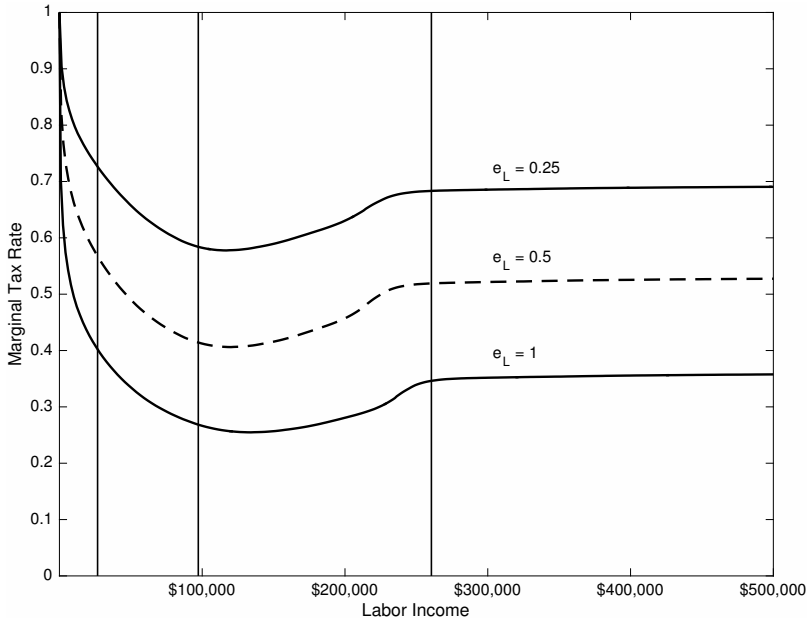
Non-parametrically fit type distributions and empirical Pareto parameters.

Solve for optimal  $T'_K, T'_L$ , and  $T'_Y$  using sufficient stats formulas.

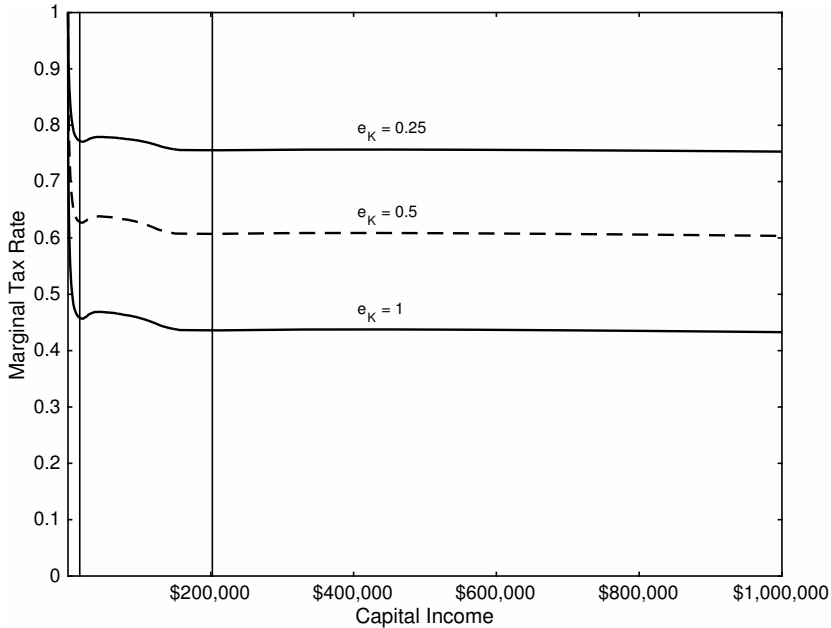
For capital – our simpler theory provides a much easier way to compute optimal tax rates based on the data.

Simulations set  $g_i = \frac{1}{\text{disposable income}_i}$  and use several values for elasticities.

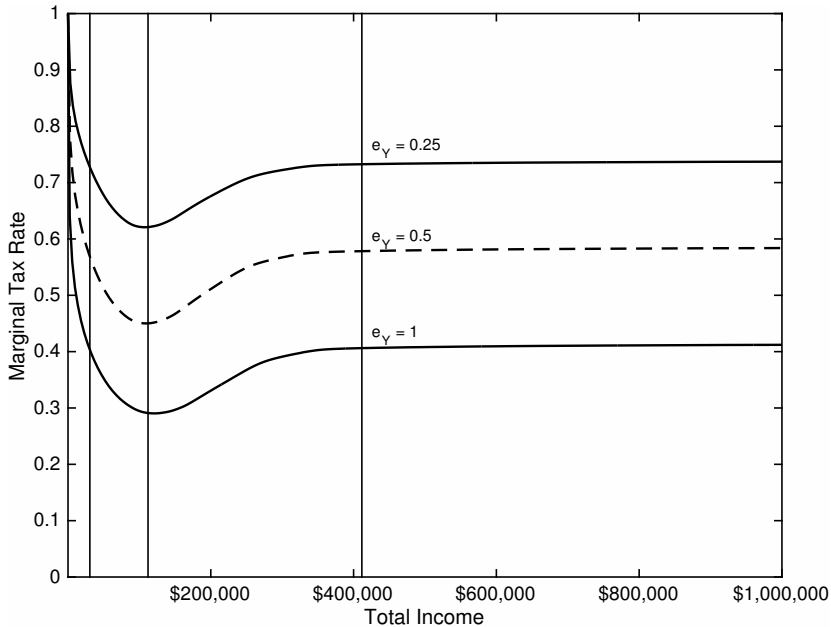
# Optimal Labor Income Tax Rate $T'_L(z)$



# Optimal Capital Income Tax Rate $T'_K(rk)$



# Optimal Tax Rate on Comprehensive Income $T'_Y(y)$



# Generalized Model

## The generalized model

Utility is

$$V_i(\{c_i(t), k_i(t), z_i(t)\}_{t \geq 0}) = \delta_i \cdot \int_{t=0}^{\infty} u_i(c_i(t), k_i(t), z_i(t)) e^{-\delta_i t} dt$$

with  $u_i(\underset{+}{c}, \underset{+}{k}, \underset{-}{z})$  **concave in  $c$** , concave in  $k$ , concave in  $z$

$\Rightarrow$  consumption smoothing  $\Rightarrow$  sluggish transitional dynamics (a sum of anticipatory and build-up effects).

Convergence to steady state no longer instantaneous:

$$u_{ik} / u_{ic} = \delta_i - \bar{r}, u_{ic} \cdot (1 - T'_L) = -u_{iz} \text{ and } c = rk + z - T(rk, z).$$

Social welfare:

$$SWF = \int_i \omega_i V_i(\{c_i(t), k_i(t), z_i(t)\}_{t \geq 0})$$

## Optimal Linear Capital Tax in the Steady State

Given  $\tau_K$  and  $\tau_L$ , rebated lump-sum  $\rightarrow$  convergence to steady state.

At time 0, start from steady state, consider unanticipated small reform  $d\tau_K$ , with elasticities:

$$e_K(t) = dk^m(t) / d\bar{r}(\bar{r}/k^m(t)) \rightarrow e_K.$$

$$e_{L,(1-\tau_K)} = dz^m / d\bar{r}(\bar{r}/z^m).$$

Optimal linear capital income tax in steady state:

$$\tau_K = \frac{1 - \bar{g}_K - \tau_L \frac{z^m}{k^m} e_{L,1-\tau_K}}{1 - \bar{g}_K + \bar{e}_K}$$

If fast responses  $\bar{e}_K \approx e_K$ , quantitative results of simpler model hold.

Slow adjustment:  $\bar{e}_K < e_K$ .

But is it reasonable to exploit short-run sluggishness?

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At time 0, start from steady state, consider unanticipated small reform  $d\tau_K$ , with elasticities:

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$$e_{L,(1-\tau_K)} = dz^m / d\bar{r}(\bar{r}/z^m).$$

Optimal linear capital income tax in steady state:

$$\tau_K = \frac{1 - \bar{g}_K - \tau_L \frac{z^m}{k^m} e_{L,1-\tau_K}}{1 - \bar{g}_K + \bar{e}_K}$$

If fast responses  $\bar{e}_K \approx e_K$ , quantitative results of simpler model hold.

Slow adjustment:  $\bar{e}_K < e_K$ .

But is it reasonable to exploit short-run sluggishness?

## Optimal Linear Capital Tax in the Steady State

Given  $\tau_K$  and  $\tau_L$ , rebated lump-sum  $\rightarrow$  convergence to steady state.

At time 0, start from steady state, consider unanticipated small reform  $d\tau_K$ , with elasticities:

$$e_K(t) = dk^m(t) / d\bar{r}(\bar{r}/k^m(t)) \rightarrow e_K.$$

$$e_{L,(1-\tau_K)} = dz^m / d\bar{r}(\bar{r}/z^m).$$

Optimal linear capital income tax in steady state:

$$\tau_K = \frac{1 - \bar{g}_K - \tau_L \frac{z^m}{k^m} e_{L,1-\tau_K}}{1 - \bar{g}_K + \bar{e}_K} \quad \text{with} \quad \bar{e}_K = \int_i g_i \delta_i \int_0^\infty e_K(t) \cdot e^{-\delta_i t} dt$$

If fast responses  $\bar{e}_K \approx e_K$ , quantitative results of simpler model hold.

Slow adjustment:  $\bar{e}_K < e_K$ .

But is it reasonable to exploit short-run sluggishness?

# General analysis of reforms

Comparison to standard dynamic objective:

$$SWF_d = \int_i \omega_i \cdot V_i(\{c_i(t), k_i(t), z_i(t)\}_{t \geq 0})$$

Any reform can be summarized by:

$$e_K^{total} = e_K^{ante} + e_K^{post}$$

Simpler model:  $e_K^{total} = e_K$ .

Generalized model:  $\bar{e}_K = e_K^{total} = e_K^{ante} + e_K^{post}$  (if anticipated),  
 $\bar{e}_K = e_K^{post}$  if not anticipated.

In every model: difference between primitives vs. reform considered.

## Comparison with Previous Dynamic Models

$e_K$  steady state: Chamley-Judd model:

Infinite (degenerate) steady state elasticity  $e_K = \infty$ .

Aiyagari and wealth-in-utility have  $e_K < \infty$ .

$e_K^{ante}$  anticipation elasticity:

If reform announced infinitely in advance,  $e^{ante} = \infty$ , always, with full certainty.

Reasonable?

$e^{ante} < \infty$  if uncertainty (Aiyagari).

$e_K^{post}$  adjustment to reform: sluggish in all models, except with no transitional dynamics (linear utility).

# Conclusion

Tractable model for K taxation centered on efficiency-equity tradeoff.

**Step 1:** Linear utility model with wealth in the utility.

Simplicity allows us to consider various policy relevant issues: shifting, consumption taxation, cross-elasticities, ...

**Step 2:** Extend results to general model.

Qualitative intuitions and results still apply if define elasticity  $\bar{e}_K$  properly.

Quantitative difference: sluggish adjustments, reflected in elasticity.

Sufficient stats map easily to the data to simulate optimal tax rates.

Asymptotic optimal capital tax rate relevant for most of capital distribution, given that capital highly concentrated.

# Appendix

## Exogenous Economic Growth at rate $g$

Same theory replacing  $\delta_i$  by  $\delta_i - g$  and  $r$  by  $r - g$ .

Proof:  $a_{it}(k(t)) = e^{gt} \cdot a_i(\tilde{k}(t))$  (needed for BGP), with  $\tilde{c}(t) = c(t) \cdot e^{-g \cdot t}$ ,  $\tilde{k}(t) = k(t) \cdot e^{-g \cdot t}$ , then maximization equivalent to:  $U_i = \int_{t=0}^{\infty} [\tilde{c}(t) + a_i(\tilde{k}(t))] \cdot e^{-[\delta_i - g] \cdot t}$   
 $\dot{\tilde{k}}(t) = (\bar{r} - g)\tilde{k}(t) + r \cdot \tau_K \cdot \tilde{k}^m - \tilde{c}_i(t)$

With growth, maintaining wealth per capita requires higher savings, but those are less costly: acts as if discount rate were reduced from  $\delta_i$  to  $\delta_i - g$ .

If  $\bar{r} < g$ , wealth lovers hold more wealth, but have lower consumption.

If we care about consumption:  $\Rightarrow \bar{\tau}_K = 1 - g/r$  (i.e.,  $\bar{r} = g$ ) may be natural **upper** bound for  $\tau_K$ .

## Link with Chamley-Judd model of perfect certainty

Same formulas apply.

Chamley-Judd zero tax result relies critically on anticipation effects to long-distance capital tax reforms (Piketty and Saez, 2013)

→  $e_K^{ante} = \infty$  for long distance reforms.

Without uncertainty, wealth in the utility model, or endogenous discount rate (Judd, 1985) also have infinite anticipation elasticities to reforms far in the future.

Steady state elasticity  $e_K = \infty$  in contrast to our model (impossible to incorporate heterogeneous discount rates).

⇒ Not very useful for policy recommendations (absent compelling empirical evidence that anticipatory effects are large) given that reforms not announced far in advance in practice.

In paper: Formulas also robust to Judd (1985) endogenous discount rate  $\delta_i(c_i)$  model.