Ramsey Taxation in the Global Economy

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Revisit Ramsey Taxation in the global economy

- Is free trade in goods and services optimal?
- Is free capital mobility optimal?
- Are border adjustments desirable?

Revisit Ramsey Taxation in the global economy

- Is free trade in goods and services optimal? YES
- Is free capital mobility optimal? YES
- Are border adjustments desirable? YES

Revisit Ramsey Taxation in the global economy

- Is free trade in goods and services optimal? YES
- Is free capital mobility optimal? YES
  - Many think answers to these two are obvious:
    - Well known paper in AER (2004) argues the answer is NO
- Bhatwati and Johnson argue free trade is not optimal with distortions
  - If taxes not optimal, free trade not optimal
  - If taxes optimal, free trade optimal

Revisit Ramsey Taxation in the global economy

- Are border adjustments desirable? YES
  - Public finance economists say YES
  - International trade economists say IRRELEVANT (Lerner symmetry)

Model sheds light on current policy debates

- Examples:
  - Should every good have the same tax rate in every country? (Tax harmonization)
  - Should trade agreements also have fiscal policy agreements?

Model sheds light on current policy debates

- Examples:
  - Should every good have the same tax rate in every country? NO
  - Should trade agreements also have fiscal policy agreements? YES

Model sheds light on current policy debates

- Other questions:
  - Should goods be taxed based on origin or destination?
  - Is the residence principle for asset income taxation optimal?
  - Should capital income be taxed?

Model sheds light on current policy debates

- Other questions:
  - Should goods be taxed based on origin or destination? DESTINATION
  - Is the residence principle for asset income taxation optimal? YES
  - Should capital income be taxed? NO WITH STANDARD MACRO PREFERENCES

Recent Literature

- Costinot - Werning, Hosseini - Shourideh argue free trade not optimal with distorting taxes
- Use Naito's framework
- Why do results differ?
- No hidden trade in this paper
- Albrecht, De, Eslami, Chari argue results differ because of hidden trade

Ramsey Approach: Tax Instruments Given

- We assume rich tax system: taxes commonly used worldwide
- Focus on cooperative Ramsey equilibrium
- Ramsey approach yields wedges
  - Taxes not necessarily pinned down
  - Multiple implementations
- Need to take stand on initial policies or promises
  - Assume value of wealth cannot be below benchmark level

Two-Country BKK Model

Preferences and Technology

- Preferences

$$U^i = \sum_{t=0}^{\infty} \beta^t u^i \left(c_{it}, n_{it}\right)$$

- Intermediate goods (only traded goods)

$$y_{i1t} + y_{i2t} = y_{it} = F^i \left(k_{it}, n_{it}\right)$$

y_{ijt}: amount of good i used in country j

- Final goods

$$c_{it} + g_{it} + x_{it} \leq G^i \left(y_{1it}, y_{2it}\right)$$
$$x_{it} = k_{it+1} - (1-\delta) k_{it}$$

Efficiency Conditions with Lump-Sum Taxes

- No labor wedge:

$$-\frac{u^i_{c,t}}{u^i_{n,t}} = \frac{1}{G^i_{i,t} F^i_{n,t}}$$

- No investment wedge:

$$\frac{u^i_{c,t}}{\beta u^i_{c,t+1}} = G^i_{i,t+1} F^i_{k,t+1} + 1 - \delta$$

- Static production efficiency:

$$\frac{G^1_{2,t}}{G^1_{1,t}} = \frac{G^2_{2,t}}{G^2_{1,t}}$$

- Dynamic production efficiency:

$$\frac{G^1_{j,t}\left[G^1_{1,t+1} F^1_{k,t+1} + 1 - \delta\right]}{G^1_{j,t+1}} = \frac{G^2_{j,t}\left[G^2_{2,t+1} F^2_{k,t+1} + 1 - \delta\right]}{G^2_{j,t+1}}$$

Benchmark Tax System

- Consumption tax: τ_{it}^{c}
- Labor income tax: τ_{it}^{n}
- Taxes on imports and exports: τ_{ijt}^{m} and τ_{ijt}^{x}
- Tax on initial wealth: l_{i0}
- Transfers to government i: T_{i0}
  - $T_{10} + T_{20} = 0$
  - Can be interpreted as relabeling initial claims

Competitive Equilibrium

- CE is allocation (c, n, y), prices (p, q, w, Q), policies (τ, T_0) such that
  - Households maximize
  - Firms maximize
  - Government budget constraint satisfied
  - Markets clear
    - In particular, balance of payments condition is met:

$$\sum_{t=0}^{\infty} Q_t \left[p_{it} y_{ijt} - p_{jt} y_{jit}\right] = -\left(1 + r_0^f\right) f_{i,0} - T_{i,0}$$

$f_{i,0}$ is initial claims of country i on country j

p_{it} obtained from firm and household first order conditions

Wedges in Competitive Equilibrium

- Labor wedge:

$$-\frac{u^i_{c,t}}{u^i_{n,t}} = \frac{(1+\tau^c_{it})}{(1-\tau^n_{it})\, G^i_{l,t} F^i_{n,t}}$$

- Investment wedge:

$$\frac{u^i_{c,t}}{\beta u^i_{c,t+1}} = \frac{(1+\tau^c_{it})}{(1+\tau^c_{it+1})}\left[G^i_{i,t+1} F^i_{k,t+1} + 1 - \delta\right]$$

Wedges in Competitive Equilibrium

- Static wedge (static production inefficiency):

$$\frac{G^1_{2t}}{G^1_{1t}} = \frac{\left(1+\tau^m_{21t}\right)\left(1+\tau^m_{12t}\right)}{\left(1-\tau^x_{21t}\right)\left(1-\tau^x_{12t}\right)} \frac{G^2_{2t}}{G^2_{1t}}$$

- Dynamic wedge (dynamic production inefficiency):

$$\frac{\left(1+\tau^m_{12t}\right)/\left(1-\tau^x_{12t}\right)}{\left(1+\tau^m_{12t+1}\right)/\left(1-\tau^x_{12t+1}\right)} \frac{G^1_{1t}}{G^1_{1t+1}} \left[G^1_{1t+1}F^1_{kt+1} + 1 - \delta\right]$$
$$= \frac{G^2_{1t}}{G^2_{1t+1}} \left[G^2_{2t+1}F^2_{kt+1} + 1 - \delta\right]$$

Implementable Set Used for Characterization Theorem

- Implementability constraint

$$\sum_{t=0}^{\infty} \left[\beta^t u^i_{c,t} c_{it} + \beta^t u^i_{n,t} n_{it}\right] = \mathcal{W}_{i0},$$

where

$$\mathcal{W}_{i0} = \frac{(1 - l_{i0})\, u^i_{c,0}}{(1 + \tau^c_{i0})} \left[\left(1 - \delta + G^i_{i,0} F^i_{k,0}\right) k_{i0} + Q_{-1} b_{i0} + \left(1 + r^f_0\right) \frac{f_{i,0}}{q_{i,0}}\right]$$

- Resource constraints
- Balance of payments condition

Necessary and Sufficient Conditions

- **Proposition 1:** Allocation and period zero policies implementable as competitive equilibrium if and only if they satisfy
  - Implementability condition
  - Resource constraints
  - Balance of payments condition

Cooperative Ramsey Equilibrium

- Maximize

$$\lambda U^1 + (1-\lambda) U^2$$

over the implementable set

- Without restrictions on initial policies: Lump-sum tax allocation
- We impose wealth restriction in utility terms: $\mathcal{W}_{i0} \geq \bar{\mathcal{W}}_i$, where

$$\mathcal{W}_{i0} = \frac{(1-l_{i0})\, u^i_{c,0}}{(1+\tau^c_{i0})} \left[\left(1 - \delta + G^i_{i,0} F^i_{k,0}\right) k_{i0} + Q_{-1} b_{i0} + \left(1 + r^f_0\right) \frac{f_{i,0}}{q_{i,0}} \right]$$

  - Can be implemented as Markov equilibrium with one-period commitment (Chari, Nicolini & Teles, 2016)

Analog of Second Welfare Theorem

- For any λ, there exists transfers T_0 such that the Ramsey allocation has static and dynamic production efficiency
  - Free trade optimal: One implementation sets tariffs to zero
  - Tax rates on consumption and labor income in general different across countries (tax harmonization not optimal)
  - Free capital mobility optimal
    - Tax system allows distortions to capital mobility by letting tariffs change over time. But it is not optimal to use these distortions
    - Can allow for taxes on capital income. Implementable set unchanged. One implementation sets these taxes to zero

Optimal wedges

$$-\frac{u^i_{c,t}}{u^i_{n,t}} \frac{\left[1+\frac{\varphi^i}{\lambda^i}\left[1-\sigma^i_t-\sigma^{cni}_t\right]\right]}{\left[1+\frac{\varphi^i}{\lambda^i}\left[1+\sigma^{ni}_t-\sigma^{nci}_t\right]\right]} = \frac{1}{G^i_{i,t}F^i_{n,t}},$$

$$\frac{u^i_{c,t}}{\beta u^i_{c,t+1}} \frac{\left[1+\frac{\varphi^i}{\lambda^i}\left[1-\sigma^i_t-\sigma^{cni}_t\right]\right]}{\left[1+\frac{\varphi^i}{\lambda^i}\left[1-\sigma^i_{t+1}-\sigma^{cni}_{t+1}\right]\right]} = 1-\delta+G^i_{i,t+1}F^i_{kt+1}$$

$$\frac{G^1_{2,t}}{G^1_{1,t}} = \frac{G^2_{2,t}}{G^2_{1,t}}$$

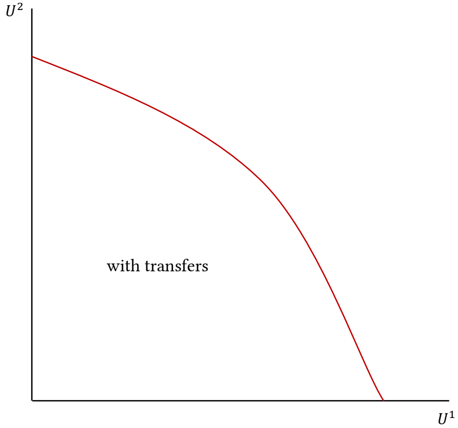
$$\frac{G^1_{j,t}\left[G^1_{1,t+1}F^1_{k,t+1}+1-\delta\right]}{G^1_{j,t+1}} = \frac{G^2_{j,t}\left[G^2_{2,t+1}F^2_{k,t+1}+1-\delta\right]}{G^2_{j,t+1}}$$

where σ's are own and cross elasticities

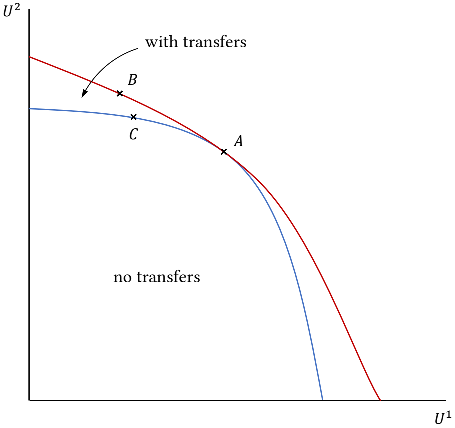
Analogue of First Welfare Theorem

- There exists a $\lambda \in (0, 1)$ such that transfers are zero in the Ramsey allocation
  - Implies that even if planner cannot make transfers, there exists a Ramsey equilibrium that cannot be Pareto improved

Utility Possibility Set



Utility Possibility Set



A: Analogue of first welfare theorem

B: Given initial endowment, need transfers to implement B

C: Given welfare weights, without transfers planner implements C

No Government-to-Government Transfers

- Consider relaxed problem:

$$\max \quad \lambda U^1 + (1-\lambda) U^2$$

subject to

  - implementability constraint
  - resource constraint

- Let

$$s_i(\lambda) = \sum_{t=0}^{\infty} Q_t \left[p_{it} y_{ijt} - p_{jt} y_{jit}\right]$$

where Q, p, y are all functions of λ

- Walras' law implies

$$\sum_i s_i(\lambda) = 0$$

No Government-to-Government Transfers

- Negishi argument:
  - Define $g_i(\lambda)$: *unit simplex* $\rightarrow$ *unit simplex*

$$g_i(\lambda) = \frac{\max\{\lambda_i, \lambda_i + s_i(\lambda)\}}{\sum_i \max\{\lambda_i, \lambda_i + s_i(\lambda)\}}$$

  - Apply Brouwer's fixed point theorem:

$$g(\lambda^*) = \lambda^*$$

  - If $s_1((0,1)) > 0$ and $s_2((1,0)) > 0$, then fixed point exists with $s_i(\lambda^*) = 0$ for all i
- There exist Pareto weights such that free trade is optimal

Alternative Implementations

Value Added Taxes with Border Adjustment

- τ_{it}^{v}: value added taxes
- τ_{it}^{n}: labor income tax
- No tax on exports, cannot deduct imports
- Turns out to be equivalent to a consumption tax

Value Added Taxes with Border Adjustment

- Intermediate good firm in country 1 maximizes

$$\sum_{t=0}^{\infty} Q_t \left[(p_{11t} y_{11t} + p_{2t} y_{12t}) - w_{1t} n_{1t} - q_{1t} x_{1t} \right] - \sum_{t=0}^{\infty} Q_t \tau_{1t}^{v} \left[p_{1t} y_{11t} - q_{1t} x_{1t} \right]$$

- Final good firm in country 1 maximizes

$$\sum_{t=0}^{\infty} Q_t \left[q_{1t} G^1 \left(y_{11t}, y_{21t} \right) - p_{1t} y_{11t} - p_{2t} y_{21t} \right] - \sum_{t=0}^{\infty} Q_t \tau_{1t}^{v} \left[q_{1t} G^1 \left(y_{11t}, y_{21t} \right) - p_{1t} y_{11t} \right]$$

- **Proposition:** VAT equivalent to consumption tax with

$$1 - \tau_{it}^{v} = \frac{1}{\left(1 + \tau_{it}^{c}\right)}$$

Value Added Taxes without Border Adjustment

- τ^m_{ijt}: tariff levied by j on imports from i
- Intermediate good firms in country 1 maximize

$$\sum_{t=0}^{\infty} Q_t \left[(1-\tau^v_{1t})(p_{11t}y_{11t} + (1-\tau^e_{12t})p_{12t}y_{12t} - q_{1t}x_{1t}) - w_{1t}n_{1t}\right]$$

- Final good firms in country 1 maximize

$$\sum_{t=0}^{\infty} Q_t(1-\tau^v_{1t})\left[q_{1t}G^1(y_{11t}, y_{21t}) - p_{11t}y_{11t} - (1+\tau^m_{21t})p_{21t}y_{21t}\right]$$

and similarly in country 2

Value Added Taxes without Border Adjustment

- First order conditions:

$$\frac{(1+\tau^m_{21t})G^2_{2,t}}{(1-\tau^e_{21t})G^1_{2,t}} = \frac{(1-\tau^e_{12t})G^2_{1,t}}{(1+\tau^m_{12t})G^1_{1,t}}$$

and

$$\frac{1-\tau^v_{1t+1}}{1-\tau^v_{1t}}\frac{(1+\tau^m_{12t})}{(1-\tau^e_{12t})}\frac{(1-\tau^e_{12t+1})}{(1+\tau^m_{12t+1})}\frac{G^1_{1,t}}{G^1_{1,t+1}}[G^1_{1,t+1}F^1_{k,t+1}+1-\delta]$$
$$= \frac{1-\tau^v_{2t+1}}{1-\tau^v_{2t}}\frac{G^2_{1,t}}{G^2_{1,t+1}}[G^2_{2,t+1}F^2_{k,t+1}+1-\delta]$$

- In general cannot implement Ramsey equilibrium with zero tariffs

Bottomline of Border Adjustment Issue

- Ramsey allocations implementable with border adjustment
- Ramsey allocations not implementable without border adjustment and zero tariffs
- Border adjustment seems like a tax on imports
- No border adjustment seems like a tax on exports
- Lerner symmetry says these should be equivalent
- What's going on?

Connection with Lerner Symmetry

- Lerner symmetry theorem: taxes on imports equivalent to taxes on exports
  - Pf: With one import good and one export good only relative price matters. Transfers take care of the effect of tariffs on the balance of payments condition
- With multiple import goods and multiple export goods, each with different tax rates, cannot replace taxes on imports by taxes on exports
  - Pf: Such a tax change alters prices of imported goods relative to each other
- Can interpret dynamic model as static model with multiple import and export goods
- Lerner symmetry typically fails in dynamic models

Residence Based Taxation of income

- τ_{it}^{k}: tax rate on firms' capital income
- τ_{it}: tax rate on households' asset income
- τ_{it}^{n}: tax rate on labor income
- Note: No consumption taxes

Intermediate Goods Firms' Problem

- Intermediate good firm maximizes present value of dividends

$$\sum_{t=0}^{\infty} Q_t d_{it}$$

where

$$\begin{aligned} d_{it} &= p_{it} F(k_{it}, n_{it}) - w_{it} n_{it} \\ &\quad - \tau_{it}^{k} \left[p_{it} F(k_{it}, n_{it}) - w_{it} n_{it} - q_{it} \delta k_{it} \right] - q_{it} \left[k_{it+1} - (1 - \delta) k_{it} \right] \end{aligned}$$

Households' Problem

- Flow of funds

$$b_{it+1} + V_{it}s_{it+1} + f_{it+1} = \frac{Q_{t-1}}{Q_t}b_{it} + (V_{it} + d_{it})\, s_{it}$$
$$- \tau_{it}\left(V_{it} - V_{it-1} + d_{it} - \frac{(q_{it} - q_{it-1})\, V_{it-1}}{q_{it-1}}\right) s_{it}$$
$$+ \left(1 + r_t^f\right) f_{it} - \tau_{it}\left(r_t^f - \frac{q_{it} - q_{it-1}}{q_{it-1}}\right) f_{it}$$
$$+ \left(1 - \tau_{it}^n\right) w_{it} n_{it} - \left(1 + \tau_{it}^c\right) q_{it} c_{it}$$

  where f_{it} is holdings of foreign assets

- Note income defined net of valuation changes

Wedges and Production Efficiency in Competitive Equilibrium

- Static production efficiency met

$$\frac{G^2_{1,t}}{G^2_{2,t}} = \frac{G^1_{1,t}}{G^1_{2,t}}$$

- Intertemporal production efficiency not necessarily met

$$\frac{G^1_{j,t}}{G^1_{j,t+1}}\left[1+\left(1-\tau^k_{1t+1}\right)\left(G^1_{1,t+1}F^1_{k,t+1}-\delta\right)\right]$$
$$=\frac{G^2_{j,t}}{G^2_{j,t+1}}\left[1+\left(1-\tau^k_{2t+1}\right)\left(G^2_{2,t+1}F^2_{k,t+1}-\delta\right)\right]$$

Ramsey Allocation

- Must set $\tau^k_{1t+1} = \tau^k_{2t+1} = 0$ or set

$$\tau^k_{1t+1}\left(G^1_{1,t+1}F^1_{k,t+1} - \delta\right) = \tau^k_{2t+1}\left(G^1_{1,t+1}F^1_{k,t+1} - \delta - \left(\frac{G^1_{j,t+1}/G^2_{j,t+1}}{G^1_{j,t}/G^2_{j,t}} - 1\right)\right)$$

$$\frac{u^i_{c,t}}{\beta u^i_{c,t+1}} = 1 + \left(1 - \tau_{it+1}\right)\left(1 - \tau^k_{it+1}\right)\left(G^i_{i,t+1}F^i_{k,t+1} - \delta\right)$$

- Joint distortion from taxes on asset income and firm's profits
- **Proposition:** In Ramsey equilibrium, set τ_{it+1} and τ^n_{it+1} appropriately
- **Proposition:** With standard macro preferences set taxes to 0
- Residence based taxation implements Ramsey outcome

Mirrlees Taxation and Production Efficiency

- Household k in country i indexed by parameter θ_i^k
- Type-θ_i^k household supplies $l_t = \theta_i^k n_t$ units of *effective* labor
- Distribution of types $H_i(\theta_i^k)$

Cooperative Planner

- **observes**
  - consumption of each type
  - effective labor of each type
- does **not observe**
  - household type

Mirrlees Taxation and Production Efficiency

An **allocation** consists of household allocations $\{c_t(\theta_i^k), l_t(\theta_i^k)\}$ and aggregate allocations $\{y_{ijt}, k_{it+1}, x_{it}\}$ for each country. Allocation is:

- *feasible* if resource constraints are met:

$$y_{i1t} + y_{i2t} = y_{it} = F^i \left(k_{it}, \int l_t(\theta_i^k) \mathrm{d}H_i(\theta_i^k) \right),$$

$$\int c_t(\theta_i^k) \mathrm{d}H_i(\theta_i^k) + g_{it} + x_{it} \leq G^i(y_{1it}, y_{2it});$$

- *incentive compatible* if for all $\theta_i^k, \hat{\theta}_i^k$

$$\sum_{t=0}^{\infty} \beta^t u^i(c_t(\theta_i^k), l_t(\theta_i^k)/\theta_i^k) \geq \sum_{t=0}^{\infty} \beta^t u^i \left(c_t(\hat{\theta}_i^k), l_t(\hat{\theta}_i^k)/\theta_i^k \right).$$

Households rank allocations according to

$$U^i(\theta_i^k) = \sum_{t=0}^{\infty} \left[u^i \left(c_t(\theta_i^k), \frac{l_t(\theta_i^k)}{\theta_i^k} \right) + h^i(g_{it}) \right].$$

Mirrlees Problem

A **cooperative Mirrlees outcome** is an allocation, which is a solution to:

$$\omega^1 \int U^1(\theta_1^k) \mathrm{d} J_1(\theta_1^k) + \omega_2 \int U^2(\theta_2^k) \mathrm{d} J_2(\theta_2^k) \to \max$$

subject to

- incentive compatibility,
- resource feasibility.

Proposition:

- Mirrleesian outcome satisfies production efficiency so that free trade and unrestricted capital mobility are optimal,
- if preferences are separable, then it is optimal to have no intertemporal distortions.

Summary

- Production efficiency optimal in Ramsey and Mirrleesian outcomes with widely used taxes
- Border tax adjustments desirable
- Residence based taxation optimal

When is it optimal to deviate from Production efficiency

- Results that production efficiency not optimal often comes from unrealistic restrictions on tax systems
- Private information? NOT BY ITSELF
- Private and information and hidden trading? YES (See Albrecht, Chari, De & Eslami, *forthcoming*)