Winners and losers from international cooperation. The case of non-commitment optimal policies in non-symmetric countries

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Outline

Motivation

- Tax competition is an ongoing debate at both theory and policy level. Especially, regarding capital/corporate taxes.
- As the countries become more integrated, they may engage more and more in tax competition for mobile factors, resulting in contraction of government revenues and under-provision of public goods. In equilibrium (Nash), this is self-defeating. Cooperation is productive (i.e. it is preferable to non-cooperation). Typical prisoner's dilemma problem.
- Note that cooperation may become counter-productive when there are other distortions in the background. For instance, inability of policymakers to commit to future policies (see next), politically motivated governments (Persson and Tabellini, 1995), incomplete factor mobility (Perotti, 2001), etc.

Purpose of this paper

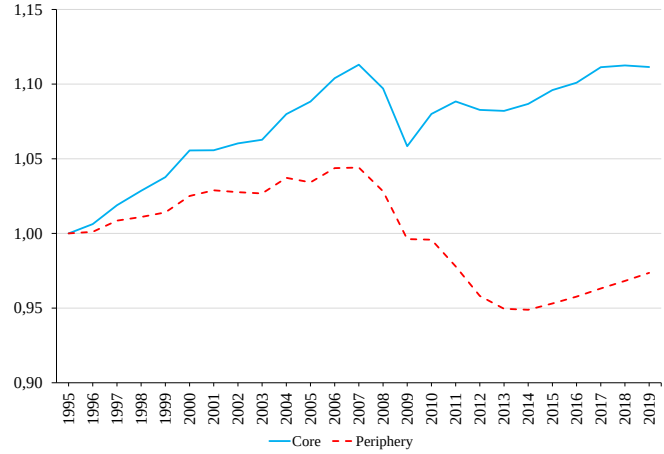
- What happens when countries differ?
- Does it make any difference if policymakers can commit themselves or not?
- In other words, we revisit the comparison between non-cooperative (Nash) and cooperative fiscal policies in the presence of cross-country asymmetries, both under commitment and non-commitment on behalf of the policymakers.

Purpose of this paper

- We will focus on cross-country asymmetries in TFP and inherited public debt, which are considered to be among the striking differences between core and periphery EZ countries, especially after the 2008 crisis (*see e.g. Micossi, 2016*) and the data presented right below.
- And we ask: Is international cooperation productive at aggregate level?
- Even if it is productive at country level, are there winners and losers?

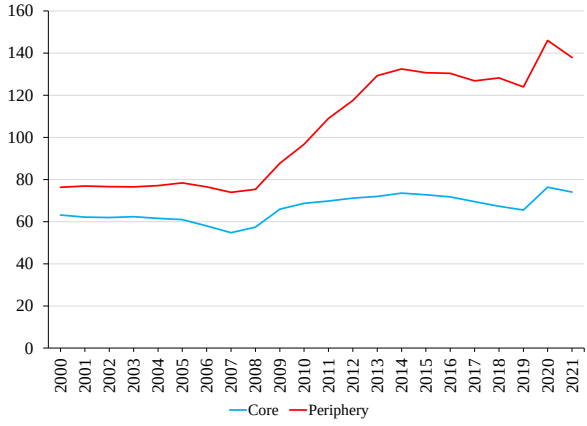
Purpose and Research Question

Figure: Total factor productivity (TFP) in the Eurozone, *Source: Penn World Table 10.0*



Purpose and Research Question

Figure: Public debt-to-GDP in the Eurozone, *Source: OECD*



Literature on international cooperation in fiscal policies

- Fischer (1980) on the dynamic inconsistency of optimal policy
- Cooper and John (1988) on coordination failures
- Kehoe (1988) on "undesirable" policy cooperation
- Persson and Tabellini (1992) on fiscal policy and European integration
- Persson and Tabellini (1995) review paper
- Persson and Tabellini (2000) on welfare reduction under tax competition
- Perotti (2001) on non-efficient outcomes of centralized decision-making, when there is incomplete factor mobility
- Alesina et al. (2005) on International Unions
- Mendoza and Tesar (2005) on tax competition in EU
- Kammas and Philippopoulos (2009) on international public goods and their role in cooperation
- Klein et al. (2017) on the transition path of capital taxation
- and many more....

The Model (in words)

- We use a conventional neoclassical world economy model with two countries.
- Two periods only, for simplicity as in *Persson and Tabellini (1992, 1995, 2000)* and many others.
- Single traded good (PPP holds).
- In each country, a *household*, a *firm* and a *government*.
- The household chooses consumption, leisure and savings in the form of domestic capital, domestic government bonds and foreign assets/liabilities to solve a standard utility max problem.
- The firm chooses capital and labor services to solve a standard profit max problem.
- The government taxes domestic capital and labor, and capital and labor from foreigners (*territorial system of taxation*), and also issues bonds to finance utility-enhancing public expenditures. DCE
- Optimally chosen cooperative and non-cooperative fiscal policies.

The Model (in words): Sequence of moves and types of equilibria

Commitment (Ramsey-type policy)

1. Governments choose their policies either non-cooperatively or cooperatively.
2. Private agents make their decisions competitively and markets clear.

Non-commitment (Time-consistent policy)

1. Private agents make their first-period choices acting competitively and by taking as given first-period policy and markets clear: Stage (A).
2. Government observes agents' first-period choices and chooses first-period policy instruments (for simplicity we will assume that first-period tax instruments are exogenous): Stage (B).
3. Private agents make their second-period decisions acting competitively and markets clear: Stage (C).
4. Government observes agents' second-period choices and chooses second-period policy: Stage (D).

Note: in the case of cooperation the social welfare function is the weighted average of the welfare of the household in each country with equal weights given to each country.
We solve the above problems by backward induction.

Results: symmetric equilibria (1/2)

Table: Tax rates

Capital tax rate, τ_2^k

	Commitment (Ramsey)	**Non-commitment (Time-consistent)**
Nash	0.0341	0.5039
Coop	0.1694	0.6598

Labor tax rate, τ_2^l

	Commitment (Ramsey)	**Non-commitment (Time-consistent)**
Nash	0.1697	0.1045
Coop	0.2577	0.0000

Commitment

- **Capital under-taxation result**: (Judd, 1985; Chamley, 1986).
- **Race-to-the-bottom result**: τ_2^k is lower under Nash than under Cooperation; policy makers compete through tax cuts with each other for mobile factors..

Non-commitment

- **Labor tax rates lower than capital tax rates**, both under Nash and under Cooperation. **Tax competition moderates capital overtaxation**.
- Without commitment almost all of the burden goes to capital rather than to labor because capital is inelastic in the second period (Fischer, 1980).

Results: symmetric equilibria (2/2)

Table: Output and Welfare

Lifetime discounted output, y

	Commitment (Ramsey)	**Non-commitment (Time-consistent)**
Nash	1.2871	1.2191
Coop	1.2839	1.1719

Lifetime discounted welfare, W

	Commitment (Ramsey)	**Non-commitment (Time-consistent)**
Nash	-1.4761	-1.4805
Coop	-1.4627	-1.5106

- In terms of welfare the best outcome is **cooperation with commitment**, whereas in terms of output the best outcome is **Nash with commitment**, because tax competition is good for investment and output.
- In the absence of a commitment-inducing technology, cooperation has detrimental effects not only on output, but also on lifetime discounted utility.
- This happens mainly because, without commitment, capital tax rates are too high in general, so that tax competition works to mitigate this distortion.

Results: asymmetries in TFP (1/3)

Table: Tax rates (* denotes the low-TFP country)

Capital tax rate, τ_2^k

	Commitment (Ramsey)		**Non-commitment (Time-consistent)**	
Nash	0.0474	0.0249*	0.6591	0.6385*
Coop	0.2224	0.1461*	0.7645	0.6771*

Labor tax rate, τ_2^l

	Commitment (Ramsey)		**Non-commitment (Time-consistent)**	
Nash	0.1861	0.1545*	-0.0270	0.1207*
Coop	0.2901	0.2461*	-0.0274	-0.0171*

Commitment

- Capital under-taxation and race-to-the-bottom results also present in a commitment-type NSNE.
- As compared to the symmetric case, the productive economy sustains a higher tax burden than the non-productive one, however, the race-to-the-bottom result is now milder $\longrightarrow$ policymakers are forced to set higher tax rates on capital, in order to offset the distortions caused by the relatively low tax rates on labor.
- Labor tax rates are higher than capital tax rates in both countries, with the productive economy bearing the cost of asymmetry.

Results: asymmetries in TFP (2/3)

Table: Tax rates (* denotes the low-TFP country)

Capital tax rate, τ_2^k

	Commitment (Ramsey)		**Non-commitment (Time-consistent)**	
Nash	0.0474	0.0249*	0.6591	0.6385*
Coop	0.2224	0.1461*	0.7645	0.6771*

Labor tax rate, τ_2^l

	Commitment (Ramsey)		**Non-commitment (Time-consistent)**	
Nash	0.1861	0.1545*	-0.0270	0.1207*
Coop	0.2901	0.2461*	-0.0274	-0.0171*

Non-commitment

- Both countries impose substantially higher capital tax rates, relative to symmetry, with the productive country (wider tax base) sustaining a higher capital tax burden than its non-productive counterpart.
- The productive country subsidizes labor, while the non-productive country taxes 12% of labor income under Nash and subsidizes 1.7% under Cooperation.
- The near-confiscating capital taxes in the productive economy are counterbalanced by important subsidies to labor, while, tax revenues from capital are too low in the non-productive country and the country needs to raise its tax on labor.

Results: asymmetries in TFP (3/3)

Table: Output and Welfare

Lifetime discounted output, y

	Commitment (Ramsey)		**Non-commitment (Time-consistent)**	
Nash	1.3534	1.0896*	1.2526	0.9783*
Coop	1.3079	1.1241*	1.1525	1.0297*

Lifetime discounted welfare, W

	Commitment (Ramsey)		**Non-commitment (Time-consistent)**	
Nash	-1.4600	-1.5961*	-1.4862	-1.6435*
Coop	-1.4629	-1.5570*	-1.5557	-1.5961*

- For the productive country, the best policy regime is Nash Ramsey, and this is both in terms of output and welfare.
- For the less productive country, the best policy regime is Cooperative Ramsey, and this is both in terms of output and welfare.
- Non-commitment hurts both countries.
- Being an efficient country, I do not want this to be reduced by high tax rates implied by cooperation.
- On the other hand, the inefficient country cannot afford tax competition.

Results: asymmetries in initial public debt-to-GDP (1/3)

Table: Tax rates (* denotes the high-debt country)

Capital tax rate, τ_2^k

	Commitment (Ramsey)		**Non-commitment (Time-consistent)**	
Nash	0.0360	0.0471*	0.6035	0.6018*
Coop	0.2011	0.1873*	0.7094	0.6887*

Labor tax rate, τ_2^l

	Commitment (Ramsey)		**Non-commitment (Time-consistent)**	
Nash	0.1716	0.1732*	0.0335	0.1371*
Coop	0.2817	0.2715*	0.0067	0.0021*

Commitment

- The "race-to-the-bottom" result intensifies the Chamley-Judd result $\longrightarrow$ Nash capital tax rates are low in both countries.
- However, due to the nature of asymmetry the indebted country needs to sustain a higher tax burden than the low-debt country in the Nash equilibrium.
- On top of this, not only the indebted country, but also the country with healthy fiscal balances needs to raise its own tax burden (relative to the symmetric case).

Results: asymmetries in initial public debt-to-GDP (2/3)

Table: Tax rates (* denotes the high-debt country)

Capital tax rate, τ_2^k

	Commitment (Ramsey)		**Non-commitment (Time-consistent)**	
Nash	0.0360	0.0471*	0.6035	0.6018*
Coop	0.2011	0.1873*	0.7094	0.6887*

Labor tax rate, τ_2^l

	Commitment (Ramsey)		**Non-commitment (Time-consistent)**	
Nash	0.1716	0.1732*	0.0335	0.1371*
Coop	0.2817	0.2715*	0.0067	0.0021*

Non-commitment

- The low-debt country imposes higher capital tax rates than its high-debt counterpart, as an exchange for its relatively low tax rates on labor.
- The high-debt country needs a higher Nash labor tax rate to compensate for its low tax revenues from capital taxation.
- However, the higher initial public debt only marginally affects the labor tax rates in both countries under Cooperation.

Results: asymmetries in initial public debt-to-GDP (3/3)

Table: Output and Welfare

Lifetime discounted output, y

	Commitment (Ramsey)		**Non-commitment (Time-consistent)**	
Nash	1.2926	1.2646*	1.2263	1.1494*
Coop	1.2700	1.2813*	1.1488	1.1645*

Lifetime discounted welfare, W

	Commitment (Ramsey)		**Non-commitment (Time-consistent)**	
Nash	-1.4743	-1.4988*	-1.4833	-1.5176*
Coop	-1.4682	-1.4616*	-1.5308	-1.5130*

- For the low-debt country the best policy regime is Nash Ramsey in terms of output, whereas, when the criterion is welfare the best policy regime is Cooperative Ramsey.
- For the country with high public debt the best policy regime is Cooperative Ramsey, and this is both in terms of output and welfare.
- Similar results to the case with asymmetries in TFP.

Conclusions

- The low TFP (and high public debt) country cannot afford tax competition. The latter would exacerbate its relative disadvantage.
- Or, symmetrically opposite, tax cooperation, implying higher taxes for all, closes its gap vis-à-vis the other countries by making countries more alike.

Household

The representative household in country $i = d, f$ maximizes

$$\max_{c,k,f,b,l,s} U_i = \mu_1 \log c_{i,1} + \mu_2 \log(1 - l_{i,1}) + \mu_3 \log g_{i,1} + \beta\Big\{\mu_1 \log c_{i,2} + \mu_2 \log(1 - l_{i,2}) + \mu_3 \log g_{i,2}\Big\}$$

subject to

$$c_{i,1} + k_{i,2} + b_{i,2} + f_{i,2} = = (1 + (1 - \tau^k_{i,1})r_{i,1} - \delta)k_{i,1} + (1 - \tau^l_{i,1})w_{i,1}l_{i,1} + (1 + r^b_{i,1})b_{i,1} + (1 - \tau^k_{i,1})\Pi_{i,1}$$

$$c_{i,2} = (1 + (1 - \tau^k_{i,2})r_{i,2} - \delta)k_{i,2} + (1 - \tau^l_{i,2})w_{i,2}l_{i,2} + (1 + \rho^b_{i,2})b_{i,2} + (1 - \tau^k_{i,2})\Pi_{i,2} + (1 + (1 - \tau^k_{-i,2})r_{-i,2} - \delta)f_{i,2} - m\frac{f^2_{i,2}}{2} + (1 - \tau^l_{-i,2})w_{-i,2}s_{i,2} - j\frac{(s_{i,2} - \bar{s})^2}{2}$$

Firm

The single traded good is produced by a single firm $i = d, f$ that acts competitively. In each period, $t = 1, 2$, the firm chooses capital, $\bar{k}_{i,t}$, and labour, $\bar{l}_{i,t}$, to maximize profit:

$$\max_{\bar{k}_{i,t}, \bar{l}_{i,t}} \Pi_{i,t} = y_{i,t} - r_{i,t}\bar{k}_{i,t} - w_{i,t}\bar{l}_{i,t}$$

subject to a Cobb-Douglas production function, $y_{i,t} = A\left(\bar{k}_{i,t}\right)^{\alpha}\left(\bar{l}_{i,t}\right)^{1-\alpha}$, where $\alpha \in (0, 1)$ and A are standard technology parameters. The optimality conditions for the two inputs are:

$$r_{i,t} = \alpha\frac{y_{i,t}}{\bar{k}_{i,t}} \text{ and } w_{i,t} = (1-\alpha)\frac{y_{i,t}}{\bar{l}_{i,t}}$$

where, $\bar{k}_{i,2} = k_{i,2} + f_{-i,2}$ and $\bar{l}_{i,2} = l_{i,2} + s_{-i,2}$ so that profits are zero in equilibrium.

The Model

Government

The government taxes domestic and foreign capital and effective labour at the rates $0 \leq \tau_{i,t}^{k} < 1$ and $0 \leq \tau_{i,t}^{l} < 1$. The within-period government budget constraints are standard

$$g_{i,1} + \left(1 + r_{i,1}^{b}\right) b_{i,1} = \tau_{i,1}^{k} \left(r_{i,1} k_{i,1} + \Pi_{i,1}\right) + \tau_{i,1}^{l} w_{i,1} l_{i,1} + b_{i,2}$$

$$g_{i,2} + \left(1 + r_{i,2}^{b}\right) b_{i,2} = \tau_{i,2}^{k} \left(r_{i,2} \left(k_{i,2} + f_{-i,2}\right) + \Pi_{i,2}\right) + \tau_{i,2}^{l} w_{i,2} \left(l_{i,2} + s_{-i,2}\right)\}$$

where $g_{i,1}$ and $g_{i,2}$ account for total government spending, and $b_{i,1}$ and $b_{i,2}$ are the government bonds issued at periods 1 & 2 respectively.

The Model

Decentralized Equilibrium (for any feasible policy)

We solve for a decentralized competitive equilibrium (DCE) in which

1. all agents (household, firm) maximise, subject to their constraints, taking as given prices and tax rates
2. all constraints are satisfied
3. all markets clear

We obtain one set of standard equilibrium equations for each country. The DCE is a system of 20 equations in

1. Allocations: $\{c_{i,t}, c_{-i,t}, k_{i,2}, k_{-i,2}, l_{i,t}, l_{-i,t}, s_{i,2}, s_{-i,2}, f_{i,2}, f_{-i,2}\}_{t=1}^{2}$

2. Policies: $\{b_{i,2}, b_{-i,2}, g_{i,2}, g_{-i,2}, \rho_{i,2}, \rho_{-i,2}\}$

for any feasible policy: $\{\tau_{i,t}^{k}, \tau_{-i,t}^{k}, \tau_{i,t}^{l}, \tau_{-i,t}^{l}, g_{i,1}, g_{-i,1}\}_{t=1}^{2}$

The Model

Decentralized Equilibrium (for any feasible policy)

$$c_{i,1} + k_{i,2} - (1-\delta)k_{i,1} + f_{i,2} + g_{i,1} = y_{i,1} \tag{1}$$

$$c_{i,2} - (1-\delta)k_{i,2} + g_{i,2} = y_{i,2} + (1-\tau^k_{i,2})r_{i,2}f_{-i,2} - m\frac{f^2_{i,2}}{2} \tag{2}$$
$$+ \left(1 + \left(1 - \tau^k_{-i,2}\right) r_{-i,2} - \delta\right) f_{i,2}$$

$$\mu_1(1-\tau^l_{i,1})\,(1-l_{i,1})\,w_{i,1} = \mu_2 c_{i,1} \tag{3}$$

$$\mu_1(1-\tau^l_{i,2})\,(1-l_{i,2}-s_{i,2})\,w_{i,2} = \mu_2 c_{i,2} \tag{4}$$

$$\mu_1\left((1-\tau^l_{-i,2})w_{-i,2} - j(s_{i,2}-\bar{s})\right)(1-l_{i,2}-s_{i,2}) = \mu_2 c_{i,2} \tag{5}$$

The Model

Decentralized Equilibrium (for any feasible policy)

$$c_{i,2} = \beta\left\{1 + (1 - \tau^k_{i,2})r_{i,2} - \delta\right\}c_{i,1} \tag{6}$$

$$c_{i,2} = \beta\left\{1 + (1 - \tau^k_{-i,2})r_{-i,2} - \delta - mf_{i,2}\right\}c_{i,1} \tag{7}$$

$$c_{i,2} = \beta\left\{1 + \rho_{i,2}\right\}c_{i,1} \tag{8}$$

$$g_{i,1} + \left(1 + r^b_{i,1}\right) b_{i,1} = \tau^k_{i,1}\left(r_{i,1}k_{i,1} + \Pi_{i,1}\right) + \tau^l_{i,1}w_{i,1}l_{i,1} + b_{i,2} \tag{9}$$

$$g_{i,2} + \left(1 + r^b_{i,2}\right) b_{i,2} = \tau^k_{i,2}\left(r_{i,2}\left(k_{i,2} + f_{-i,2}\right) + \Pi_{i,2}\right) + \tau^l_{i,2}w_{i,2}\left(l_{i,2} + s_{-i,2}\right)\} \tag{10}$$

The Model

Optimal cooperative policies with commitment

The Ramsey planner maximises a weighted average of households' welfare in each country with equal weights, γ, given to each one of them. Thus, the objective is now:

$$\max W^{coop} = \gamma U_i + (1-\gamma) U_{-i}$$

subject to the 20 WDCE equations.

The maximization is with respect to the independent policy instruments in the two countries, $\tau^k_{i,2}, \tau^l_{i,2}, \tau^k_{-i,2}$ and $\tau^l_{-i,2}$. We will thus have a system of 44 equations in 44 unknowns. Counting equations, we have the 20 constraints/equations of the WDCE, the optimality conditions for the 20 variables being determined by the WDCE system, plus the four optimality conditions for the independent policy instruments.

The Model

Optimal cooperative policies without commitment

The cooperative equilibrium without commitment is a system of 32 equations in 32 endogenous variables, which includes the optimality conditions of each stage (A-D), the corresponding Lagrangean multipliers and the budget constraints of the household and the government in each economy and in each period.

In particular, counting endogenous variables, we have the 20 variables of the WDCE system, plus the 8 dynamic Lagrangean multipliers corresponding to the 8 equations of the WDCE system in stage (C), plus the four optimally chosen instruments, $\tau^k_{i,2}, \tau^l_{i,2}, \tau^k_{-i,2}, \tau^l_{-i,2}$.

The Model

Optimal non-cooperative policies with commitment

Each government sets, independently of the other, capital and labor tax rates, $\tau^k_{i,2}, \tau^l_{i,2}$, to maximize the welfare of its own households, subject to the DCE system of equations. It takes as given that

1. domestic and foreign private agents optimize,
2. foreign taxes are given (at their equilibrium level),
3. markets clear, and
4. its own budget constraint is satisfied.

Thus, the set of choice variables for each government is

$$\left\{c_{i,t}, c_{-i,t}, k_{i,2}, k_{-i,2}, l_{i,t}, l_{-i,t}, s_{i,2}, s_{-i,2}, f_{i,2}, f_{-i,2}, b_{i,2}, b_{-i,2}, \rho_{i,2}, \rho_{-i,2}\right\}_{t=1}^{2}$$

$$\left\{\tau^k_{i,2}, \tau^l_{i,2}\right\}$$

Notice, that we solve two optimization problems, instead of one (i.e. two best response functions).

This is a well-known feature in the literature of optimal taxation (see e.g. *Chamley, 1986*). Their joint numerical solution is the Nash equilibrium of the model (i.e. a system of 64 equations in 64 unknowns). The Model

Optimal non-cooperative policies without commitment

The non-cooperative equilibrium (Nash) without commitment is a system of 40 equations in 40 endogenous variables, which includes the optimality conditions of each stage, the corresponding Lagrangean multipliers and the budget constraints of the household and the government in each economy and in each period.

In particular, counting endogenous variables, we have the 20 variables of the WDCE system, plus the 16 dynamic Lagrangean multipliers corresponding to the 16 optimality conditions of stage (C), plus the four optimally chosen instruments, $\tau^k_{i,2}, \tau^l_{i,2}, \tau^k_{-i,2}, \tau^l_{-i,2}$.

The Model