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Asymmetric Yardstick Competition: Traditional Procurement *versus* Public-Private Partnerships

Abstract

We investigate yardstick competition between local jurisdictions in which pure rent-seeking incumbents undertake an identical infrastructure project choosing be- tween two contractual arrangements with different financing profiles, namely traditional procurement (TP) and public-private partnership (PPP). We show that a mixed regime, in which TP is used in one jurisdiction and PPP in the other, is likely to arise when projects are mildly lucrative, and/or jurisdictions have a moderate fiscal capacity. We find that, in the mixed equilibrium, incumbents provide different levels of public services, face different probabilities of re-election, and obtain different rents. The adoption of different forms of project governance permits incumbents to disguise themselves and undermine voters' ability to assess their performances. Therefore, yardstick competition is hindered, even if jurisdictions display identical revenue capacities.

JEL-Codes: D720, H770.

Keywords: political yardstick competition, rent seeking, infrastructure projects, traditional procurement, public-private partnership.

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1 Introduction

Motivation and aim Political yardstick competition consists in comparing the administrators of local jurisdictions, taking the level of public services provided in each jurisdiction as a benchmark for evaluation purposes. A relatively good performance in the provision of public services is "rewarded" through a higher probability of the administrator being confirmed in office; a relatively bad performance is "penalized" through a lower probability, instead. The idea of political yardstick competition was first formalized by Besley and Case (1995). They offered a political economy model of tax-setting in a multi-jurisdictional world, which has been further explored in several research pieces thereafter. Those models all represent the fact that voters cannot directly observe the cost of the services provided by the local administrator. Nor can they observe the rent the administrator is able to extract while being in office. To overcome these political agency problems, and be able to decide whether or not to vote again for the incumbent in the next election, citizens compare their own administrator with those in office in other jurisdictions, being based on some observable index of performance, such as the quality/quantity of the provided services. This rests on the common assumption that there exist jurisdictions which are identical or "similar" and can thus be compared. The comparison forces incumbents into a competitive mechanism, in which each incumbent takes the others' behaviour into account to maximize her own rent, considering how the probability of re-election will be thereby affected. To be confirmed in office, incumbents will attempt to make the government they lead well placed in the cross-jurisdiction comparisons made by their respective voters. In this way, although yardstick competition cannot eliminate the informational asymmetry between administrators and voters, it will nonetheless mitigate its consequences.

A number of empirical analyses provide evidence of the existence of a tax-mimicking behaviour across local governments. Among others, Besley and Case (1995) find confirmation of this phenomenon using US State data over the period 1960 - 1988. In turn, using data about 143 adjacent Italian municipalities, Bordignon et al. (2003) find a positive spatial auto-correlation in local property tax rates in jurisdictions whose mayors run

for re-election in uncertain contests. By contrast, no interaction is found in jurisdictions whose mayors either face a term limit, or they are backed by large majorities. In a more recent study, relying on data about German States and local governments, Buettner and von Schwerin (2016) find empirical evidence of the existence of yardstick competition among sub-national jurisdictions in the choice of business tax rates.

Whereas, as we said, most studies have hitherto assumed the existence of identical (or "similar") jurisdictions to be compared, only in recent years some attention has been devoted to the effects that disparities across jurisdictions may have on political yardstick competition. In a theoretical investigation, A. Allers (2012) highlights that when jurisdictions differ in terms of revenue capacity and/or spending needs, so that fiscal disparities appear, political yardstick competition may be biased because administrators of "richer" jurisdictions can provide high-quality services and still keep the local tax burden low, thus extracting higher rents. In formal terms, the ratio between the re-election probabilities differs from the ratio between the rents. Provided re-election probabilities are not aligned with rents, incumbents extracting higher rents are, yet, more likely to be confirmed in office. The existence of a bias, due to differences in revenue capacity and/or expenditure needs, seems to be corroborated by the outcome of some recent laboratory experiments (Di Liddo and Morone, 2017).

Tax bases and expenditure needs are not the only possible sources of disparities across local jurisdictions. Disparities may also appear when adopting different ways of financing expenditures, leading to different cash flow profiles. This is especially plausible as far as infrastructure projects are concerned.[1] Here is the focus of our investigation.

There are two main ways of developing infrastructure projects, namely *traditional procurement* (henceforth, TP) and the more recent *public-private partnership* (henceforth, PPP), corresponding to two different organizational forms and financing patterns. Under TP, the construction of the infrastructure and its subsequent management are delegated to different firms through (short-term) contracts. Public funds are disbursed in each phase of the project to cover the cost pertaining to that specific phase, although user charges

[1]Many such projects display local dimensions, provided in a number of countries municipalities are directly responsible for the provision of infrastructure services (see, for instance, Allain-Dupré (2011)).

may also be used to cover the cost of operation when the service is provided. Under PPP, the finance, construction and management of the infrastructure are bundled altogether in a single (longer-term) contract with a consortium of firms, which is transferred the operational risk. Private funds are initially mobilized to finance construction and then recouped during operation. Public funds are disbursed only in this latter stage, but then they must be set to cover the overall costs of the project, together with user charges (if feasible).

The theoretical literature identifies an efficiency rationale for the use of PPP. That is, if there are any synergies between project phases, then bundling and endogenous risk transfer incentivize the private partner to account for - hence, minimize - the lifecycle costs of the project (Bennett and Iossa, 2006; Danau and Vinella, 2015, 2017; Hart, 2003; Iossa and Martimort, 2016; Martimort and Pouyet, 2008). However, empirical investigations highlight that politicians may want to use PPP even when it is less efficient than TP, for other reasons. Antellini Russo and Zampino (2010) find that the reliance on PPP is often motivated by purely financial considerations, particularly in local jurisdictions, where public expenditure is subject to tight fiscal rules.[2] This is because, so long as the IPSAS 32 international standards are not implemented, under certain circumstances, the involvement of private finance permits to build infrastructures *off balance*. Actually, according to Engel et al. (2011), this was the ultimate motivation for introducing PPPs in the UK in the first place. Thereby, the claim that the use of PPP relieves public budgets is deceptive, since the official accounting figures hide liabilities, which will appear in future budgets.[3] That claim is, yet, functional to political opportunism. As suggested by the recent empirical findings in Buso et al. (2017) and Tran and Klien (2017), "kicking the can down the road" may be a convenient strategy for political incumbents wishing to gain support through the undertaking of new investments before elections, without

[2]In recent years, the use of PPP at the local level has proved massive in several countries. For instance, nearly 80% of the infrastructure projects developed through PPP in Italy over the period 2002 - 2016, were procured at the municipal level and amounted to more than 33 billion euros overall (Ufficio Valutazione Impatto. Senato della Repubblica, 2018).

[3]Maskin and Tirole (2008) point out that one of the reasons why the involvement of private finance is beneficial is that, by certifying the costs of the projects publicly, it permits to securitize the associated public sector liabilities. However, this would require recording those liabilities correctly in the public budgets.

excessively burdening the yearly budget accounting.

These empirical findings all point to the conclusion that the ways in which public projects are financed and developed may (and often do) serve strategic purposes in political contests. However, to the best of our knowledge, the literature has not yet explored how political yardstick competition may be affected thereof. The goal of our study is to investigate how the choice of developing infrastructure projects by means of either TP or PPP impacts on yardstick competition among non-benevolent (rent-seeking) administrators, shedding light on the incentives which lead them to prefer one or the other form of project governance. To pursue that goal, we innovate on previous studies on political yardstick competition in three main respects. First, rather than focusing on fiscal disparities across jurisdictions (although they are not disregarded), we concentrate on disparities associated with different disbursement patterns. Second, we allow for the disparities to result from the decisions made by the administrators, rather than taking them as being exogenous in line with A. Allers (2012). Third, precisely because disparities are endogenous in our model, we can account for the possibility of using them deliberately as a strategic tool to influence the yardstick competition outcome and appropriate higher rents. With this approach, we also contribute to the literature on public procurement, in that we reconsider the TP/PPP dichotomy from an institutional perspective, nesting the choice of the contractual arrangement in the strategic interactions among (local) governments, rather than insisting on budgetary reasons along the lines of previous research.

Setting and results We construct a theoretical model representing two identical jurisdictions over a time horizon of two periods, capturing the term limit. In either jurisdiction, the administrator in office delegates the development of a public project to the private sector under either TP or PPP. In the first period, the infrastructure is built and new elections take place; in the second period, the infrastructure is managed to provide a new service to citizens. Each incumbent aims at extracting the highest attainable rent, taking into account the other incumbent's behaviour and the impact on the probability of re-election. As in Kotsogiannis and Schwager (2008), voters are uninformed of the cost

of services and do not observe the rent-seeking behaviour of the incumbent of their jurisdiction. Hence, they assess her performance being based on the supplies of public services in both jurisdictions. An incumbent providing poorer services will see her jurisdiction fare worse in this comparison and her chances of re-election decrease.

In this framework, two bunches of results are derived.

The first bunch of results is drawn taking the choice of the project governance as given. On the one hand, when the same project governance is used in the two jurisdictions yardstick competition generally leads to a symmetric equilibrium, unless the market revenues generated by the projects (hence, the revenue capacities) differ between jurisdictions. In the symmetric equilibrium, administrators devote the same amount of expenditure for service provision, face the same probability of running a new mandate, and extract the same rent from office. It means that political yardstick competition is effective, in general, when both incumbents use either PPP or TP. On the other hand, when different project governances are used in the two jurisdictions, an asymmetric equilibrium arises. Administrators set different expenditure levels, and face different probabilities of re-election and rents. The extent of the asymmetry is found to depend finely on the size and cost of the investment, the efficiency gain granted by the PPP (if any), and the market revenues generated by the project (if different). Unlike in the previous case, political yardstick competition is now biased, in general. The bias is especially pronounced if big investments are made and/or the interest rate on capital is high.

The second bunch of results is derived by endogenising the choice of the project governance, and abstracting from any differences in cost of operation and market revenues between TP and PPP. That is, on the one hand, PPP does not grant any cost savings in management, hence it is not justified on efficiency grounds. On the other hand, there is no other source of disparity between jurisdictions than the financing form of the project. Under these circumstances, the choice between TP and PPP is determined exclusively by the incumbents' seek of rents. We identify essentially two situations in which one should be concerned with the strategic use of PPP, absent any efficiency reasons. First, when projects are highly lucrative - as often in energy and transportation sectors - and/or

jurisdictions have a substantial capability of raising resources through taxation, PPP is a better rent-extraction tool for either incumbent. Second, when projects are mildly lucrative - as plausible with sport arenas and other entertainment facilities - and/or jurisdictions have a moderate capability of raising taxes, the incumbents find it convenient to differentiate their strategies to appropriate surplus. Hence, while one relies on TP, the other opts for PPP. Importantly, whereas in the former situation political yardstick competition is effective, in the latter it is hindered instead. Indeed, by choosing different contractual arrangements to develop the public project, the incumbents are able to disguise themselves and undermine the voters' ability to assess their performances.

Outline The remainder of the paper is organized as follows. In section 2 we describe the model. In section 3 we first examine the cases where both incumbents use either TP or PPP. We next explore situations in which different financing forms are adopted in the two jurisdictions. In section 4 we identify and discuss the equilibria which can actually be expected to arise in the strategic game between local incumbents. Section 5 concludes and proposes alleys to further research. Mathematical details are relegated to an appendix.

2 The model

We consider two identical jurisdictions, A and B, with identical voters and population, whose size is normalized to the unity. We assume that, as in a number of local electoral systems, such as the UK districts and the Italian municipalities, incumbents can be in office for a maximum of two mandates. To represent this time horizon, we consider two periods, denoted 1 and 2. In period 1 both administrators run their first mandate. At the end of period 1 an election takes place for a mandate to be run in period 2. Given the term limit, if an administrator is re-elected, then her second mandate will be the last one.

In jurisdiction $i \in \{A, B\}$ an expenditure of $E_{i,t}$ is incurred to provide public services in period $t \in \{1, 2\}$. This can be viewed as a measure of the level (or quality) of public

services, with the minimum normalized to zero.[4] To fund the cost of provision of public services, a tax is levied on the exogenously determined tax base B at a rate of τ, which is set by the central government. The total tax revenue is thus $\Upsilon = \tau B$ in either jurisdiction.

Infrastructure project In the two jurisdictions an (identical) infrastructure project is undertaken and developed through the two periods. In period 1 an infrastructure which costs $K \in (0, \Upsilon]$ is built (the *construction* phase). In period 2 the infrastructure is used to provide an *additional* service to the population (the *operation* phase). This occasions a cost of operation, to be specified in a moment.

Project governance Prior to construction, each administrator chooses the financial and organizational form of development of the project. Two options are available, namely TP and PPP. Contracts are signed with private operators according to the selected option.

Under TP, each phase of the project is delegated to a different operator. A construction contract is signed with the infrastructure builder at the beginning of period 1. A service contract is signed with the service provider at the beginning of period 2, and takes into account that the provider will sustain a cost of operation equal to C_T in period 2. Under this contractual arrangement, the pattern of disbursements for the jurisdiction coincides with the pattern of costs sustained for the project. In compliance with the construction contract and the service contract respectively, the administrator makes a payment of K to the infrastructure builder, and a payment of C_T to the service provider. In turn, she receives user fees of F from the service provider, who collects them in the market.

Under PPP, the two phases of the project are bundled together and delegated to a single operator. A construction-and-service contract is signed with the private partner at the beginning of period 1. Bundling induces the operator to account for all the costs over the whole lifecycle of the project. Hence, unlike under TP, if there are externalities between the two phases of the project, then the operator internalizes them.[5] Accordingly,

[4] A level (or quality) of services equal to zero indicates that only basic services are provided, whereas a strictly positive level indicates that more sophisticated services are provided.

[5] Actually, the private partner in charge of the two phases of the project is motivated to internalize

the cost of operation C_P will be below C_T if the externalities are positive, in which case internalization is desirable. It will be above C_T if the externalities are negative, in which case internalization is undesirable. It will be equal to C_T if there are no externalities at all. On efficiency grounds, PPP is the appropriate regime only in the first case. Nonetheless, administrators may want to adopt it also in the other cases. Unlike under TP, here the pattern of disbursements for the jurisdiction diverges from the pattern of costs sustained for the project. Indeed, according to the PPP contract, the cost of construction K is initially financed by the private operator and then recouped during the operation phase. As a result, the cost of construction burdens the jurisdiction only in period 2. However, at that time, it amounts to $(1+r)K$, where $r \in (0,1)$ is the interest rate. Besides, in period 2 the administrator also receives the revenues which the private partner collects in the market charging users with the contractually defined fee.[6]

Administrators and voters Each administrator acts as a pure rent-seeker. In period 1 she attempts to maximize the rent she can obtain over the two-periods horizon. This requires taking into account that a second mandate, to be run in period 2, will be obtained only with some probability, which will depend on the voters' appreciation. To represent the voters' behaviour, we do not model preferences through a utility function, and only take preferences to be homogeneous between jurisdictions. In line with the literature on political yardstick competition, we assume that voters take a purely *retrospective* behaviour. In each jurisdiction, they decide whether or not to vote again for the incumbent, being based on the outputs of the administration decisions made in the *two* jurisdictions, which they can observe and compare. In other words, they assess the performance of one administrator relative to that of the other, using observable outcomes as a proxy for the effort the administrators exert. Essentially, these outcomes are the

the externalities through an incentive contract, which also establishes an efficient allocation of the risks of the project. Given that our aim is to study political yardstick competition, we omit any explicit representation of the contract to keep the analysis well focused.

[6]The practice of returning the user fees collected by the private company to the public partner is common in PPP projects as well. For instance, this was the case of the Vélib' project launched in Paris in 2007 to offer citizens a bicycle-sharing scheme. As Iossa and Saussier (2018) point out, although the Vélib' contract stipulated by the City of Paris with the private partner JCDecaux was officially a TP contract, it was tantamount to a PPP contract on technical grounds.

levels of public services provided in period 1, as measured by $E_{A,1}$ and $E_{B,1}$. Actually, there are two more things which voters observe in period 1. However, none of them is useful for comparison. First, voters observe the tax rates, according to which local taxes are levied; local taxation is exogenous and equal in the two jurisdictions though. Second, voters observe that an infrastructure has been built for future use in either jurisdiction, under a given contractual arrangement. Nonetheless, whereas the project is identical in the two jurisdictions, voters do not yet know its outcome, namely, the service to be available in a later stage. Being uninformed of how the costs of the project will differ under the two contractual arrangements, the particular choice of one or the other arrangement is irrelevant to voters. Beyond a generic desire that administrators do the "right thing," voters need to wait until after they will have observed outputs (services) to be able to form an assessment of the project.[7] In definitive, the probability of re-election will only depend on $E_{A,1}$ and $E_{B,1}$ for either incumbent.

Probability of re-election To represent the probability of re-election, we follow the *contest success function approach*, in line with a number of existing studies (Bodenstein and Ursprung, 2005; Long, 2013; Tullock, 1980). This reduced-form, simple contest approach is convenient in that it permits to capture the basic relationship between voters' behaviour and rent-seekers' policy choices, yet, abstracting from the specific institutional setting and agents' preferences (Epstein and Nitzan, 2006). Following this approach, we can thus represent the political contest without making any specific assumptions on local

[7]Under PPP, because the contract is stipulated at the beginning of period 1, the fee of the service to be supplied in period 2 is also known in the first period. This is not the case under TP, instead. Of course, an administrator who chooses PPP might advertise the price information among voters. However, there is no much use that can be made of it, as long as voters cannot see what that price is for. One may object that in situations where one administrator chooses PPP and the other chooses TP, early availability of the price of a future service would be *per se* a good signal of the former administrator. In fact, this is not necessarily the case. Indeed, it is equally plausible that voters would dislike current politicians to commit to policies restraining future administrators' choices. Along the argument made by A. Allers (2012), yardstick competition is a simple tool used by unsophisticated voters, who typically do not have enough economic expertise to judge over such complex issues as the choice of the suitable contractual arrangement. Likewise, in the words of Cunha Marques and Berg (2011), "those bearing the costs (customers) are diffuse and lack information regarding relative performance under alternative arrangements." (p.1602). If voters were able to assess contractual alternatives, then, plausibly, they would also be able to read budgets, estimate cost curves, and deduce rents. Yardstick competition itself would become useless in that case.

preferences, as we said. Formally, the contest success function is given by

$$\rho_i\left(E_{i,1}, E_{j,1}\right) = \frac{E_{i,1}}{E_{i,1} + E_{j,1}},\ \forall i \neq j \in \{A, B\},$$

and respect two natural properties. First, it is increasing and concave in the expenditure for services made in the own jurisdiction, whereas it is decreasing in the expenditure made in the rival jurisdiction. Second, the probability boils down to 1/2 when the incumbents behave exactly in the same manner in the two jurisdictions ($E_{i,1} = E_{j,1}$). Thus, under the yardstick mechanism, the incumbent who provides better services, which signal more effort, gains consensus; the other looses it.

3 Characterization of the equilibria

We are now ready to characterize the non-cooperative equilibria of the game between incumbents. After considering a case where both jurisdictions rely on TP, denominated *TT regime*, we turn to explore a case where both jurisdictions rely on PPP, denominated *PP regime*. Although these two cases are similar, we present them separately to make it clear how they differ in terms of inter-temporal disbursement profiles. We conclude this part of the analysis with the description of a "mixed" case where TP is used in one jurisdiction and PPP in the other. This will be referred to as the *T/P regime*.

3.1 The TT regime

Suppose that TP is used in both jurisdictions. Under TP each phase of the project is delegated to a different operator so that, if there are externalities between phases of the project, then they are not internalized. Accordingly, the expected value of the rent of the incumbent in jurisdiction $i \in \{A, B\}$ is given by

$$R_i\left(E_{i,1}, E_{i,2}, E_{j,1}\right) = \Upsilon - E_{i,1} - K + \beta\rho_i\left(E_{i,1}, E_{j,1}\right)\left(\Upsilon - E_{i,2} + F_i - C_T\right),$$

where $\beta \in [0,1]$ is the discount factor. In period 1 the rent is given by the tax revenues net of the expenditure in public services and the cost of investment in the new infrastructure. In period 2 the rent (to be obtained only in case of re-election) includes the tax revenues net of the expenditure in public services and, in addition, the market revenues F_i of the new service net of the cost of supplying the service. The administrator of jurisdiction i chooses the levels of expenditure $E_{i,1}$ and $E_{i,2}$ in such a way as to attain the highest expected rent. The choice of $E_{i,2}$ is straightforward. Because the rent decreases with $E_{i,2}$ and the incumbent no more has any electoral concerns in period 2, she is aware that there will be no point to set $E_{i,2}$ above the minimum as period 2 begins. Hence, $E_{i,2}^{TT} = 0$, where the superscript TT denotes the regime here considered. Given this result, we can save on notation and drop the time index from the levels of expenditure in period 1. Accordingly, the incumbent's problem boils down to choosing E_i to maximize

$$R_i\left(E_i, E_j\right) = \Upsilon - E_i - K + \frac{\beta E_i}{E_i + E_j}\left(\Upsilon + F_i - C_T\right). \tag{1}$$

One may wonder why F_i is not taken to be a choice variable of the administrator, together with the level of expenditure, an approach which will also be followed in the next two regimes. There are a number of reasons for this. First, in many instances, procurement contracts are tendered out and the fees are determined through the auction mechanism (given the market conditions). Second, even if the contract is awarded through a negotiation with the firm, in which the public authority has all the bargaining power, the determination of the fees cannot abstract from considerations about the firm's willingness to participate and incentives to behave virtuously, the representation of which is beyond the scope of this study. Third, in some sectors (notably, public utilities), service fees are subject to regulatory policies designed by independent authorities, sometimes placed at higher tiers within the institutional hierarchy, which typically reflect efficiency and/or redistribution concerns. This all justifies why we take the local administrator to choose the level of expenditure, *given the level of the fee*. In a later stage, plausible hypotheses on the level of the fees in the two jurisdictions will help us derive insights on different scenarios.

Inspection of (1) highlights that the incumbent faces a trade-off in the choice of E_i. Whereas more expenditure reduces the rent in period 1, it makes it more likely that further surplus will be retained through a second mandate. The best is to set E_i such that the marginal loss in period 1 exactly equals the marginal expected benefit in period 2, according to the following rule:[8]

$$1 = \frac{\beta E_j}{(E_i + E_j)^2} (\Upsilon + F_i - C_T). \tag{2}$$

This condition can be used to derive a more explicit formulation of E_i, given the expenditure choice made in the competing jurisdiction, namely

$$E_i(E_j) = \sqrt{\beta (\Upsilon + F_i - C_T) E_j} - E_j.^{9} \tag{3}$$

Considering that this is true, *mutatis mutandis*, for administrator $j \neq i$ as well, one can pin down the equilibrium levels of expenditure and, hence, the resulting probabilities of re-election and expected rents $\forall i \neq j \in \{A, B\}$:[10]

$$E_i^{TT} = \beta (\Upsilon + F_j - C_T) \frac{(\Upsilon + F_i - C_T)^2}{(2\Upsilon + F - 2C_T)^2} \tag{4a}$$

$$\rho_i^{TT} = \frac{\Upsilon + F_i - C_T}{2\Upsilon + F - 2C_T} \tag{4b}$$

$$R_i^{TT} = \Upsilon - K + \beta \frac{(\Upsilon + F_i - C_T)^3}{(2\Upsilon + F - 2C_T)^2}, \tag{4c}$$

where we have denoted $F = \sum_{i \in \{A,B\}} F_i$, for shortness. Inspection of (4a) to (4c) permits to draw a few insights.

[8] The concavity of this and the next optimization problems is verified in appendix.

[9] All throughout, we assume that $\Upsilon + F_i - C_T > 0$, $\forall i \in \{A, B\}$, entailing that no budget deficit is induced to have the project developed. This assumption might be thought of as reflecting the existence of any legal or constitutional budget-balancing requirements at the sub-national government level. For instance, in Italy, such a requirement was introduced by Law n. 2012/243 to implement the budget-balancing principle stated in article 81 of the Italian Constitution (as modified by Constitutional Law n. 2012/1).

[10] As usual in this kind of games (see Di Liddo and Giuranno (2016), among others), in addition to the solution presented in the text, there is also a corner solution. In the resulting equilibrium, the yardstick mechanism fails to motivate the incumbents to exert any effort, and they both provide the minimum level of public services (*i.e.*, $E_i^{TT} = 0$, $\forall i$), facing a re-election probability of 1/2, and extracting the maximum available rents given the fees (*i.e.*, $\Upsilon - K + \beta (\Upsilon + F_i - C_T)/2$, $\forall i$). We do not insist on equilibria of this sort, which would not add to the insights of our study.

First, an asymmetric equilibrium can only arise if user fees differ between jurisdictions. This boils down to a case where there is a disparity in revenue capacity between jurisdictions, as analysed in previous studies. For instance, if $F_i > F_j$, then $E_i^{TT} > E_j^{TT}$, $\rho_i^{TT} > \frac{1}{2} > \rho_j^{TT}$, and $R_i^{TT} > R_j^{TT}$. In words, if there is any jurisdiction where more market revenues can be collected in period 2, then the incumbent of that jurisdiction can also afford to spend more in public services in period 1. Whereas more revenues raise the rent in period 2, a higher expenditure in period 1 makes re-election more likely. Provided one of the two incumbents both enjoys an electoral advantage and faces a higher expected rent, there is a bias in yardstick competition, as should be expected, indeed, in the presence of a disparity in revenue capacity.

However, in a context where jurisdictions are homogeneous in any other respect, a reasonable conjecture is that also user fees, hence market revenues, will be equal. Letting F^{TT} denote the equal revenues, the equilibrium triplet reduces to

$$\begin{aligned} E^{TT} &= \frac{\beta}{4}\left(\Upsilon + F^{TT} - C_T\right) \\ \rho^{TT} &= \frac{1}{2} \\ R^{TT} &= \Upsilon - K + \frac{\beta}{4}\left(\Upsilon + F^{TT} - C_T\right) \end{aligned}$$

for either incumbent. Clearly, yardstick competition is effective in the absence of disparities.

Second, a unitary increase in K leads to a unitary reduction in the extracted rent, whereas it leaves the level of services unaltered. Intuitively, an incumbent cannot afford downgrading public services to pass (a part of) the cost of investment onto citizens. Indeed, that choice would decrease her chance to be in office in period 2. Yet, under TP, it is precisely in period 2 that the incumbent can extract more surplus, provided the entire cost of investment was sustained in period 1.

3.2 The PP regime

Suppose that PPP is adopted in both jurisdictions. Under PPP the two phases of the

project are delegated to a single operator, who invests up-front to build the infrastructure and internalizes the externalities between phases of the project, if any. Accordingly, the expected value of the rent of the incumbent in jurisdiction $i \in \{A, B\}$ amounts to

$$R_i\left(E_{i,1}, E_{i,2}, E_{j,1}\right) = \Upsilon - E_{i,1} + \beta\rho_i\left(E_{i,1}, E_{j,1}\right)\left[\Upsilon - E_{i,2} + F_i - (1+r)\,K - C_P\right],$$

In period 1 the rent is now given by the tax revenues net of the sole expenditure in public services. In period 2 the rent embodies, first, the tax revenues net of the expenditure in public services; it also embodies the market revenues of the new service net of the total cost of building and managing the infrastructure for supply, which includes the interests on capital. For the same reason as in the TT regime, there is no point for the administrator to set the expenditure above the minimum level in the second period. Hence, $E_{i,2}^{PP} = 0,\ \forall i \in \{A, B\}$, where the superscript PP denotes the regime here considered. Dropping again the time index, the incumbent's problem boils down to choosing E_i in such a way as to maximize

$$R_i\left(E_i, E_j\right) = \Upsilon - E_i + \frac{\beta E_i}{E_i + E_j}\left[\Upsilon + F_i - (1+r)\,K - C_P\right]. \tag{6}$$

As under TP, the incumbent faces a trade-off in the choice of E_i, which is now captured through the following optimization rule:

$$1 = \frac{\beta E_j}{\left(E_i + E_j\right)^2}\left[\Upsilon + F_i - (1+r)\,K - C_P\right]. \tag{7}$$

Accordingly, E_i can be further expressed as a function of the expenditure choice in the competing jurisdiction, namely

$$E_i\left(E_j\right) = \sqrt{\beta\left[\Upsilon + F_i - (1+r)\,K - C_P\right]E_j} - E_j.^{11} \tag{8}$$

Considering that this is true, *mutatis mutandis*, for administrator $j \neq i$ as well, the levels of expenditure, the probabilities of re-election and the expected rents in equilibrium are

[11] For the same reason as in the TT regime, we assume that $\Upsilon + F_i - (1+r)\,K - C_P > 0,\ \forall i \in \{A, B\}$.

determined as follows $\forall i \neq j \in \{A, B\}$:[12]

$$E_i^{PP} = \beta \left[\Upsilon + F_j - (1+r)K - C_P\right] \frac{\left[\Upsilon + F_i - (1+r)K - C_P\right]^2}{\left[2\Upsilon + F - 2(1+r)K - 2C_P\right]^2} \tag{9a}$$

$$\rho_i^{PP} = \frac{\Upsilon + F_i - (1+r)K - C_P}{2\Upsilon + F - 2(1+r)K - 2C_P} \tag{9b}$$

$$R_i^{PP} = \Upsilon + \beta \frac{\left[\Upsilon + F_i - (1+r)K - C_P\right]^3}{\left[2\Upsilon + F - 2(1+r)K - 2C_P\right]^2}. \tag{9c}$$

Let us inspect (9a) to (9c) to draw insights also in this regime.

First, exactly as in the TT regime, an asymmetric equilibrium can only arise if $F_i \neq F_j$, *i.e.*, if the two jurisdictions differ in terms of revenue capacity. Not surprisingly, yardstick competition is biased in that situation. In a (perhaps more plausible) case where market revenues are equal in the two jurisdictions, namely $F_i = F_j \equiv F^{PP}$, the equilibrium triplet reduces to

$$\begin{aligned} E^{PP} &= \frac{\beta}{4}\left[\Upsilon + F^{PP} - (1+r)K - C_P\right] \\ \rho^{PP} &= \frac{1}{2} \\ R^{PP} &= \Upsilon + \frac{\beta}{4}\left[\Upsilon + F^{PP} - (1+r)K - C_P\right] \end{aligned}$$

for either incumbent, and yardstick competition is clearly effective.

Second, in the PP equilibrium, not only does a unitary increase in K trigger a reduction of $\beta(1+r)/4$ in the expected rent. It also triggers an equal reduction in the level of services, which was found to remain unaltered under TT instead. Moreover, because $[\beta(1+r)/4] < 1$, the rent reduction is lower in the PP regime than in the TT regime. Intuitively, when PPP is used the cost of investment generates a public disbursement in period 2, which reduces the surplus an administrator can appropriate in that period. Because of this, incumbents care less of a second mandate, and are thus less concerned with downgrading public services in period 1 in order to pass a part of the cost of investment

[12] As in the TT regime, in addition to the solution presented in the text, there is also a corner solution of the game, namely, an equilibrium in which both incumbents provide the minimum level of public services, face a re-election probability of 1/2, and extract the maximum rent, given the market revenues (*i.e.*, $\Upsilon + \beta\left[\Upsilon + F_i - (1+r)K - C_P\right]/2$, $\forall i$).

onto citizens. In definitive, whereas the cost of investment only burdens the incumbents under TT, it is shared with the citizens in the PP regime.

3.3 The T/P regime

Suppose that the project is developed by means of TP in one jurisdiction and PPP in the other. To avoid confusion, we will append the subscript T to indicate the former jurisdiction and the subscript P to indicate the latter, instead of the subscripts i and j previously used.

In jurisdiction T the expected rent is as presented in (1), hence the incumbent's reaction function is given by (3), where now $i = T$ and $j = P$. Likewise, in jurisdiction P the expected rent is as presented in (6), hence the incumbent's reaction function is given by (8), with the same adapted notation. Using (3) together with (8), one derives the levels of expenditure, the probabilities of re-election and the expected rents in the T/P equilibrium, for any given pair of market fees (F_T, F_P).[13] Denoting $C \equiv C_T + C_P$, they are respectively given by

$$E_T^{T/P} = \beta \left[\Upsilon + F_P - C_P - (1+r)K\right] \frac{\left(\Upsilon + F_T - C_T\right)^2}{\left[2\Upsilon + F - C - (1+r)K\right]^2} \tag{10a}$$

$$E_P^{T/P} = \beta \left(\Upsilon + F_T - C_T\right) \frac{\left[\Upsilon + F_P - (1+r)K - C_P\right]^2}{\left[2\Upsilon + F - C - (1+r)K\right]^2} \tag{10b}$$

and

$$\rho_T^{T/P} = \frac{\Upsilon + F_T - C_T}{2\Upsilon + F - C - (1+r)K} \tag{11a}$$

$$\rho_P^{T/P} = \frac{\Upsilon + F_P - C_P - (1+r)K}{2\Upsilon + F - C - (1+r)K} \tag{11b}$$

[13] As in the TT and PP regimes, in addition to the solution presented in the text, there is also a corner solution such that both incumbents provide the minimum level of public services and are re-elected with probability of 1/2. Furthermore, each of them extracts the maximum rent, given F_T and F_P. Specifically, the rent of administrator T amounts to $\Upsilon - K + \beta\left(\Upsilon + F_T - C_T\right)/2$, that of administrator P amounts to $\Upsilon + \beta\left[\Upsilon + F_P - (1+r)K - C_P\right]/2$.

and

$$R_T^{T/P} = \Upsilon - K + \beta \frac{(\Upsilon + F_T - C_T)^3}{[2\Upsilon + F - C - (1+r)K]^2} \tag{12a}$$

$$R_P^{T/P} = \Upsilon + \beta \frac{[\Upsilon + F_P - C_P - (1+r)K]^3}{[2\Upsilon + F - C - (1+r)K]^2}. \tag{12b}$$

It is straightforward to see that, whereas the ratio between probabilities of re-election equals that between levels of expenditure, it differs from the ratio between expected rents, in general. Hence, political yardstick competition is likely to be biased.

There is an important novel aspect to the T/P regime, as compared to TT and PP. In addition to the disparity in revenue capacity between jurisdictions, which arises if market fees are different, there are two other (potential) sources of disparities, associated with the two different forms of project governance, namely the cost of operation (if synergies between project phases are present) and the inter-temporal disbursement profile.

To derive insights, we first inspect (10a) to (12b) allowing for market revenues to differ between jurisdictions ($F_T \neq F_P$), hence for a disparity in revenue capacity to be present. In the T/P regime, this may look plausible, *a priori*, since different contractual arrangements are used in the two jurisdictions. We begin by remarking that $E_T^{T/P} > E_P^{T/P}$ together with $\rho_T^{T/P} > \rho_P^{T/P}$ if and only if

$$F_T - F_P > (C_T - C_P) - (1+r)K.$$

This depends on three elements: first, and not surprisingly, the disparity in revenue capacity, namely $F_T - F_P$; second, the cost saving (possibly) granted by the PPP, namely $C_T - C_P$; third, the cost of investment under PPP, which induces a disbursement of $(1+r)K$ in period 2. Suppose that $F_T > F_P$. If the cost saving granted by the PPP is sufficiently little to be more than compensated by the excess revenues obtained under TP ($C_T - C_P < F_T - F_P$), then the cost of investment does not really matter. The incumbent using TP can afford to invest more in public services, and is thus more likely to obtain a second mandate. If the PPP permits important cost savings instead, then

this outcome carries over limitedly to sufficiently big investments. In good substance, the inefficiency in service management makes a second mandate little attractive under TP, the cost of investment to be repaid in period 2 makes it little attractive under PPP. The comparison between expected rents is less immediate, instead, and little useful to make progress with the analysis of the T/P regime, unless specific cases are considered. To that end, we shall thus make plausible hypotheses about the fees.

A first possible case is one where the consumer willingness to pay for the service is not sufficiently high to ensure that the market revenues cover all the costs of the project. To illustrate, one can think of theatres and cemetery planning. One way to formalize situations of this kind is to assume that the fees cover the cost of management under both TP and PPP, namely $F_T^{T/P} = C_T$ and $F_P^{T/P} = C_P$. Under this circumstance, the incumbent who uses TP spends more in public services and faces a higher probability of re-election. Yet, how his expected rent compares with that of the incumbent who uses PPP, depends on how costly capital is. If capital is sufficiently costly $(r > 1/3)$, then the incumbent who uses TP also faces a higher expected rent. Yardstick competition is biased in that case. If capital is not that costly $(r < 1/3)$, then the bias persists with sufficiently big investments $\left(K > \Upsilon \left[3r - 1 + \sqrt{1 - 2r - 3r^2}\right] / 2r\left(1 + r\right)\right)$, which obviously involve higher interests. However, as investments become smaller, PPP yields a higher expected rent, and the effectiveness of yardstick competition may be restored (see Appendix A.3.1 for details).

In other situations, consumers display a higher willingness to pay and higher fees can be charged. For instance, under PPP they can be set not only to cover the cost of management, but also to pay back the cost of investment. To illustrate, this represents the case of the garbage collection and disposal in the Italian municipalities.[14] Formally, $F_T^{T/P} = C_T$ and $F_P^{T/P} = (1 + r) K + C_P$. With this revenue profile, any asymmetry is eliminated in both the expenditure choices and the probabilities of re-election, whereas

[14] According to the Italian legislation (D.P.R. n. 1999/158), the fees must be determined in such a way as to cover both the cost of investment in disposal plants and the cost of collection management.

a difference persists in terms of rents, namely

$$\begin{aligned} E^{T/P} &= \frac{\beta}{4}\Upsilon \\ \rho^{T/P} &= \frac{1}{2} \\ R_T^{T/P} &= \Upsilon - K + \frac{\beta}{4}\Upsilon \quad \text{and} \quad R_P^{T/P} = \Upsilon + \frac{\beta}{4}\Upsilon. \end{aligned}$$

Clearly, it is $R_P^{T/P} > R_T^{T/P}$. Indeed, because under TP the cost of investment fully burdens the incumbent in period 1, whereas under PPP it is transferred to period 2 and entirely paid by service users through the fees, the expected rent of incumbent P exceeds that of incumbent T by exactly that amount (K). Yardstick competition is biased.

Although the project governance is different, fees may well be equal in the two jurisdiction. For instance, this is the case if the service is subject to some form of price regulation by an independent authority, say, in the energy or transportation sector. Alternatively, equal fees may result from the use of standardized contracts.[15] As already mentioned, with equal fees there is no longer any disparity in revenue capacity, and the effectiveness of yardstick competition only depends on the costs and disbursement profiles. One can verify that $E_T^{T/P} > E_P^{T/P}$ and $\rho_T^{T/P} > \rho_P^{T/P}$ as long as TP is not particularly inefficient relative to PPP and/or the disbursement associated with the cost of investment is sufficiently high under PPP, namely $C_T - C_P \leq (1+r)K$. With projects of this kind, the expected rent may be lower under PPP because there is no much to save in cost of management and/or there is much to repay in terms of capital in period 2. Hence, yardstick competition may be biased.

[15] Standardized contracts for the provision of infrastructure services are widely used in the UK to boost the transparency of the awarding process and the accountability of public officials (H.M. Treasury, 2006). They are considered to be especially useful as far as local governments are concerned. Indeed, on the one hand, local governments have a limited expertise in the use of complex procurement mechanisms. On the other hand, they are particularly exposed to opportunism and corruption (see Iossa and Martimort (2016), for instance).

4 What are the relevant equilibria?

We now turn to establish which of the explored regimes will actually arise, hence what equilibria are relevant. This will enable us to understand whether and under what conditions incumbents should be expected to make a strategic use of the financing form of the project. To that end, we will compare the incumbents' rents across regimes and identify the regime under which they are highest. That is the regime for which the incumbents will opt.

We restrict attention to a case where, first, the administrators collect the same fees with the two financing forms and, second, the costs of operation are equal with TP and PPP. This focus is functional to the purpose of our analysis. Indeed, once any considerations on disparities in revenue capacity and costs of operation are net out, the choice of a specific form will mirror only strategic motivations associated with the inter-temporal disbursement profile. Particularly, because there is no advantage to using PPP in terms of cost of operation, there would be no justification, on efficiency grounds, for turning down TP. We will see that equilibria with PPP being utilized do emerge, in fact.

Formally, we assume that $C_P = C_T = C/2$, and that $F_i = F_j = F/2$ regardless of the regime. Further letting $X \equiv 2\Upsilon + F - C$, for shortness, we can write the rents respectively in the TT and PP regimes as

$$R^{TT} = \Upsilon - K + \frac{\beta}{8}X \quad \text{and} \quad R^{PP} = \Upsilon + \frac{\beta}{8}\left[X - 2(1+r)K\right],$$

where $R^{TT} < R^{PP}$. Moreover, the rents in the T/P regime are specified as

$$R_T^{T/P} = \Upsilon - K + \frac{\beta}{8}\frac{X^3}{\left[X - (1+r)\,K\right]^2} \quad \text{and} \quad R_P^{T/P} = \Upsilon + \frac{\beta}{8}\frac{\left[X - 2\,(1+r)\,K\right]^3}{\left[X - (1+r)\,K\right]^2}.$$

The four regimes to be considered are *one TT regime*, in which both incumbents opt for TP; *one PP regime*, in which both incumbents opt for PPP; and *two T/P regimes*, in which one incumbent opts for TP and the other opts for PPP. To help the visualization of the pairs of rents available to the incumbents in each of the regimes, it is useful to regroup

		Incumbent j: TP	Incumbent j: PPP
Incumbent i	TP	$\left(R^{TT}, R^{TT}\right)$	$\left(R_T^{T/P}, R_P^{T/P}\right)$
	PPP	$\left(R_P^{T/P}, R_T^{T/P}\right)$	$\left(R^{PP}, R^{PP}\right)$

Figure 1: Payoff matrix

them in the payoff matrix in Figure 1. In each cell of the matrix, the first payoff is the rent of the player to the left (incumbent i), the second payoff is the rent of the player to the top (incumbent j). Our goal is to identify the Nash equilibria of the game represented by the matrix, given the two strategies (TP and PPP) available to the incumbents.

Letting

$$\begin{aligned}\psi(X,K,r) &\equiv \frac{8\left[X-(1+r)K\right]^2}{(1+r)\left[4X^2-5(1+r)KX+2(1+r)^2K^2\right]}\\ \phi(X,K,r) &\equiv \frac{8\left[X-(1+r)K\right]^2}{(1+r)\left[4X^2-11(1+r)KX+8(1+r)^2K^2\right]},\end{aligned}$$

which are both non-negative, the following equivalences are found to hold:

$$\begin{aligned}R^{PP} &> R_T^{T/P} \Leftrightarrow \beta < \psi(X,K,r)\\ R^{TT} &> R_P^{T/P} \Leftrightarrow \beta > \phi(X,K,r).\end{aligned}$$

Observing that $\phi(X,K,r) \geq \psi(X,K,r)$, we identify five cases according to the magnitude of β, for given values of the other parameters.[16]

Case 1: $\beta < \psi(X,K,r)$ In this case, $R^{TT} < R_P^{T/P}$ and $R^{PP} > R_T^{T/P}$, hence the Nash equilibrium of the game is (PPP, PPP). That is, although PPP grants no savings in terms of management cost relative to TP, it will be used in either jurisdiction, and the

[16] One can check that $\phi(X,K,r) \geq \psi(X,K,r)$ if and only if $K \leq 3\left(2\Upsilon + F - C\right)/\left(1+r\right)$, which holds as a strict inequality under the assumption that $X \geq (1+r)K$.

PP regime will arise.

Case 2: $\beta = \psi(X, K, r)$ In this case, $R^{TT} < R_P^{T/P}$ and $R^{PP} = R_T^{T/P}$, hence the Nash equilibria of the game are (PPP, PPP), (PPP, TP) and (TP, PPP). In the latter two equilibria, TP will be adopted in one jurisdiction and PPP in the other so that the T/P regime will arise.

Case 3: $\psi(X, K, r) < \beta < \phi(X, K, r)$ In this case, $R^{TT} < R_P^{T/P}$ and $R^{PP} < R_T^{T/P}$ and the Nash equilibria of the game are (PPP, TP) and (TP, PPP).

Case 4: $\psi(X, K, r) < \beta = \phi(X, K, r)$ In this case, $R^{TT} = R_P^{T/P}$ and $R^{PP} < R_T^{T/P}$ and the Nash equilibria of the game are (PPP, TP), (TP, PPP) and (TP, TP). In the latter equilibrium, TP will be used in both jurisdictions and the TT regime will arise.

Case 5: $\beta > \phi(X, K, r)$ In this case, $R^{PP} < R_T^{T/P}$ and $R^{TT} > R_P^{T/P}$ so that the Nash equilibrium of the game is (TP, TP).

In substance, both the homogeneous regimes and the mixed regime may arise as equilibria of the game, depending on the size of the discount factor β.

The PP regime arises for sufficiently low values of β, *i.e.*, when incumbents care relatively little about the future and point to grasping surplus up-front. Nonetheless, PPP appeals also to patient incumbents, if the revenues net of the cost of management are *largely above* the disbursement associated with the cost of investment in period 2. To see it, consider that

$$\lim_{X \to +\infty} \psi(X, K, r) = \lim_{X \to +\infty} \phi(X, K, r) = \frac{2}{1+r} > 1 \geq \beta.$$

This tells that, with very high revenues, Case 1 will arise regardless of the weight the incumbents attach to the future. Intuitively, when X is very high PPP grants a double benefit. Not only does it enable the administrator to share the cost of investment with citizens through a reduction in public services in period 1. It also leaves much surplus to

be gained in period 2, even if the cost of investment must still be paid back. Therefore, both administrators will have an incentive to adopt PPP, although that choice is not justified on efficiency grounds, as we said.

On the opposite, the TT regime arises for high values of β, *i.e.*, when incumbents are patient and care of being re-elected to extract surplus in the second period essentially. Nonetheless, also impatient incumbents will prefer to choose TP, if the net revenues are *close to* the disbursement, which should be made under PPP to pay back the cost of investment in period 2. This can be viewed by computing

$$\lim_{X \to (1+r)K} \psi(X, K, r) = \lim_{X \to (1+r)K} \phi(X, K, r) = 0 < \beta,$$

which shows that, with very low revenues, Case 5 will arise regardless of the weight the incumbents attach to the future. To see the intuition behind this finding, suppose that the incumbents consider using PPP. Because, with X very low, there is nothing to gain in period 2 under PPP, one administrator will want to switch from PPP to TP in seek of a higher rent (since $R_T^{T/P} > R^{PP}$). But then the same strategy will be convenient to the other administrator as well (since $R^{TT} > R_P^{T/P}$). As a result, they will both end up using TP. From a social viewpoint, this is a desirable outcome in that PPP would grant no efficiency advantage in management.

Lastly, the T/P regime arises for intermediate values of β, provided that the revenues net of the cost of management are *moderately above* the disbursement which is required to pay back the cost of investment in period 2, if PPP is used. PPP granting a contained surplus in the second period, this is a case where its use is moderately appealing to the administrators. Hence, they will not both insist on PPP. One of the two will rather switch to TP. The key driver to this outcome is that the choice of different forms of project governance permits the incumbents to disguise themselves *vis-à-vis* their voters. As the incumbents become less comparable, they will also be able to appropriate more surplus ($R_T^{T/P} > R^{PP}$ and $R_P^{T/P} > R^{TT}$).

4.1 Discussion

Our analysis highlights that there are essentially two situations in which one should be concerned with the strategic use of PPP, in environments where that choice would not be backed by an efficiency rationale.

First, one should expect to see a pronounced use of PPP when jurisdictions have a substantial capability of raising resources through taxation, and/or projects are highly lucrative. Because important rents are available in those contexts, administrators will all prefer to use the contractual solution which permits to extract more of those rents (and more rapidly). That solution is given by PPP. Indeed, it was found that $R^{PP} > R^{TT}$, since the cost of investment is partially collectivized under PPP, whereas it only burdens administrators under TP. This result is in line with the observation that rich municipalities rely recurrently on PPP to undertake profitable projects, notably in energy, transportation, water, and ICT sectors, and that PPP arrangements are primarily adopted when (local) governments are maximizing up-front benefits in the seek of rents.[17] Noticeably, absent any revenue disparities, successful rent extraction does not prevent yardstick competition from being effective, as was found in the analysis of the PP regime.

Second, one should expect to see only a limited dissemination of PPP when jurisdictions have a moderate fiscal/revenue capacity, and/or projects are mildly lucrative. With less surplus being available in those situations, the best way for administrators to extract more of it, is to differentiate their strategies by choosing different contractual arrangements. Therefore, in addition to administrators who follow a short-term strategy, using PPP to appropriate much of the available surplus up-front, with little interest in a second mandate, there will also be administrators who follow a longer-term strategy, using TP to extract surplus over time, hence caring more of a second mandate. This result is consistent with the observation that, in general, moderately rich municipalities make only some use of PPP, and undertake moderately profitable projects, such as sport arenas and entertainment facilities.[18] Importantly, because by differentiating their choices of project

[17] See, for instance, Cunha Marques and Berg (2011) on a case of Portuguese municipalities.

[18] According to the data reported by Ufficio Valutazione Impatto. Senato della Repubblica (2018), whereas 100% of the Italian municipalities with more than 20000 residents have used PPP at least once

governance incumbents are able to disguise themselves and undermine the voters' ability to assess their performances, yardstick competition is hindered, even if jurisdictions are alike in terms of revenue capacity.

5 Conclusions

Political yardstick competition is deemed to help voters infer the effort made by local administrators to pursue social interests. By comparing the level of public services provided by their own incumbent with that of similar jurisdictions, voters can re-elect good politicians and send non-performers packing, thus giving administrators incentives to a better performance. Whereas it is now well known that this mechanism may nonetheless be biased when jurisdictions display fiscal disparities, which voters do not perceive correctly, our study highlighted that the effectiveness of political yardstick competition may also be hindered when pure rent-seeking administrators use different financing (and organizational) forms to develop similar public infrastructure projects. Provided different financing forms are associated with different inter-temporal disbursement profiles, the administrators' reaction functions exhibit asymmetric slopes. Unusual in models of symmetric yardstick competition, this difference in slope, which results from the decisions made by the administrators, translates into asymmetric re-election probabilities and rents. By taking an institutional perspective on the TP/PPP dichotomy, we could thus clarify how the use of different forms of public project governance may help opportunistic administrators pursue private interests, given their strategic interactions in the political arena.

There are a number of alleys to further research.

First, the analysis could be extended to allow for the functional form of the re-election probability to differ under the two contractual forms. This hypothesis is backed by recent

over the period 2002 - 2016, this is only the case of 40% of the municipalities with less than 2000 residents and, 68% of the municipalities with 2000 to 5000 residents. The biggest and most profitable projects are concentrated in Rome, Milan and a few other big cities. Of course, one cannot exclude the possibility of this observation also capturing the administrators' attempt to take advantage of externalities existing between project phases, which are ruled out in the final part of our analysis. We yet offer an additional reason potentially underlying that observation.

studies, which suggest that the attitude of citizens towards the involvement of private finance in public projects may abstract from efficiency considerations and rather reflect ideological factors, at least to some extent. Particularly, the more familiar that citizens are with PPPs, the more likely that they will be to welcome their use in new projects (Boyer and Slyke, 2018).

Second, we took the undertaking and completion of the project as given and allowed the local administrators to decide on its specific governance. It would be interesting to endogenise also the decision to undertake or not the project and, in addition, to let the completion of the project occur after the term limit so that the service is not available for use until after the next administrator will be in office. On the one hand, the possibility of the benefits of the project being delayed to future administrations might hinder the current administrators' interest in the project. On the other, the very fact of launching a new project, together with the choice of a convenient financing form, might raise the probability of the incumbents' re-election within the term limit and boost their ability to extract rents. Examining this more complex environment is on our research agenda.

Lastly, we considered jurisdictions which are perfectly alike as to their tax bases and tax revenues, but may decide to set different expenditures. We would like to look at jurisdictions which, while having equal fiscal capacities, are characterized by different compositions of the aggregate tax bases (properties, incomes, tourists).

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A Characterization of the equilibria

A.1 The TT regime

Concavity of the problem To verify concavity, we compute the second derivative of (1) with respect to E_i and we check that it is negative. Indeed, we have

$$-2\beta E_j \frac{\Upsilon + F_i - C_T}{(E_i + E_j)^3} < 0.$$

Derivation of (4a) The equilibrium levels of expenditure is found by solving the following system of reaction functions:

$$\begin{aligned} E_i(E_j) &= \sqrt{\beta(\Upsilon + F_i - C_T)E_j} - E_j \\ E_j(E_i) &= \sqrt{\beta(\Upsilon + F_j - C_T)E_i} - E_i, \end{aligned}$$

where $\Upsilon + F_i - C > 0$. Rewriting the former as

$$E_i + E_j = \sqrt{\beta(\Upsilon + F_i - C_T)E_j}$$

and taking squares of both sides to remove the square root, we obtain

$$E_i^2 + E_j^2 = [\beta(\Upsilon + F_i - C_T) - 2E_i]E_j.$$

One solution to this equation is $E_i = E_j = 0$. To find the other solution, replace E_j from the second reaction function. It yields

$$(2\Upsilon + F - 2C)\, E_i = (\Upsilon + F_i - C_T)\sqrt{\beta\,(\Upsilon + F_j - C_T)\, E_i}.$$

Taking squares of both sides, we further get

$$E_i^{TT} = \beta \frac{(\Upsilon + F_i - C_T)^2\,(\Upsilon + F_j - C_T)}{(2\Upsilon + F - 2C_T)^2}.$$

Replacing this expression in $E_j\,(E_i)$ we then obtain

$$E_j + \beta \frac{(\Upsilon + F_i - C_T)^2\,(\Upsilon + F_j - C_T)}{(2\Upsilon + F - 2C_T)^2} = \beta\sqrt{\frac{(\Upsilon + F_i - C_T)^2\,(\Upsilon + F_j - C_T)^2}{(2\Upsilon + F - 2C_T)^2}}.$$

Removing the square root in the right-hand side, this leads to

$$\begin{aligned} E_j^{TT} &= \beta \frac{(\Upsilon + F_i - C_T)\,(\Upsilon + F_j - C_T)}{2\Upsilon + F - 2C_T} - \beta \frac{(\Upsilon + F_i - C_T)^2\,(\Upsilon + F_j - C_T)}{(2\Upsilon + F - 2C_T)^2} \\ &= \beta \frac{(\Upsilon + F_j - C_T)^2\,(\Upsilon + F_i - C_T)}{(2\Upsilon + F - 2C_T)^2} \end{aligned}$$

so that (4a) is found.

Derivation of (4b) Replacing (4a) in the probability function yields

$$\begin{aligned} \rho_i^{TT} &= \frac{(\Upsilon + F_i - C_T)^2\,(\Upsilon + F_j - C_T)}{(\Upsilon + F_i - C_T)^2\,(\Upsilon + F_j - C_T) + (\Upsilon + F_j - C_T)^2\,(\Upsilon + F_i - C_T)} \\ &= \frac{\Upsilon + F_i - C_T}{2\Upsilon + F - 2C_T} \end{aligned}$$

so that (4b) is found.

Derivation of (4c) Replacing (4a) in (1) yields

$$\begin{aligned} R_i^{TT} &= \Upsilon - \beta \frac{(\Upsilon + F_i - C_T)^2\,(\Upsilon + F_j - C_T)}{(2\Upsilon + F - 2C_T)^2} - K + \beta \frac{(\Upsilon + F_i - C_T)\,(\Upsilon + F_i - C_T)}{2\Upsilon + F - 2C_T} \\ &= \Upsilon - K + \beta \frac{(\Upsilon + F_i - C_T)^3}{(2\Upsilon + F - 2C_T)^2} \end{aligned}$$

so that (4c) is found.

A.2 The PP regime

Concavity of the problem To verify concavity, we compute the second derivative of (6) with respect to E_i and we check that it is negative. Indeed, we have

$$-2\beta E_j \frac{\Upsilon + F_i - (1+r)\,K - C_P}{(E_i + E_j)^3} < 0.$$

Derivation of (9a) The equilibrium levels of expenditure is found by solving the following system of reaction functions:

$$\begin{aligned} E_i\left(E_j\right) &= \sqrt{\beta\left[\Upsilon + F_i - (1+r)K - C_P\right]E_j} - E_j \\ E_j\left(E_i\right) &= \sqrt{\beta\left[\Upsilon + F_j - (1+r)K - C_P\right]E_i} - E_i, \end{aligned}$$

where $\Upsilon + F_j - (1+r)K - C_P > 0$. Rewriting the former as

$$E_i + E_j = \sqrt{\beta\left[\Upsilon + F_i - (1+r)K - C_P\right]E_j}$$

and taking squares of both sides to remove the square root, we obtain

$$E_i^2 + E_j^2 + 2E_iE_j = \beta\left[\Upsilon + F_i - (1+r)K - C_P\right]E_j.$$

One solution to this equation is $E_i = E_j = 0$. To find the other solution, replace E_j from the second reaction function. It yields

$$\begin{aligned} & \left[\sqrt{\beta\left[\Upsilon + F_j - (1+r)K - C_P\right]E_i} - E_i\right]^2 \\ & +2E_i\sqrt{\beta\left[\Upsilon + F_j - (1+r)K - C_P\right]E_i} - E_i^2 \\ = \;& \beta\left[\Upsilon + F_i - (1+r)K - C_P\right]\left[\sqrt{\beta\left[\Upsilon + F_j - (1+r)K - C_P\right]E_i} - E_i\right], \end{aligned}$$

which is rearranged as

$$\begin{aligned} & E_i\left[2\Upsilon + F_i + F_j - 2(1+r)K - 2C_P\right] \\ = \;& \left[\Upsilon + F_i - (1+r)K - C_P\right]\sqrt{\beta\left[\Upsilon + F_j - (1+r)K - C_P\right]E_i}. \end{aligned}$$

Taking squares of both sides we further obtain

$$E_i^{PP} = \frac{\beta\left[\Upsilon + F_j - (1+r)K - C_P\right]\left[\Upsilon + F_i - (1+r)K - C_P\right]^2}{\left[2\Upsilon + F_i + F_j - 2(1+r)K - 2C_P\right]^2}.$$

Replacing this expression in $E_j\left(E_i\right)$ we then get

$$\begin{aligned} E_j^{PP} &= \beta\sqrt{\frac{\left[\Upsilon + F_j - (1+r)K - C_P\right]^2\left[\Upsilon + F_i - (1+r)K - C_P\right]^2}{\left[2\Upsilon + F_i + F_j - 2(1+r)K - 2C_P\right]^2}} \\ & \quad - \frac{\beta\left[\Upsilon + F_j - (1+r)K - C_P\right]\left[\Upsilon + F_i - (1+r)K - C_P\right]^2}{\left[2\Upsilon + F_i + F_j - 2(1+r)K - 2C_P\right]^2} \\ &= \frac{\beta\left[\Upsilon + F_i - (1+r)K - C_P\right]\left[\Upsilon + F_j - (1+r)K - C_P\right]^2}{\left[2\Upsilon + F_i + F_j - 2(1+r)K - 2C_P\right]^2}. \end{aligned}$$

Hence, (9a) is found. It is immediate to check that $E_i^{PP} > E_j^{PP} \Leftrightarrow F_i > F_j$.

Derivation of (9b) Replacing (9a) in the probability function yields

$$\begin{aligned}\rho_i^{PP} &= \frac{\frac{[\Upsilon+F_j-(1+r)K-C_P][\Upsilon+F_i-(1+r)K-C_P]^2}{[2\Upsilon+F_i+F_j-2(1+r)K-2C_P]^2}}{\frac{[\Upsilon+F_j-(1+r)K-C_P][\Upsilon+F_i-(1+r)K-C_P]^2}{[2\Upsilon+F_i+F_j-2(1+r)K-2C_P]^2}+\frac{[\Upsilon+F_i-(1+r)K-C_P][\Upsilon+F_j-(1+r)K-C_P]^2}{[2\Upsilon+F_i+F_j-2(1+r)K-2C_P]^2}} \\ &= \frac{\Upsilon+F_i-(1+r)K-C_P}{2\Upsilon+F_i+F_j-2(1+r)K-2C_P}\end{aligned}$$

so that (9b) is found. It is immediate to check that $\rho_i^{PP} > \rho_j^{PP} \Leftrightarrow F_j > F_i$.

Derivation of (9c) Replacing (9a) and (9b) in (6) yields

$$\begin{aligned}R_i^{PP} &= \Upsilon - \beta\frac{[\Upsilon+F_j-(1+r)K-C_P][\Upsilon+F_i-(1+r)K-C_P]^2}{[2\Upsilon+F_i+F_j-2(1+r)K-2C_P]^2} \\ &\quad +\beta\frac{[\Upsilon+F_i-(1+r)K-C_P]^2}{2\Upsilon+F_i+F_j-2(1+r)K-2C_P} \\ &= \Upsilon+\beta\frac{[\Upsilon+F_i-(1+r)K-C_P]^3}{[2\Upsilon+F_i+F_j-2(1+r)K-2C_P]^2}\end{aligned}$$

so that (9c) is found. We see that $R_i^{PP} > R_j^{PP}$ if $F_i > F_j$.

A.3 The T/P regime

Concavity of the problem of incumbent P The concavity of the problem of incumbent T was verified with regards to the TT regime. We now verify the concavity of the problem of incumbent P. Indeed, we have

$$-2\beta E_T\frac{\Upsilon+F_P-(1+r)K-C_P}{(E_T+E_P)^3}<0.$$

Derivation of (10a) and (10b) The equilibrium levels of expenditure is found by solving (3) and (8). Rewriting the former as

$$E_T^2+E_P^2=[\beta(\Upsilon+F_T-C_T)-2E_T]E_P,$$

we again see that one solution is $E_T = E_P = 0$. To find the other solution, we replace E_P from the second reaction function and obtain

$$E_T[2\Upsilon+F-(1+r)K-C]=(\Upsilon+F_T-C)\sqrt{\beta E_T[\Upsilon+F_P-(1+r)K-C_P]}.$$

Taking squares of both sides and rearranging, (10a) is derived. Replacing in (8), one also find

$$\begin{aligned}E_P^{T/P} &= \beta(\Upsilon+F_T-C_T)\frac{[\Upsilon+F_P-(1+r)K-C_P]}{2\Upsilon+F-(1+r)K-(1+\gamma)C} \\ &\quad -\beta[\Upsilon+F_P-(1+r)K-C_P]\frac{(\Upsilon+F_T-C_T)^2}{[2\Upsilon+F-(1+r)K-C]^2}.\end{aligned}$$

Rearranging, (10b) is obtained.

Derivation of (11a) and (11b) Replacing (10a) and (10b) in the probability function of administrator T yields

$$\begin{aligned}
&\rho_T^{T/P} \\
= &\frac{\beta\frac{[\Upsilon+F_P-(1+r)K-C_P](\Upsilon+F_T-C_T)^2}{[2\Upsilon+F-(1+r)K-C]^2}}{\beta\frac{[\Upsilon+F_P-(1+r)K-C_P](\Upsilon+F_T-C_T)^2}{[2\Upsilon+F-(1+r)K-C]^2}+\beta\frac{[\Upsilon+F_P-(1+r)K-C_P]^2(\Upsilon+F_T-C_T)}{[2\Upsilon+F-(1+r)K-C]^2}} \\
= &\frac{[\Upsilon+F_P-(1+r)K-C_P](\Upsilon+F_T-C_T)^2}{[\Upsilon+F_P-(1+r)K-C_P](\Upsilon+F_T-C_T)^2+[\Upsilon+F_P-(1+r)K-C_P]^2(\Upsilon+F_T-C_T)},
\end{aligned}$$

from which (11a) is derived. Replacing (10a) and (10b) in the probability function of administrator P yields

$$\begin{aligned}
&\rho_P^{T/P} \\
= &\frac{\beta\frac{[\Upsilon+F_P-(1+r)K-C_P]^2(\Upsilon+F_T-C_T)}{[2\Upsilon+F-(1+r)K-C]^2}}{\beta\frac{[\Upsilon+F_P-(1+r)K-C_P]^2(\Upsilon+F_T-C_T)}{[2\Upsilon+F-(1+r)K-C]^2}+\beta\frac{[\Upsilon+F_P-(1+r)K-C_P](\Upsilon+F_T-C_T)^2}{[2\Upsilon+F-(1+r)K-C]^2}} \\
= &\frac{[\Upsilon+F_P-(1+r)K-C_P]^2(\Upsilon+F_T-C_T)}{[\Upsilon+F_P-(1+r)K-C_P]^2(\Upsilon+F_T-C_T)+[\Upsilon+F_P-(1+r)K-C_P](\Upsilon+F_T-C_T)^2},
\end{aligned}$$

from which (11b) is derived.

Derivation of (12a) and (12b) Replacing (10a) and (10b) in (1) yields

$$\begin{aligned}
R_T^{T/P} &= \Upsilon-\beta\left[\Upsilon+F_P-(1+r)K-C_P\right]\frac{(\Upsilon+F_T-C_T)^2}{[2\Upsilon+F-(1+r)K-C]^2} \\
&\quad -K+\beta\frac{(\Upsilon+F_T-C_T)^2}{2\Upsilon+F-(1+r)K-C} \\
&= \Upsilon-K+\frac{\beta(\Upsilon+F_T-C_T)^2}{2\Upsilon+F-(1+r)K-C}\left[1-\frac{\Upsilon+F_P-(1+r)K-C_P}{2\Upsilon+F-(1+r)K-C}\right],
\end{aligned}$$

from which (12a) is derived. Replacing (10a) and (10b) in (6) yields

$$\begin{aligned}
R_P^{T/P} &= \Upsilon-\beta(\Upsilon+F_T-C_T)\frac{[\Upsilon+F_P-(1+r)K-C_P]^2}{[2\Upsilon+F-(1+r)K-C]^2} \\
&\quad +\beta\frac{[\Upsilon+F_P-(1+r)K-C_P]^2}{2\Upsilon+F-(1+r)K-C} \\
&= \Upsilon+\beta\frac{[\Upsilon+F_P-(1+r)K-C_P]^2}{2\Upsilon+F-(1+r)K-C}\left[1-\frac{\Upsilon+F_T-C_T}{2\Upsilon+F-(1+r)K-C}\right],
\end{aligned}$$

from which (12b) is derived.

A.3.1 Comparisons

Using (12a) and (12b), we compute

$$R_T^{T/P}-R_P^{T/P}=\beta\frac{(\Upsilon+F_T-C_T)^3-[\Upsilon+F_P-(1+r)K-C_P]^3}{[2\Upsilon+F-(1+r)K-C]^2}-K. \tag{13}$$

We see that $R_T^{T/P} \geq R_P^{T/P}$ if and only if

$$\beta \frac{(\Upsilon + F_T - C_T)^3 - [\Upsilon + F_P - (1+r)K - C_P]^3}{[2\Upsilon + F - (1+r)K - C]^2} - K \geq 0. \tag{14}$$

Case 1: $F_T = C_T$ and $F_P = C_P$ Using these values of F_T and F_P in (10a) and (10b), we find

$$E_T^{T/P} = \beta \Upsilon^2 \frac{\Upsilon - (1+r)K}{[2\Upsilon - (1+r)K]^2} > \beta \Upsilon \frac{[\Upsilon - (1+r)K]^2}{[2\Upsilon - (1+r)K]^2} = E_P^{T/P}.$$

Further using the values of F_T and F_P in (11a) and (11b), we also find

$$\rho_T^{T/P} = \frac{\Upsilon}{2\Upsilon - (1+r)K} > \frac{\Upsilon - (1+r)K}{2\Upsilon - (1+r)K} = p_P^{T/P}.$$

Moreover, (14) reduces to

$$\beta \frac{\Upsilon^3 - [\Upsilon - (1+r)K]^3}{[2\Upsilon - (1+r)K]^2} \geq K.$$

There are three values of K such that this condition holds as an equality:

$$K_1 = 0; \qquad K_2 = \Upsilon \frac{3r - 1 - \sqrt{1 - 2r - 3r^2}}{2r(1+r)}; \qquad K_3 = \Upsilon \frac{3r - 1 + \sqrt{1 - 2r - 3r^2}}{2r(1+r)}.$$

K_1 can be ruled out. K_2 and K_3 are real numbers if and only if $1 - 2r - 3r^2 \geq 0$, which is the case if and only if $r < 1/3$.

Case 1.1: $r < 1/3$ K_2 is a positive value if and only if $1 - 3r + \sqrt{1 - 2r - 3r^2} < 0$, which is not the case for $r < 1/3$. Thus, we rule out K_2.

K_3 is a positive value if and only if $3r - 1 + \sqrt{1 - 2r - 3r^2} > 0$, which is indeed the case for $r < 1/3$. For K_3 to be an admissible value of K, it must be the case that $(1+r)K_3 < \Upsilon$, that is $\sqrt{1 - 2r - 3r^2} < 1 - r$, which is true for $r < 1/3$. Therefore, $R_T^{T/P} = R_P^{T/P}$ for $K = K_3$. We have

$$\frac{\partial \left(R_T^{T/P} - R_P^{T/P}\right)}{\partial K} = 6\beta \frac{r(1+r)^2 \left[\Upsilon - \frac{1}{6}(1+r)K\right] K^2 - \frac{1-3r}{3}\left[\Upsilon - \frac{3}{2}(1+r)K\right]\Upsilon^2}{[2\Upsilon - (1+r)K]^2}.$$

Evaluated at $K = K_3$, this specifies as

$$\left.\frac{\partial \left(R_T^{T/P} - R_P^{T/P}\right)}{\partial K}\right|_{K=K_3} = -4r\beta \frac{\left(1 - 2r - 3r^2\right)^{3/2} - (1-3r)\left(1 - r^2\right)}{\left(1 + r - \sqrt{1 - 2r - 3r^2}\right)^3}.$$

The denominator is positive if and only if $1 + r - \sqrt{1 - 2r - 3r^2} > 0$, which is true for $r < 1/3$. The numerator is negative for any value of r between the roots $r = 0$ and $r = 1/3$. Therefore, the derivative is positive for $K = K_3$. Hence, $R_T^{T/P} < R_P^{T/P}$ for $K < K_3$ and $R_T^{T/P} > R_P^{T/P}$ for $K > K_3$.

Case 1.2: $r > 1/3$ There is no value of K such that

$$\beta \frac{\Upsilon^3 - [\Upsilon - (1+r)K]^3}{[2\Upsilon - (1+r)K]^2} - K = 0.$$

Rewrite (13) as

$$R_T^{T/P} - R_P^{T/P} = \beta K \left\{ (1+r) \frac{3\Upsilon^2 - 3(1+r)\Upsilon K + (1+r)^2 K^2}{[2\Upsilon - (1+r)K]^2} - 1 \right\}.$$

Let us analyze the first term in brackets. We see that the denominator is positive. The numerator is also positive since we have

$$\begin{aligned} & 3\Upsilon^2 - 3(1+r)\Upsilon K + (1+r)^2 K^2 \\ = \; & \Upsilon^2 - 2(1+r)\Upsilon K + (1+r)^2 K^2 + 2\Upsilon^2 - (1+r)\Upsilon K \\ = \; & [\Upsilon - (1+r)K]^2 + [2\Upsilon - (1+r)K]\Upsilon \\ > \; & 0. \end{aligned}$$

Thus, the first term in brackets is positive. We also see that, as $K \to 2\Upsilon/(1+r)$, its denominator tends to zero, whereas its numerator tends to Υ^2. Therefore,

$$\lim_{K \to \frac{2\Upsilon}{1+r}} \frac{3\Upsilon^2 - 3(1+r)\Upsilon K + (1+r)^2 K^2}{[2\Upsilon - (1+r)K]^2} = +\infty$$

and so $R_T^{T/P} - R_P^{T/P} \to +\infty$. Considering that $\nexists K > 0$ such that $R_T^{T/P} - R_P^{T/P} = 0$ for $r > 1/3$, it must be the case that $R_T^{T/P} > R_P^{T/P}$, $\forall K > 0$.

Case 2: $F_T = C_T$ and $F_P = (1+r)K + C_P$ The comparison between the expenditure levels and that between the probabilities are both straightforward. In this case, (14) reduces to $K \leq 0$, which is impossible. Hence, $R_T^{T/P} < R_P^{T/P}$.

Case 3: $F_T = F_P = F^{T/P}$ Replacing $F_T = F_P = F^{T/P}$ in (10a) - (11b) yields

$$\begin{aligned} E_T^{T/P} &= \beta \left[\Upsilon + F^{T/P} - (1+r)K - C_P \right] \frac{\left(\Upsilon + F^{T/P} - C_T \right)^2}{\left[2\Upsilon + 2F^{T/P} - (1+r)K - C \right]^2} \\ E_P^{T/P} &= \beta \left(\Upsilon + F^{T/P} - C_T \right) \frac{\left[\Upsilon + F^{T/P} - (1+r)K - C_P \right]^2}{\left[2\Upsilon + 2F^{T/P} - (1+r)K - C \right]^2} \end{aligned}$$

and

$$\begin{aligned} \rho_T^{T/P} &= \frac{\Upsilon + F^{T/P} - C_T}{2\Upsilon + 2F^{T/P} - (1+r)K - C} \\ \rho_P^{T/P} &= \frac{\Upsilon + F^{T/P} - (1+r)K - C_P}{2\Upsilon + 2F^{T/P} - (1+r)K - C}, \end{aligned}$$

and we have $E_T^{T/P} > E_P^{T/P}$ and $p_T^{T/P} > p_P^{T/P}$ if and only if $K > (C_T - C_P)/(1+r)$. Replacing $F_T = F_P = F^{T/P}$ in (12a) and in (12b) further yields

$$\begin{aligned} R_T^{T/P} &= \Upsilon - K + \beta \frac{\left(\Upsilon + F^{T/P} - C_T \right)^3}{\left[2\Upsilon + 2F^{T/P} - (1+r)K - C \right]^2} \\ R_P^{T/P} &= \Upsilon + \beta \frac{\left[\Upsilon + F^{T/P} - (1+r)K - C_P \right]^3}{\left[2\Upsilon + 2F^{T/P} - (1+r)K - C \right]^2}. \end{aligned}$$