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“Incentives and the City: Towards a Theory
of Urban Governance”

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Abstract

We develop a theory of urban governance based on the allocation of residual claims over urban surplus. A developer undertakes non-verifiable investments that attract productive residents and generate agglomeration benefits. We compare five urban governance modes: two single-agent modes, public and private ownership of the developer, and three hybrid arrangements. Public ownership internalizes urban rents but weakens investment incentives. Private ownership restores these incentives but restricts access because the developer does not capture property-market rents. We characterize this trade-off and study the three hybrid arrangements. Performance contracts subsidize access, equity contributions make quality observable and contractible, and rights transfers consolidate access and property rights. These arrangements provide alternative ways to improve urban development when investment is non-verifiable.

Keywords: Urban Development, Urban Governance, Public–Private Partnerships, Contract Theory.

JEL Classification: D86, H54, L33, R58.

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1 Introduction

Large-scale urban development increasingly relies on partnerships between governments and private developers. From new cities and special economic zones to urban regeneration and transit-oriented developments, public authorities delegate important development decisions to private actors. Such arrangements are particularly attractive when governments face fiscal or administrative constraints, but they raise a fundamental question: how should urban development be governed when the investments that determine its success are difficult to observe and contract upon?

This question connects urban development to the incomplete-contract literature. Ownership and control rights shape incentives when investments are non-contractible (Grossman and Hart, 1986; Hart and Moore, 1990; Hart, 1995). In public-service provision, this creates a trade-off between public control and private incentives (Hart, Shleifer and Vishny, 1997), while the public-private partnership literature studies how contractual arrangements can mitigate it (Hart, 2003; Bennett and Iossa, 2006; Hoppe and Schmitz, 2013; Iossa and Martimort, 2015). Urban development adds an important dimension to this problem: investments affect access, property values, and agglomeration benefits, so that the surplus they create accrues to several different parties.

Urban governance can be understood as the allocation of residual claims over the different components of urban surplus. This paper develops a theory of urban governance centered on this fragmentation of residual claims. A developer coordinates urban development and undertakes non-verifiable investments that attract productive residents and raise local productivity. The resulting surplus is divided among access revenues, property-market rents, residents' productivity gains, and fiscal revenues. Because the developer captures only part of this surplus, investment incentives and access decisions depend on how ownership, fiscal instruments, and development rights allocate residual claims. This perspective is consistent with the variety of arrangements observed in large-scale urban development, including fiscal incentives, public-private joint ventures, and long-term development concessions (Li and Rama, 2023).

The central issue is therefore not simply whether private developers invest enough, but which components of the value they create they are able to internalize. Different governance arrangements generate different patterns of access, infrastructure quality, population composition, and property prices. In our benchmark model, however, they leave the city's spatial extent unchanged: the rents affected by governance vanish at the urban fringe, where the mass of residents served goes to zero. Governance therefore affects the intensity of urban development rather than its geographical footprint. We use this framework to compare alternative governance arrangements and ask how the allocation of residual claims can bring private decisions closer to the social optimum.

MODEL. We develop a parsimonious spatial model of large-scale urban development built

around three objects: an endogenous *access margin*, an endogenous *property rent*, and an *agglomeration benefit*. Infrastructure provision becomes more costly with distance from the city center, while productivity depends on the composition of residents sharing the infrastructure (Glaeser, 1999; Baum-Snow et al., 2024). Broader access therefore benefits more residents but lowers their average productivity. Access becomes increasingly selective with distance, and the city ends where the surplus generated by the most productive resident no longer covers the cost of provision.

A developer coordinates urban development and undertakes local investments that raise infrastructure quality and attract productive residents. Because these investments are non-verifiable, governance affects both incentives to improve quality and the allocation of the rents generated by development. We study how alternative ownership and contractual arrangements affect access, quality, property prices, and the composition of residents, and compare the resulting welfare outcomes.

OVERVIEW OF THE RESULTS. The analysis reveals a trade-off between investment incentives and the internalization of urban rents. Public ownership allows the local government to capture the developer’s revenues but destroys its incentive to undertake non-verifiable quality investment. Private ownership restores this incentive: conditional on access, quality investment is efficient. Yet the private developer does not internalize the property-market rents generated by broader access and therefore restricts access excessively. The resulting restriction also reduces quality investment indirectly by shrinking the number of residents who benefit from it.

We then study three hybrid arrangements. A *Performance Contract* subsidizes access and thereby corrects the property-market benefit ignored by the developer; quality remains non-verifiable and responds indirectly through broader access. An *Equity Contribution* instead gives the local government the information rights needed to make quality observable and contractible. Finally, a *Rights Transfer* bundles access and property rights, allowing the developer to internalize the property rents generated by its decisions. The three arrangements thus address the governance problem through different channels: incentive correction, observability, and consolidation of residual claims.

When public funds are costless, these hybrid arrangements can implement the second best, subject to the conditions stated below. When public funds are costly, financing becomes consequential. Performance Contracts and Equity Contributions require public funds, whereas a Rights Transfer generates an upfront payment to the local government. The welfare comparison therefore depends both on the surplus generated by each arrangement and on the rents that must be conceded to the developer. This distinction between allocative performance and fiscal cost is central to our ranking of governance regimes.

LITERATURE REVIEW. Our spatial structure builds on the monocentric tradition of Alonso (1964), Mills (1972), and Muth (1969), while the idea that cities may be created

and operated by large agents goes back to Henderson (1974) and runs through Henderson and Venables (2009). Stiglitz (1977) famously argued that a large land developer can, in principle, do anything that a centralized government can do. By internalizing the surplus generated by local public goods, an entrepreneurial developer replicates the planner’s allocation. Our paper can be read as a qualification of this claim. When the developer’s key investments are non-verifiable and the surplus from urban development is fragmented across access revenues, land rents, productivity gains, and fiscal receipts, what a developer can achieve depends on the governance arrangement through which its residual claims are defined. A related urban literature studies the misaligned incentives of private providers of local collective goods, more precisely Helsley and Strange (1998) on private government, Henderson and Becker (2000) on city formation when developers and governments compete for control, and Helsley and Strange (2014) on the composition of cities. Relative to this work, we hold the spatial environment fixed and make the *allocation of residual claims* the object of institutional design, following the Coasian emphasis on property rights and institutional arrangements (Coase, 1960). Finally, the literature on place-based policies (Kline and Moretti, 2014; Neumark and Simpson, 2015; Duranton and Venables, 2018) evaluates interventions, like grants, tax abatements and subsidies, that our framework interprets as second-best instruments. When urban development is delegated and key investments are non-verifiable, the effects of place-based policies depend on how ownership, residual claims, and fiscal instruments align private incentives with public objectives.

Beyond urban economics, the paper builds on the incomplete-contract literature on ownership and control rights (Grossman and Hart, 1986; Hart, 1995). Hart, Shleifer and Vishny (1997), in particular, show how public and private ownership generate different incentives for non-contractible investments. We apply this logic to urban development, where a developer undertakes localized investments that attract productive residents and improve infrastructure quality. The spatial environment adds an important feature: broader access generates property-market rents that the developer does not capture. Governance therefore affects both incentives to invest and the allocation of residual claims over urban surplus.

The paper also contributes to the literature on public-private partnerships (Hart, 2003; Bennett and Iossa, 2006; Martimort and Pouyet, 2008; Hoppe and Schmitz, 2013; Iossa and Martimort, 2015). This literature studies how alternative contractual and ownership arrangements affect incentives for non-contractible investment. Our setting differs in the nature of the asset and of the externalities involved, as discussed below. Among the various governance arrangements, the Rights Transfer model implies that extracting the maximum feasible value from private partners requires some form of competition for the market. Although we abstract from modelling this explicitly, this arrangement gives rise to the standard challenges long associated with traditional concession contracts, which

may constrain its viability. These challenges range from the difficulty of attracting a sufficient number of credible developers for large-scale urban projects, to strategic underbidding, ex post renegotiation, and potential too-big-to-fail concerns (Guasch et al., 2007, 2008; Engel et al., 2014).

A third connection is with the literature on local public goods and fiscal federalism (Tiebout, 1956; Oates, 1972; Epple and Zelenitz, 1981; Henderson, 1985; Lockwood, 2002; Besley and Coate, 2003). We study a delegated version of the local-public-good problem, in which a private developer controls investments and access while their benefits are distributed across residents, property markets, and the public budget.

Against this background, our contribution is to provide a general theory of urban governance that combines these perspectives. The important caveat is that urban development is a spatial platform rather than a single construction contract, infrastructure asset, or residential neighborhood. This is why governance affects not only investment and quality, but also access, residential composition, property rents, and local productivity.

ORGANIZATION OF THE PAPER. Section 2 introduces a large scale database of city governance arrangements that serves as motivation for this paper. Section 3 then develops the model. Section 4 derives the first best, a hypothetical benchmark in which the local government appropriates the entire surplus and infrastructure quality is observable at no cost. Section 5 investigates the second best, when the local government can no longer use location-specific lump-sum taxes but quality remains observable. Section 6 studies the five governance modes: the Conventional City, Private City, Performance Contract, Equity Contribution, and Rights Transfer. These governance modes differ in how residual claims are allocated when those two conditions fail. Section 7 compares governance modes in terms of access, composition, productivity and welfare. Section 8 concludes. Appendix A provides some real-world examples illustrating the various governance modes studied in the paper. Proofs are relegated to Appendix B.

2 Empirical motivation

Large-scale urban development increasingly takes forms that depart from the conventional city model, in which local governments provide infrastructure and atomistic firms and households decide where to locate. In many recent developments, a large private actor instead works alongside the local government and frequently assumes a central role in coordinating investment. New cities, edge-city developments, industrial parks, logistics hubs, mining settlements, and tourism destinations illustrate this broader class of arrangements. They have become particularly prominent in developing countries, where fiscal, technical, or administrative constraints may limit the ability of local governments

to coordinate urban development on their own.

To document these arrangements, we construct a new database of large-scale urban developments in low- and middle-income countries. Existing datasets generally focus on narrower categories, such as new cities, infrastructure projects, real-estate developments, or statutory economic zones. Our database instead identifies integrated developments that combine economic and residential functions within a sufficiently large and spatially concentrated area. Projects are selected using several measures of scale, including population, employment, land area, and density. The database combines cross-country sources covering cities, real estate, infrastructure, economic zones, and mining activities with detailed investigations of three Chinese mega-regions, Indonesia, and Sub-Saharan Africa (see Figure 1).

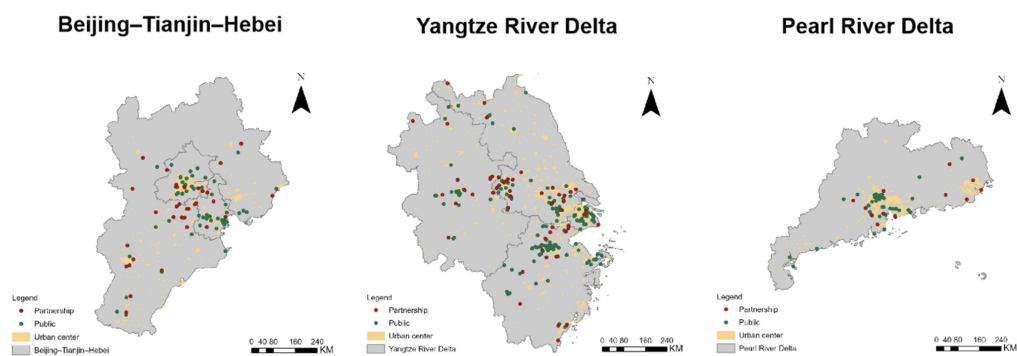
The resulting database contains more than 1,300 large-scale urban developments, including nearly 200 partnership cases documented in greater detail. The importance of partnerships varies substantially across regions. In the three Chinese mega-regions, 97 of 379 developments involve significant private actors, with partnerships located disproportionately outside the more dynamic metropolitan cores. In Indonesia, by contrast, private participation is pervasive: 48 of 62 developments are partnerships, including 40 developments located on Java and around greater Jakarta. In Sub-Saharan Africa, 41 of 75 identified developments involve partnerships, with particularly large numbers in Kenya, Nigeria, Rwanda, and South Africa.

Arrangement	Type	Example	Country
Conventional City	Polar	Nusantara	Indonesia
Private City	Polar	Waterfall City	South Africa
Equity Contribution	Hybrid	Suzhou New Industrial Park	China
Performance Contract	Hybrid	Gu'an	China
Rights Transfer	Hybrid	Batam	Indonesia

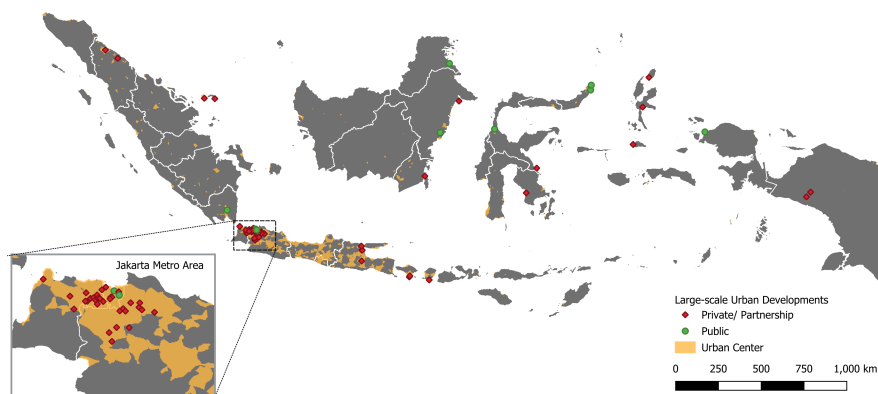
Table 1: Selected examples of governance arrangements

The cases in the database span two polar governance arrangements and three hybrid forms. Table 1 provides an example of each category. At one extreme, conventional cities such as Nusantara in Indonesia remain under public leadership. At the other, privately led developments such as Waterfall City in South Africa concentrate development and management decisions in a private actor. Between these poles, Equity Contributions rely on joint ownership, as in Suzhou Industrial Park in China; Performance Contracts reward developers for observable development outcomes, as in Gu'an in China; and Rights Transfers delegate broad development rights through long-term concessions, as in Batam in Indonesia.

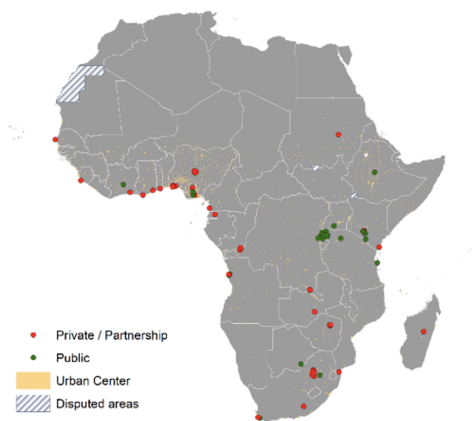
These arrangements differ in who controls land, provides infrastructure, develops



(a) China



(b) Indonesia



(c) Sub-Saharan Africa

Figure 1: Infrastructure Development in China, Indonesia, and Sub-Saharan Africa

property, attracts firms, and captures the value generated by urban development. A full description of these five cases is in Appendix A.

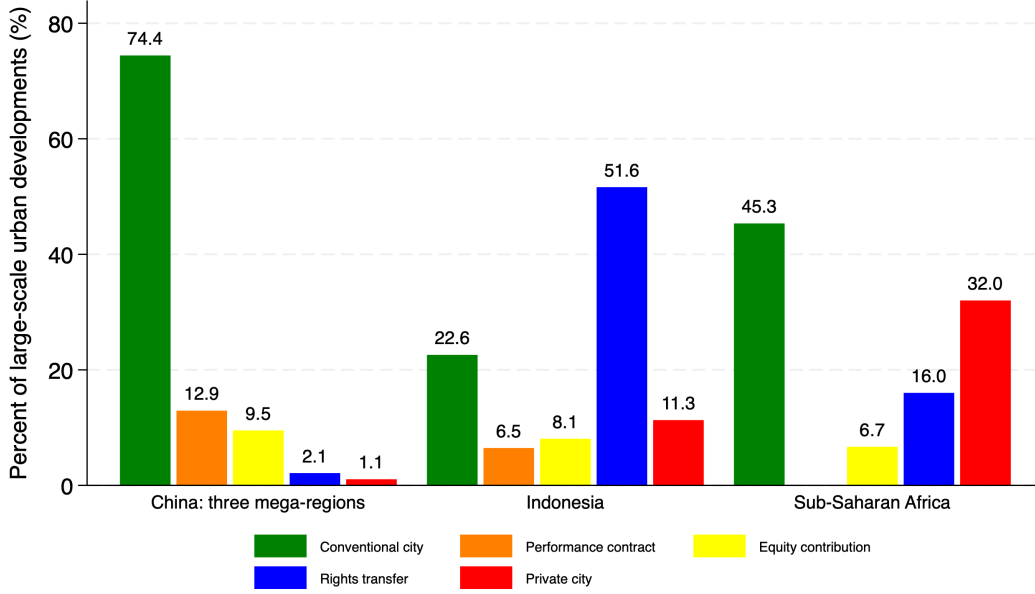


Figure 2: Distribution of governance arrangements

The mix of governance arrangements differs substantially across places (see Figure 2). While Chinese authorities rely mostly on performance contracts and equity contributions when entering into partnerships, in Indonesia and Sub-Saharan Africa, rights transfers and outright private cities are much more frequent. Next, our model illustrates the main features of these different arrangements.

3 The Model

The model features residents, property builders, a developer, and a local government. Residents comprise households and firms, whose distinction is immaterial for the analysis, while builders provide property services. The developer provides infrastructure at specific locations and charges residents for access. It may be private, publicly owned, or jointly owned with the local government, which determines urban policy.

3.1 Overview: Sorting, Rents, and Residual Claims

Before describing each agent’s problem, it is useful to lay out the overall structure of the model, the driver of agglomeration, and the claims over the surplus that urban development creates.

PRODUCTION AND AGGLOMERATION THROUGH SORTING. Locations differ in their distance to the city center. A resident who pays for access to the local infrastructure earns an income that combines subsistence income, individual productivity, the quality of the infrastructure chosen by the developer, and an agglomeration benefit that depends on the average productivity of the residents who also access it.¹ Only residents with productivity above an endogenous *access threshold* find it worthwhile to do so. Two primitives govern this production structure. The distribution of productivity captures local heterogeneity. Households and firms differ in what they contribute to, and gain from, urban interactions. The strength of the local externality determines the importance of these interactions. It is high in knowledge-intensive, specialized cities and low where production is routine. A distinctive feature of this formulation is that agglomeration operates through the *composition* of the pool of users rather than through its sheer size. What matters is not density per se but *who* is granted access. Moving from density to sorting as the driver of agglomeration is what allows governance to affect urban productivity by shaping access policies.

RESIDUAL CLAIMS OVER URBAN SURPLUS. Urban development creates surplus on several margins, each with a different claimant. Residents enjoy an expected income surplus from access, net of fees, together with their surplus from consuming property services. Landowners, who hold development rights, collect a scarcity rent as access is capitalized into property prices. The developer collects access fees, net of provision costs and of its expenditure on quality. Finally, the local government collects taxes and its contractual share of the developer's profits, and disburses subsidies or equity contributions, or receives franchise fees, depending on the governance mode. With quasi-linear preferences, welfare at location x is simply the sum of these surpluses, with public receipts carrying an extra weight:

$$\mathcal{W}(x) = \text{residents' surplus} + \text{land rent} + \text{developer's profit} + \lambda \times \text{net public revenue},$$

a decomposition stated formally in (3.11) below. The parameter $\lambda \geq 0$ is the social cost of public funds. One unit of revenue in the public budget is worth $1 + \lambda$ units of private surplus, because it substitutes for distortionary taxation elsewhere. It can be read as an inverse measure of fiscal capacity, and it will play a central role in ranking governance modes, which differ precisely in the direction and size of the fiscal flows they generate.

GOVERNANCE MODES AND CONVENTIONS. A *governance mode* is an allocation of these residual claims together with a set of fiscal instruments. It specifies the government's share of the developer's access profits, whether infrastructure quality is observable, and which of a subsidy, an equity contribution, or a franchise fee is available (Table 2 below

¹This is consistent with recent evidence that local productivity spillovers depend primarily on the productivity of nearby firms rather than their number (Baum-Snow et al., 2024).

summarizes the five modes we study, two single-agent and three hybrid). Throughout, all location-specific magnitudes are measured per resident. We distinguish the density of residents at each location, the city's total population, and the city boundary. Aggregation across locations weights each location by its equilibrium density, as detailed at the end of Section 3.5.

The full notation and formalization of the model are introduced next.

3.2 Residents

There is a unit mass of residents, initially distributed over the positive real line according to G_0 . Residents may subsequently relocate in response to market conditions. A location $x \in \mathbb{R}_+$ denotes its distance from the city center at $x = 0$, and the city extends to $\bar{x}$. While total population is fixed, the population within city limits is endogenous and determined by the land market. Residents who do not locate within the city remain beyond $\bar{x}$, where property services are priced at their opportunity cost r_0 and residents obtain their reservation utility $y_0 + H(r_0)$. We assume that the outside region can accommodate all remaining residents.

Residents have quasi-linear preferences over property services, access to local infrastructure, and a numeraire good. Let $S(q)$ denote the gross surplus from consuming q units of property services, with $S' > 0 > S''$, $S(0) = 0$, and $S'(0) = +\infty$. At property price r , indirect surplus and demand are

$$H(r) = \max_{q \geq 0} \{S(q) - rq\}, \quad D(r) = \arg \max_{q \geq 0} \{S(q) - rq\}.$$

Hence,

$$(3.1) \quad H'(r) = -D(r),$$

and we denote the elasticity of demand for property services by

$$\varepsilon(r) = -\frac{rD'(r)}{D(r)}.$$

The functions S , H and D are primitives of preferences and therefore carry no location index. Locations differ only through the equilibrium price $r(x)$ at which these functions are evaluated. Because preferences are quasi-linear, the resident's budget constraint is subsumed into the consumption of the numeraire; we make it explicit at the end of this subsection.

Within city limits, the property price $r(x)$ adjusts so that residents are indifferent across locations. Outside the city, property services are priced at their opportunity cost r_0 , with $r(x)$ continuous at the city boundary.

Residents can always earn a subsistence income y_0 . Within the city, they may instead pay an access fee $T(x)$ to use local infrastructure provided by the developer. This infrastructure may represent transportation facilities, innovation districts, industrial clusters, university campuses, special economic zones, or other local facilities that raise productivity.

A resident with productivity θ who accesses the infrastructure at location x earns

$$Y(\theta, x) = y_0 + \theta + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*(x)) + i(x),$$

where $\mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*(x))$ is the average productivity of residents who access the infrastructure at x , $\beta \geq 0$ measures the local productivity externality, and $i(x)$ is the developer's investment in infrastructure quality. Thus, productivity depends both on a resident's own productivity and on the composition of the pool of users.² Productivity θ is drawn from a distribution F with density f on $[0, \bar{\theta}]$.³ Residents choose their location before learning θ , but observe their type before deciding whether to access the infrastructure. A resident accesses whenever

$$(3.2) \quad y_0 + \theta + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*^e(x)) + i(x) - T(x) \geq y_0,$$

where $\mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*^e(x))$ denotes the resident's expectation of the average productivity of other users. Rational expectations imply an equilibrium cut-off $\theta_*(x)$ satisfying

$$(3.3) \quad \theta_*(x) + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*(x)) = T(x) - i(x).$$

Residents with $\theta \geq \theta_*(x)$ obtain access, so their mass is $1 - F(\theta_*(x))$.

The externality operates through the *composition* rather than the size of the pool of users. A higher cut-off reduces access but raises the average productivity of those admitted. Urban policy therefore trades off broader access against a more productive pool, a tension that will play a central role throughout the analysis.

Finally, expected income at location x , net of access fees, is

$$(3.4) \quad \mathcal{S}^a(x) = y_0 + \int_{\theta_*(x)}^{\bar{\theta}} \left(\theta + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*(x)) + i(x) - T(x) \right) dF(\theta),$$

²Alternatively, the outside option could be of the form $y_0 + \gamma\theta$. The analysis is unchanged after redefining $\theta' = (1 - \gamma)\theta$ and $\beta' = \beta/(1 - \gamma)$.

³No specific functional form is imposed on F . The analysis only requires the monotonicity conditions of Section 3.6. These conditions are satisfied by the usual textbook families and accommodate, in particular, truncated power-law (Pareto) distributions of productivity of the kind often used in urban economics, provided the implied hazard rate keeps the composite functions of Section 3.6 monotone. What matters for the results is the monotonicity property of the hazard rate $\frac{1-F(\theta)}{f(\theta)}$.

which, using (3.3) and integrating by parts, becomes

$$(3.5) \quad \mathcal{S}^a(x) = y_0 + \int_{\theta_*(x)}^{\bar{\theta}} (1 - F(\theta)) d\theta.$$

BUDGET CONSTRAINT AND NET SURPLUS. Two surplus notions coexist and should not be confused: $S(q)$ is the gross surplus from consuming q units of property services, whereas $\mathcal{S}^a(x)$ is expected *income* at x net of access fees. The superscript a (for *access*) marks the distinction.⁴ Under quasi-linear preferences, income and property-market surplus enter additively: $\mathcal{S}^a(x)$ collects expected income net of access fees, while $H(r(x))$ collects the net surplus from the property services financed out of that income. This decomposition underlies the welfare expression (3.11) and the free-mobility conditions (4.1) and (5.1) below.

3.3 The Property Market

Each location x contains a fixed stock ℓ of developable land. Competitive builders transform land one-for-one into property services at no additional cost and therefore earn no rents. Development surplus is instead capitalized into land values. Let $r(x)$ denote the price of property services at x and r_0 the value of land in its alternative use. Since each resident demands $D(r(x))$ units of property services, the property-market rent per resident is

$$(3.6) \quad \pi(r(x)) = (r(x) - r_0)D(r(x)).$$

This is a scarcity rent on land rather than a return to construction. Its claimant is the holder of the development rights: the local government under most arrangements considered below and the developer under the Rights Transfer of Section 6.5. The holder of these rights captures the scarcity rent *in full*; whether it owns the land *de jure* or holds the development rights by delegation is immaterial for the analysis. What the local government cannot appropriate through land rents alone is residents' surplus in excess of what free mobility capitalizes into land values. Section 3.7 develops this distinction.

Because land supply is fixed, $r(x)$ is determined by residents' willingness to pay for the location. Free mobility capitalizes the surplus from access into property values, as (5.2) below makes explicit. Outside the developed area, this surplus vanishes, so $r(x) = r_0$ and there is no property-market rent.

⁴To see how the two combine, make the budget constraint explicit. A resident of type θ at location x consumes c units of the numeraire and q units of property services subject to $c + r(x)q + t(x) = \hat{y}(\theta, x)$, where $\hat{y}(\theta, x) = Y(\theta, x) - T(x)$ if the resident purchases access and $\hat{y}(\theta, x) = y_0$ otherwise, and $t(x)$ is the lump-sum tax introduced in Section 3.5. Maximizing utility $c + S(q)$ subject to this constraint yields $q = D(r(x))$ and realized utility $\hat{y}(\theta, x) - t(x) + H(r(x))$. Taking expectations over θ and using (3.4), a resident's expected utility at location x is $\mathcal{S}^a(x) + H(r(x)) - t(x)$.

Market clearing determines the location density $n(x)$, i.e., the mass of residents residing at location x . Since each resident consumes $D(r(x))$ units of property services,

$$(3.7) \quad n(x) = \frac{\ell}{D(R(\theta_*(x)))}.$$

Broader access raises property prices and reduces land consumption per resident, so density increases. Aggregate site rent is accordingly

$$n(x)\pi(R(\theta_*(x))) = (R(\theta_*(x)) - r_0)\ell.$$

Throughout, the local government chooses access and infrastructure quality taking $n(x)$ as given. Density is thus an equilibrium response to policy, not an additional policy instrument. Section 3.7 discusses this assumption further.

Fixed land supply is essential for the capitalization mechanism. With perfectly elastic land supply at r_0 , greater demand would not raise property values and the property-market rents central to our governance problem would disappear. Our formulation therefore follows the standard bid-rent logic of Alonso (1964), Mills (1972), and Muth (1969).

3.4 The Developer

The developer provides the infrastructure that allows residents at location x to benefit from the local productivity externality. The per-capita cost of provision increases with distance from the city center:

$$C(x) = K + \tau x.$$

The term τx may alternatively be interpreted as a transportation cost borne by residents; the two formulations are equivalent after an appropriate redefinition of the access fee.

The developer charges an access fee $T(x)$ and may improve infrastructure quality by choosing $i(x)$ at a per-resident cost $\psi(i(x))$, where $\psi' > 0$, $\psi'' > 0$, $\psi(0) = \psi'(0) = 0$. We denote $\varphi \equiv \psi'^{-1}$. Development expenditure per resident at location x is therefore

$$(3.8) \quad \mathcal{I}(x) = (K + \tau x)(1 - F(\theta_*(x))) + \psi(i(x)).$$

Both components of (3.8) are measured per resident, consistently with the measure conventions spelled out after (3.12) below: $K + \tau x$ is the per-user cost of provision, incurred for the fraction $1 - F(\theta_*(x))$ of residents who obtain access, and $\psi(i(x))$ is the per-resident cost of improving quality. Since the economy has a unit mass of residents, per-resident and aggregate magnitudes coincide at the economy-wide level. When aggregating across locations, all per-resident objects are simply weighted by the equilibrium density $n(x)$, as in (3.13).

The two components of (3.8) differ in their contractibility. Infrastructure provision is observable and its cost can be reimbursed, whereas quality investment $i(x)$ is non-verifiable. Hence, whenever we refer below to moral hazard, hold-up, or investment incentives, we mean the choice of infrastructure quality.

To ensure selective access while keeping the city non-degenerate, we assume

$$(3.9) \quad \varphi(1) < K < (1 + \beta)\bar{\theta}.$$

The first inequality implies that serving every resident is inefficient even at the city center; the second ensures that serving the most productive resident there is worthwhile. The city boundary is then determined endogenously as provision costs rise with distance.

NON-VERIFIABILITY OF INFRASTRUCTURE QUALITY. The non-verifiability of quality investment is the source of the ownership trade-off studied below. Access revenues are observable and may be appropriated by the local government, whereas the cost $\psi(i(x))$ remains borne by the developer unless quality is verifiable and contractible.

Let $k \in [0, 1]$ denote the share of gross access profits appropriated by the local government.⁵ The developer's payoff when quality is non-verifiable is

$$(3.10) \quad \Pi(x) = (1 - k)(T(x) - K - \tau x)(1 - F(\theta_*(x))) - \psi(i(x)).$$

We focus mainly on the polar cases $k = 1$ and $k = 0$, corresponding respectively to public and private ownership.

The asymmetry in (3.10) is essential. Revenue sharing reduces the developer's return to quality without reducing its cost. At $k = 1$, the developer bears the full cost of quality while retaining none of the revenues it generates and therefore chooses no quality improvement. If k instead applied to net profits, it would scale costs and revenues equally and would not distort the developer's choices.

For simplicity, the developer does not participate in the property market unless explicitly stated otherwise.⁶

⁵Intermediate values of k may represent revenue sharing, taxation, or the developer's effective bargaining stake. What matters is that the developer's retained share $1 - k$ is smaller under public than under private governance.

⁶In the same way as the parameter k characterizes the ownership structure of the developer, one may introduce a parameter $\delta \in [0, 1]$ for the share of the property market the developer controls. All governance modes below have $\delta = 0$, except the Rights Transfer of Section 6.5, where $\delta = 1$: the developer then adds the entire local land rent $\pi(r(x))$ to its objective. Table 2 uses this convention. Intermediate values of δ would correspond to partial land assembly by the developer. The analysis of the two polar values conveys the economics.

3.5 The Local Government

The local government may levy a location-specific lump-sum tax $t(x)$ within city limits. Tax revenues, property-market rents, and the government's share k of access profits accrue to the public budget and have social value $1 + \lambda$, where $\lambda \geq 0$ is the cost of public funds. Welfare per resident at location x is therefore

$$(3.11) \quad \mathcal{W}(x) = \mathcal{S}^a(x) + H(r(x)) - t(x) + \Pi(x) \\ + (1 + \lambda) \left(\pi(r(x)) + t(x) + k(T(x) - K - \tau x)(1 - F(\theta_*(x))) \right).$$

Using (3.10), this becomes

$$(3.12) \quad \mathcal{W}(x) = y_0 + \int_{\theta_*(x)}^{\bar{\theta}} (1 - F(\theta)) d\theta + H(r(x)) + (1 + \lambda)\pi(r(x)) + \lambda t(x) \\ + (1 + \lambda k)(T(x) - K - \tau x)(1 - F(\theta_*(x))) - \psi(i(x)).$$

Outside city limits,

$$\mathcal{W}(x) = y_0 + H(r_0).$$

MEASURE CONVENTIONS AND AGGREGATION. All location-specific objects in (3.12) are measured per resident. In particular, $1 - F(\theta_*(x))$ is the fraction obtaining access, $K + \tau x$ is the per-user cost of infrastructure provision, and $\psi(i(x))$ is the per-resident cost of improving quality.

Because equilibrium density varies across locations and governance arrangements, aggregate welfare under governance mode g is

$$(3.13) \quad \mathcal{W}^g = \int_0^{\bar{x}} n^g(x) \mathcal{W}^g(x) dx, \quad N^g = \int_0^{\bar{x}} n^g(x) dx.$$

Here N^g is the population *of the city*, not the economy's total population, which is fixed at one throughout. What varies with the governance arrangement is how much of that fixed mass the city draws in. An arrangement that broadens access raises the property price, residents economize on space, and the same land accommodates more of them, the balance $1 - N^g$ residing beyond $\bar{x}$ at the reservation utility $y_0 + H(r_0)$. There is accordingly no tension between a fixed population and a mode-dependent N^g .

Since N^g varies across governance arrangements, welfare comparisons should exclude this outside-option utility. Every resident of the city obtains it by free mobility and would have obtained it outside, so counting it would credit an arrangement for attracting residents who are indifferent to coming. The criterion, used in Section 7 for our welfare

comparisons, is thus

$$(3.14) \quad \widehat{\mathcal{W}}^g \equiv \mathcal{W}^g - N^g(y_0 + H(r_0)).$$

This criterion measures the total surplus created by urban development rather than welfare per resident. To keep the welfare accounting transparent, $\widehat{\mathcal{W}}^g$ is the *only* criterion used to compare governance modes in this paper. The location-specific welfare $\mathcal{W}(x)$ is merely its integrand, and the aggregate surplus A^g appearing in Sections 6.4 and 7 is shorthand for a component of $\widehat{\mathcal{W}}^g$, not an alternative criterion.

Since both the benefits and the cost of quality scale with local population, density cancels from the local investment condition. Hence, the optimality condition remains

$$\psi'(i(x)) = 1 - F(\theta_*(x)).$$

Density nevertheless affects aggregate welfare through (3.13), since it is endogenously determined by land-market clearing as in (3.7).

3.6 Technical Assumptions

To simplify the exposition, obtain straightforward comparative statics, and ensure quasi-concavity of the optimization problems in all scenarios considered, we assume that the following monotonicity conditions hold:

$$(3.15) \quad (1 + \beta)\theta + \varphi(1 - F(\theta)) \quad \text{non-decreasing,}$$

$$(3.16) \quad (1 + \beta)\theta + \varphi(1 - F(\theta)) - \frac{1 - F(\theta)}{f(\theta)} \left(1 - \frac{r_0}{R(\theta)}\right) \varepsilon(R(\theta)) \quad \text{non-decreasing,}$$

$$(3.17) \quad (1 + \beta)\theta + \varphi(1 - F(\theta)) - \frac{1 - F(\theta)}{f(\theta)} \quad \text{non-decreasing.}^7$$

To simplify the exposition, and since these conditions are needed to ensure quasi-concavity (and meaningfulness) of the various problems below, they are left implicit in the statements of the results in the main text.⁸

AN INTERIOR CITY. We also assume that the city never exhausts the economy's population, i.e., that $N^g < 1$ in every governance mode g . A sufficient condition on primitives

⁷The monotone hazard rate property, namely $\frac{1-F(\theta)}{f(\theta)}$ non-*increasing*, which is familiar from the screening literature, together with (3.15) implies (3.17).

⁸Section 6.3, where the response of the cut-off to a subsidy must be finite and well defined, requires strengthening (3.17) to the assumption that $(1 + \beta)\theta + \varphi(1 - F(\theta)) - \frac{1-F(\theta)}{f(\theta)}$ is continuously differentiable and strictly increasing. We refer to this below as the strict form of (3.17).

is

$$(3.18) \quad \frac{\ell \bar{x}^{fb}}{D(r^m)} = \frac{\ell((1 + \beta)\bar{\theta} - K)}{\tau D(r^m)} < 1,$$

where $\bar{x}^{fb}$ is the (common) city boundary characterized in Section 4 and r^m , defined in (5.9) below, is the property price that maximizes land rents. Indeed, under Condition (5.10) below, equilibrium property prices in every governance mode studied in this paper satisfy $r_0 \leq r(x) \leq r^m$, so that location density is bounded above by $\ell/D(r^m)$ and city size by the left-hand side of (3.18). Under (3.18), the outside region always absorbs the residual mass $1 - N^g > 0$ of residents, the reservation utility is pinned down at $y_0 + H(r_0)$ as assumed in Section 3.2, and all the problems below can be treated as interior.

3.7 Discussion

DENSITY AS AN EQUILIBRIUM OBJECT. From (3.7), density increases with the property price. Higher prices reduce land consumption per resident, allowing more residents to locate on the fixed stock of land. Since broader access raises property prices, it also increases density.

We treat density as a market outcome rather than a policy instrument. The local government chooses access and infrastructure quality taking $n(x)$ as given, while density adjusts subsequently through the property market. Accordingly, density does not affect the local optimality conditions and enters only when welfare is aggregated across locations, as in (3.13) and (3.14).⁹

TIMING OF LOCATION AND ACCESS DECISIONS. Residents choose their location before learning their productivity but decide whether to purchase access after observing it. This sequencing does not affect location density. Because preferences are quasi-linear, property demand $D(r(x))$ is independent of θ . All residents at x consume the same amount of property services whatever their type, so density (3.7) depends only on the local property price, not on the composition of types. The ex ante location choice matters for a different reason. It implies that the pool of residents at every location is representative of F , so that a single free-mobility condition, stated in expected terms, characterizes the spatial equilibrium. Were residents instead to choose locations after learning θ , high-productivity types would outbid others for locations offering valuable access, bid rents would become type-dependent, and the equilibrium would feature sorting across locations. Such sorting would enrich the spatial predictions but would not alter the governance

⁹Allowing the local government to internalize the density response would require it to choose access partly to manipulate subsequent location decisions, as well as to know the property-demand schedule. We do not grant the government this additional information and commitment ability.

problem, which operates through the fragmentation of residual claims rather than through the composition of any particular location. Conversely, if access had to be purchased ex ante, before learning θ , the developer could extract residents' expected surplus through the access fee. Information rents would disappear, and with them the hazard-rate terms that drive the access distortions studied below. The interim access decision is thus the economically relevant case: residents learn their productivity only once established in the city, and access decisions respond to that information.

THE ROLE OF THE SPATIAL STRUCTURE. The spatial structure provides three ingredients for the governance problem: an endogenous access margin, property-market rents generated by access, and local agglomeration effects arising from the composition of residents.

These ingredients play different roles. Agglomeration gains are reflected in residents' willingness to pay for access and hence in the developer's access revenues. They affect the efficient level of access but do not themselves fragment residual claims. The relevant wedge comes from property-market rents: broader access raises land values, but a private developer does not capture these gains. It therefore restricts access and, indirectly, infrastructure quality.

The monocentric structure and location-dependent provision costs offer a tractable way of generating these effects across space. Richer spatial structures would alter the spatial equilibrium without eliminating the underlying problem of fragmented residual claims.

LAND RENTS AND THEIR TAXATION. As discussed in Section 3.3, fixed land supply capitalizes location-specific surplus into property-market rents. Competitive builders earn no economic profit, so

$$\pi(r(x)) = (r(x) - r_0)D(r(x))$$

is a scarcity rent accruing to the holder of the site.

Broader access raises these rents by increasing residents' willingness to pay for the location. Quality affects them only indirectly: for a given access cut-off, higher quality is offset by a higher access fee and leaves residents' net surplus unchanged. The property-market externality faced by the developer therefore operates through the access margin.

Finally, we assume that the local government can tax property-market rents but cannot contract on the developer's net profit. Land rents are attached to immobile assets and observable transactions, whereas developer profits depend on non-verifiable quality expenditures. Residual claims on developer revenues are therefore allocated through ownership rather than through contracts on net profits.

It is worth being precise about what the local government does and does not capture. Under all arrangements below except the Rights Transfer scenario, the government holds the development rights and appropriates the land rent $\pi(r(x))$ *in full*. The binding

constraint lies elsewhere. Absent location-specific lump-sum taxation, residents' surplus from access reaches the public budget only insofar as free mobility capitalizes it into property prices, and this conversion is distortionary. It raises $r(x)$ above r_0 and depresses property consumption, so part of the surplus is dissipated along the way rather than transferred. Land rents are thus an imperfect substitute for the missing Henry George instrument of Section 4. Their limited reach reflects the missing tax instrument, not incomplete ownership of land.

The mechanism requires only that the local government internalize more of the property-market rents than the private developer while being unable to extract residents' location-specific surplus through lump-sum taxation. These restrictions define the fiscal environment of our second-best benchmark. The requirement is deliberately weak. It identifies the minimal wedge between whoever chooses access and whoever claims property-market rents that generates the governance problem. It is trivially satisfied in the polar cases studied below, where the government claims these rents in full while the private developer claims none.

4 The Hypothetical First-Best Scenario

We begin with a hypothetical first-best benchmark. The local government fully appropriates the surplus generated by urban development and infrastructure quality is observable and contractible. Specifically, the government receives all developer profits ($k = 1$), can use location-specific lump-sum taxes, and can prescribe and reimburse quality investment. It therefore has full control over access, pricing, and infrastructure quality.

Residents choose their location before learning their productivity. Free mobility therefore requires them to be indifferent across locations:

$$(4.1) \quad \int_{\theta_*(x)}^{\bar{\theta}} (1 - F(\theta)) d\theta + H(r(x)) - t(x) = H(r_0), \quad \forall x \in \mathbb{R}_+.$$

By adjusting the location-specific tax $t(x)$, the local government can extract residents' location rents without distorting the property market. This is the Henry George logic (George, 1879).

FIRST-BEST ACCESS, INFRASTRUCTURE QUALITY AND PROPERTY PRICES. Proposition 1 characterizes the resulting efficient allocation and provides the benchmark for the governance arrangements studied below.

Proposition 1. *Suppose that investment is verifiable and that lump-sum taxation of residents is feasible at each location. The optimal policy at location x within city limits (i.e., $x \in [0, \bar{x}^{fb}]$), entails the following properties,¹⁰*

¹⁰The solution described here is interior for $x < \bar{x}^{fb}$ and reaches a corner at the fringe $x = \bar{x}^{fb}$.

- Both infrastructure quality $i^{fb}(x)$ and access $\theta_*^{fb}(x)$ are set at their efficient level:

$$(4.2) \quad 1 - F(\theta_*^{fb}(x)) = \psi'(i^{fb}(x)),$$

$$(4.3) \quad (1 + \beta)\theta_*^{fb}(x) + i^{fb}(x) = K + \tau x.$$

- The price for property services $r^{fb}(x)$ is equal to the opportunity cost of land:

$$(4.4) \quad r^{fb}(x) = r_0.$$

- The lump-sum tax at location x is

$$(4.5) \quad t^{fb}(x) = \int_{\theta_*^{fb}(x)}^{\bar{\theta}} (1 - F(\theta)) d\theta.$$

Condition (4.2) is a Lindahl–Samuelson condition in an urban context. It equates the marginal cost of quality investment to its social benefit. Since higher quality benefits every resident with access, its return increases with the mass of residents served. Access and quality are therefore complementary.

Condition (4.3) determines efficient access. At the margin, the productivity and agglomeration gains from admitting an additional resident equal the cost of serving that resident. Better infrastructure makes access more valuable, while broader access raises the return to quality investment.

Condition (4.4) sets property prices at their opportunity-cost level r_0 , so that no rents are capitalized into property values. Location-specific lump-sum taxation instead allows the local government to extract residents' surplus directly, without distorting location or property consumption.

The tax in (4.5) extracts the information rents generated by access. Broader access lowers the cut-off $\theta_*^{fb}(x)$ and increases these rents. A stronger agglomeration effect similarly broadens efficient access and therefore raises the tax.¹¹

These conditions characterize the first-best benchmark. The remainder of the paper successively removes location-specific lump-sum taxation and the verifiability of quality investment.

COMPARATIVE STATICS. Rising provision costs generate a simple spatial pattern.

¹¹The reference to Henry George concerns the principle of extracting urban rents without distorting location decisions. The instrument in (4.5) is stronger than a literal land-value tax: it is a location-specific lump-sum levy that can extract residents' information rents, whereas a land-value tax is limited to rents capitalized into property values. Its absence is one of the constraints defining the second-best environment below.

Corollary 1. *In the first-best allocation, access and infrastructure quality decrease with distance from the city center: $\theta_*^{fb}(x)$ is non-decreasing in x , while $i^{fb}(x)$ is non-increasing.*

Higher provision costs make access more selective at distant locations. The resulting decline in the mass of residents served also lowers the return to quality investment. Central locations therefore combine broader access with higher infrastructure quality. This pattern follows from rising provision costs and the complementarity between access and quality; it does not depend on the property market.

CITY SIZE. The efficient city boundary is the location at which development ceases to generate positive net surplus:

$$(4.6) \quad \mathcal{W}(\bar{x}^{fb}) = y_0 + H(r_0).^{12}$$

Corollary 2. *The optimal city size $\bar{x}^{fb}$ satisfies*

$$(4.7) \quad (1 + \beta)\bar{\theta} = K + \tau\bar{x}^{fb}.$$

Within city limits,

$$(4.8) \quad \theta_*^{fb}(x) \leq \bar{\theta} = \theta_*^{fb}(\bar{x}^{fb}), \quad x \in [0, \bar{x}^{fb}],$$

and

$$(4.9) \quad i^{fb}(x) \geq 0 = i^{fb}(\bar{x}^{fb}), \quad x \in [0, \bar{x}^{fb}].$$

The city extends to the point at which even the most productive resident just covers the cost of provision. Hence, stronger agglomeration effects expand the city, whereas higher provision costs contract it. At the boundary, access becomes fully selective, the mass served vanishes, and so does quality investment. Urban rents therefore disappear at the city fringe.

These fringe values are corner solutions. Condition (3.9) ensures interior access for every $x < \bar{x}^{fb}$, while (4.7) determines the location at which the upper bound $\bar{\theta}$ is reached.

The disappearance of urban rents at the fringe will be important below. It makes the city boundary invariant across the governance arrangements considered in the benchmark model.

THE URBAN FRINGE: A CONSOLIDATED STATEMENT. For future reference, it is worth collecting in one place the behavior of all equilibrium objects at the city boundary, which is common to *every* governance mode studied in this paper (given the interiority condition

¹²The boundary is unique because net welfare decreases with distance whenever development is active. By the envelope theorem, its derivative with respect to x is $-(1 + \lambda)\tau(1 - F(\theta_*(x))) < 0$. The same argument applies to the second-best boundary in Corollary 4.

(3.18)). At $x = \bar{x}$: access is fully selective, $\theta_*(\bar{x}) = \bar{\theta}$, so the mass of residents served vanishes. Infrastructure quality is nil, $i(\bar{x}) = 0$. The property price equals the opportunity cost of land, $r(\bar{x}) = r_0$, so the land rent $\pi(r(\bar{x}))$ vanishes. Location density reaches its floor $n(\bar{x}) = \ell/D(r_0)$. Finally, the lump-sum tax, when available, raises no revenue, $t(\bar{x}) = 0$. All urban rents are thus exhausted exactly where the city ceases to expand. This is the deep reason why the boundary condition (4.7) is the same across governance modes, and hence why governance affects the intensity of urban development but not its geographical extent (Section 7).

5 The Second Best: No Lump-Sum Taxation, Observable Investment

The first-best benchmark relies on two strong assumptions: location-specific lump-sum taxation and observable, contractible quality investment. Without the first, the local government cannot extract residents' location rents without distorting their decisions. Without the second, non-verifiable actions such as promoting the city, coordinating investments, attracting firms and residents, or improving amenities create an incentive problem.

We introduce these frictions sequentially. We first rule out location-specific lump-sum taxation, $t(x) \equiv 0$, while maintaining observability of quality. The resulting allocation $(\theta_*^{sb}(x), i^{sb}(x), r^{sb}(x))$ defines our second-best benchmark. This second best, rather than the first best, is the relevant yardstick for the governance analysis that follows. All arrangements studied in Section 6 operate without location-specific lump-sum taxation, so any allocation they implement satisfies the free-mobility condition (5.1) and is thereby feasible in the second-best program. None of them can therefore improve upon the second best, however large the subsidies, equity stakes, or franchise fees involved. Approaching the first best is not a matter of scaling up policy instruments; it would require restoring the missing lump-sum instrument itself.

Without lump-sum taxation, free mobility requires

$$(5.1) \quad y_0 + \int_{\theta_*(x)}^{\bar{\theta}} (1 - F(\theta)) d\theta + H(r(x)) = y_0 + H(r_0), \quad \forall x \in \mathbb{R}_+.$$

This condition defines the property price $r = R(\theta_*)$ through

$$(5.2) \quad \int_{\theta_*}^{\bar{\theta}} (1 - F(\theta)) d\theta = H(r_0) - H(R(\theta_*)) = \int_{r_0}^{R(\theta_*)} D(\tilde{r}) d\tilde{r},$$

with

$$(5.3) \quad \dot{R}(\theta_*) = -\frac{1 - F(\theta_*)}{D(R(\theta_*))} \leq 0.$$

Broader access therefore raises property prices: in the absence of lump-sum taxation, the surplus from access is capitalized into land values. Moreover, $R(\theta_*) \geq r_0$, with equality only when the gains from access vanish.

Proposition 2 characterizes the resulting second-best allocation.

Proposition 2. *Suppose that lump-sum taxation is not feasible but investment is observable. At any location x within city limits, the second-best allocation satisfies:*

- *Quality is conditionally efficient:*

$$(5.4) \quad 1 - F(\theta_*^{sb}(x)) = \psi'(i^{sb}(x)).$$

- *Access satisfies:*

$$(5.5) \quad (1 + \beta)\theta_*^{sb}(x) + i^{sb}(x) - K - \tau x = \frac{1 - F(\theta_*^{sb}(x))}{f(\theta_*^{sb}(x))} \left(1 - \frac{r_0}{r^{sb}(x)}\right) \varepsilon(r^{sb}(x)) \geq 0.$$

- *Property prices satisfy:*

$$(5.6) \quad r^{sb}(x) = R(\theta_*^{sb}(x)) \geq r_0.$$

Relative to the first best, the absence of lump-sum taxation causes access surplus to be capitalized into property prices. Because prices above r_0 distort property consumption, the local government restricts access. Quality remains efficient conditional on access, but the smaller mass served reduces the return to investment. The fiscal constraint therefore distorts both access and, indirectly, infrastructure quality.

ACCESS AND QUALITY INVESTMENT. Property-market distortions do not directly affect quality investment: (5.4) remains conditionally efficient. However, restricted access reduces the mass of beneficiaries and therefore lowers investment.

Corollary 3. *Without lump-sum taxation, access and infrastructure quality are below their first-best levels:*

$$(5.7) \quad \theta_*^{sb}(x) \geq \theta_*^{fb}(x), \quad i^{sb}(x) \leq i^{fb}(x).$$

Moreover, $\theta_*^{sb}(x)$ is non-decreasing and $i^{sb}(x)$ non-increasing in distance from the city center.

CITY SIZE. Although the fiscal constraint distorts development within the city, it does not affect its boundary.

Corollary 4. *The second-best city has the efficient size:*

$$(5.8) \quad \bar{x}^{sb} = \bar{x}^{fb}.$$

At the fringe, the property price equals its opportunity cost and the surplus from access vanishes. Hence $\theta_*^{sb}(\bar{x}^{sb}) = \bar{\theta}$: only the highest type is marginally served, and a lump-sum tax would raise no revenue there. The fiscal constraint therefore affects the intensity, but not the geographical extent, of development.

PROPERTY PRICES. To assess the property-price distortion, define the monopoly benchmarks $\theta_*^m(x)$ and r^m by

$$(5.9) \quad \begin{aligned} (1 + \beta)\theta_*^m(x) + \varphi(1 - F(\theta_*^m(x))) - K - \tau x &= \frac{1 - F(\theta_*^m(x))}{f(\theta_*^m(x))}, \\ \left(1 - \frac{r_0}{r^m}\right) \varepsilon(r^m) &= 1. \end{aligned}$$

The price r^m maximizes property-market rents, while $\theta_*^m(x)$ maximizes access revenues. These are reference points rather than equilibrium allocations. In particular, $\theta_*^m(x)$ coincides with the access policy of the Private City studied below.

For the comparisons that follow, assume

$$(5.10) \quad \int_{\theta_*^m(0)}^{\bar{\theta}} (1 - F(\theta)) d\theta < \int_{r_0}^{r^m} D(\tilde{r}) d\tilde{r}.$$

This condition requires the property-market distortion to be sufficiently important relative to the access distortion. It need only hold at the city center: as provision becomes more costly with distance, access becomes more selective and the condition becomes easier to satisfy.

Corollary 5. *Suppose Condition (5.10) holds. Then*

$$(5.11) \quad \left(1 - \frac{r_0}{r^{sb}(x)}\right) \varepsilon(r^{sb}(x)) < 1,$$

and therefore

$$\pi'(r^{sb}(x)) > 0 \quad \text{and} \quad r^{sb}(x) < r^m.$$

Second-best property prices thus remain below the level that maximizes property-market rents. The local government stops short of fully exploiting these rents because doing so would require more restrictive access. Condition (5.10) is maintained below and will be particularly useful for comparing the second best with the Private City.

SPATIAL PROFILES: FIRST BEST VERSUS SECOND BEST. Figure 3 summarizes the spatial profiles under the two benchmarks. In the first best, lump-sum taxation keeps property prices at the opportunity cost of land, $r^{fb}(x) = r_0$, so density is flat across the city, $n^{fb}(x) = \ell/D(r_0)$. In the second best, the surplus from access is instead capitalized into property prices, which are highest at the city center and decline with distance as access becomes more selective. Residents accordingly economize on property services near the center, and density declines with distance, converging to the first-best level at the common city boundary $\bar{x}^{sb} = \bar{x}^{fb}$, where all urban rents vanish. In both regimes, access becomes more selective and infrastructure quality declines with distance (Corollaries 1 and 3).

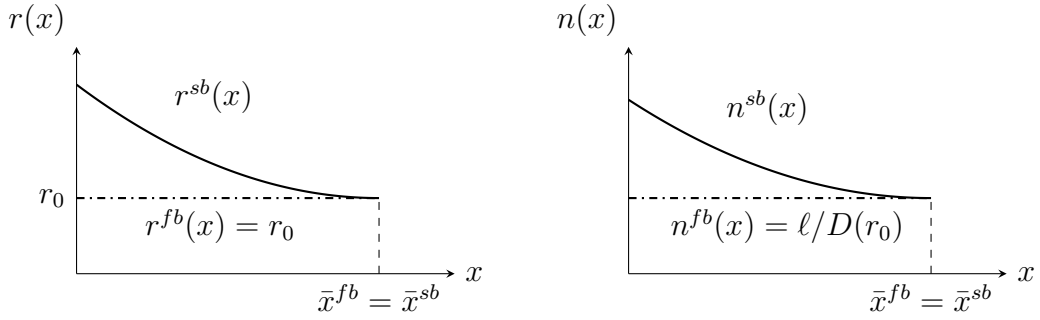


Figure 3: Property prices (left panel) and location density (right panel) as functions of distance from the city center. In the first best (dash-dotted lines), lump-sum taxation keeps property prices at the opportunity cost of land and density is flat. In the second best (solid lines), the surplus from access is capitalized into property prices, which decline with distance together with density. Both profiles reach their first-best levels at the common city boundary, where urban rents vanish.

6 Urban Governance Modes

Having characterized the second best under the fiscal constraint, we now introduce non-verifiable quality investment. Governance matters because it determines who controls the developer, bears the cost of quality, and captures the rents generated by development.

We first consider two polar cases: the publicly controlled *Conventional City* and the *Private City*. We then study three hybrid arrangements: a *Performance Contract*, an *Equity Contribution*, and a *Rights Transfer*. The first and third retain non-verifiability and improve incentives through, respectively, an access subsidy and a broader residual claim. The Equity Contribution instead makes quality observable and contractible. We evaluate all five arrangements against the second-best benchmark of Section 5.

The three hybrid arrangements are presented in increasing order of the rights they reallocate. The Performance Contract leaves ownership, information, and residual claims exactly as in the Private City and merely adds a fiscal instrument attached to observable

access. The Equity Contribution goes further and changes the information structure. The government’s stake buys observability, and hence contractibility, of quality. The Rights Transfer is the most far-reaching arrangement, reallocating to the developer the residual claim on property-market rents over an entire area. This ordering from the lightest to the deepest institutional intervention also organizes the financing requirements that shape the welfare comparison of Section 7. The Performance Contract disburses subsidies as development proceeds, the Equity Contribution requires the government to mobilize funds upfront, and the Rights Transfer requires the developer to finance the franchise fee upfront.

THE CONTRACTING ENVIRONMENTS COMPARED. The arrangements differ in the allocation of residual claims, the contractibility of quality, and the instruments available to the local government. Table 2 summarizes these differences.

Table 2: Contracting environments across governance modes

Mode	Quality observable	k (profit share)	δ (property rights)	$s(x)$ (access subsidy)	E (equity)	A (franchise fee)
Conventional City	no	1	0	—	—	—
Private City	no	0	0	—	—	—
Performance Contract	no	0	0	$s(x) \geq 0$	—	—
Equity Contribution	yes	$k \in [0, 1]$	0	—	$E \geq 0$	—
Rights Transfer	no	0	1	—	—	$A \geq 0$

The Performance Contract is deliberately restricted to a per-capita subsidy, which captures common place-based instruments and isolates the correction of the access margin. The Conventional City is likewise a polar benchmark in which the public developer retains no access revenue while bearing the cost of non-verifiable quality. Intermediate incentives can be represented by intermediate values of k .

The analysis therefore compares the specific institutional arrangements in Table 2, rather than optimal mechanisms defined over a common contracting environment.

6.1 Conventional City: The Hold-Up Problem

Under the *Conventional City*, the developer is a government agency whose revenues accrue entirely to the local government ($k = 1$). Observable infrastructure costs are publicly funded, but quality investment remains non-verifiable and cannot be reimbursed. The agency therefore bears the cost of quality while capturing none of its return, and chooses no investment.

Proposition 3. *Suppose that the developer is run as a government agency and infrastructure quality is non-verifiable.*

- *Infrastructure quality is not improved:*

$$(6.1) \quad i^{pu}(x) = 0.$$

- *Access is more restricted than at the second best, $\theta_*^{pu}(x) \geq \theta_*^{sb}(x)$, where*

$$(6.2) \quad (1 + \beta)\theta_*^{pu}(x) - K - \tau x = \frac{1 - F(\theta_*^{pu}(x))}{f(\theta_*^{pu}(x))} \left(1 - \frac{r_0}{r^{pu}(x)}\right) \varepsilon(r^{pu}(x)).$$

- *Property prices are lower than at the second best:*

$$(6.3) \quad r^{pu}(x) = R(\theta_*^{pu}(x)) \leq r^{sb}(x).$$

- *City size is unchanged and remains given by (5.8).*

Proposition 3 illustrates the hold-up problem under public ownership. Since the developer receives none of the revenues generated by quality investment, investment vanishes. Lower quality in turn makes access less valuable, leading to more restrictive access and lower property prices than at the second best. These lower prices reflect lower urban surplus rather than greater efficiency.

The distortion affects the intensity, but not the geographical extent, of development: the city boundary remains unchanged. Public ownership therefore captures the developer's revenues for the public budget at the cost of eliminating incentives for non-verifiable quality investment.

6.2 Private City: More Investment but Restricted Access

Under the *Private City*, the developer is privately owned ($k = 0$) and retains all access revenues. Following Li and Rama (2023), this benchmark captures privatized urban development without government intervention. It restores incentives for non-verifiable quality investment but leaves the developer with no claim on property-market rents.

Proposition 4. *Suppose that the developer is a private firm.*

- *Conditionally on access, infrastructure quality is optimal:*

$$(6.4) \quad 1 - F(\theta_*^{pr}(x)) = \psi'(i^{pr}(x)).$$

- *Conditionally on infrastructure quality, access satisfies*

$$(6.5) \quad (1 + \beta)\theta_*^{pr}(x) + i^{pr}(x) - K - \tau x = \frac{1 - F(\theta_*^{pr}(x))}{f(\theta_*^{pr}(x))}.$$

Suppose in addition that Condition (5.10) holds. Then:

- Access is more restricted and infrastructure quality is lower than at the second best:

$$(6.6) \quad \theta_*^{pr}(x) \geq \theta_*^{sb}(x),$$

$$(6.7) \quad i^{pr}(x) \leq i^{sb}(x).$$

- Property prices satisfy

$$(6.8) \quad r_0 \leq r^{pr}(x) = R(\theta_*^{pr}(x)) \leq R(\theta_*^{sb}(x)) = r^{sb}(x).$$

- City size is unchanged and remains given by (5.8).

Proposition 4 illustrates the trade-off under private ownership. As the residual claimant on access revenues, the developer chooses quality efficiently for any given level of access, eliminating the direct hold-up problem.

The distortion instead comes from access. The developer does not internalize the property-market rents created by admitting additional residents and therefore restricts access relative to the second best. Condition (5.10) ensures this ordering. Restricted access then lowers the return to quality, so investment is also lower than at the second best.

More restrictive access also reduces property prices, while the city boundary remains unchanged. Private ownership therefore improves investment incentives but distorts the intensity of urban development because the developer captures only part of the surplus generated by broader access.

6.3 Performance Contract: Private Ownership with Fiscal Incentives

Under a *Performance Contract*, the developer remains private but receives a location-specific subsidy $s(x)$ for serving residents. Quality investment remains non-verifiable, so the transfer is conditioned on observable access rather than on investment itself.¹³ The subsidy reduces the effective cost of provision from $K + \tau x$ to $K + \tau x - s(x)$. Since $k = 0$, quality remains conditionally efficient, while the subsidy corrects the access distortion and thereby stimulates investment indirectly.

THE VALUE OF A SUBSIDY. The local government chooses $s(x)$ anticipating the developer's access $\theta_*(x, s(x))$ and investment $i(x, s(x))$. A higher subsidy broadens access and,

¹³ Access can be documented from administrative records such as connections, occupancy certificates, or registered establishments, whereas quality investment remains non-verifiable.

because access and quality are complementary, increases investment:¹⁴

$$(6.9) \quad \frac{\partial \theta_*}{\partial s}(x, s(x)) < 0, \quad \frac{\partial i}{\partial s}(x, s(x)) > 0.$$

Proposition 5. *Suppose that the developer is a private firm operating under a Performance Contract and that the strict form of (3.17) (footnote 8) holds. The optimal subsidy $s^*(x)$ is positive whenever*

$$(6.10) \quad (1 + \lambda) \left(1 - \left(1 - \frac{r_0}{R(\theta_*(x, 0))} \right) \varepsilon(R(\theta_*(x, 0))) \right) \left| \frac{\partial \theta_*}{\partial s}(x, 0) \right| > \lambda.$$

Proposition 5 balances the gain from broader access against the fiscal cost of the subsidy. Broader access generates property-market rents that the private developer does not internalize, while the subsidy costs public funds. Subsidization is therefore more attractive when access responds strongly and the associated property-market gains are large.

When public funds are costless, Condition (6.10) becomes

$$1 > \left(1 - \frac{r_0}{R(\theta_*(x, 0))} \right) \varepsilon(R(\theta_*(x, 0))).$$

This condition holds because the Private City price $r^{pc}(x) = R(\theta_*(x, 0))$ lies below the profit-maximizing property price r^m , the monopoly's profit is quasi-concave and, from Corollary 5, (5.11) holds. Property rents are therefore increasing at the Private City allocation. A positive subsidy then improves upon the Private City. When $\lambda > 0$, this gain must also compensate for the social cost of public funds.

The mechanism provides a rationale for place-based instruments such as infrastructure grants, tax abatements, and development subsidies. They correct the access distortion without requiring quality investment itself to be contractible.

PERFORMANCE RELATIVE TO THE SECOND BEST. Let $\theta_*^{pc}(x) \equiv \theta_*(x, s^*(x))$ and $i^{pc}(x) \equiv i(x, s^*(x))$ denote the allocation induced by the optimal subsidy.

Proposition 6. *Suppose that Condition (5.10) and the strict form of (3.17) hold.*

- *The Performance Contract cannot induce broader access or higher infrastructure quality than at the second best:*

$$\theta_*^{pc}(x) \geq \theta_*^{sb}(x), \quad i^{pc}(x) \leq i^{sb}(x).$$

¹⁴See the Appendix for details.

If $s^*(x) > 0$, it strictly improves upon the Private City:

$$\theta_*^{pc}(x) < \theta_*^{pr}(x), \quad i^{pc}(x) > i^{pr}(x).$$

- If $\lambda = 0$, the Performance Contract implements the second best. The optimal Pigouvian subsidy is

$$(6.11) \quad s^*(x) = \frac{1 - F(\theta_*^{sb}(x))}{f(\theta_*^{sb}(x))} \left[1 - \left(1 - \frac{r_0}{r^{sb}(x)} \right) \varepsilon(r^{sb}(x)) \right] > 0.$$

- If $\lambda > 0$ and $s^*(x) > 0$, the subsidy is strictly below its Pigouvian level and the allocation lies strictly between the Private City and the second best:

$$\theta_*^{sb}(x) < \theta_*^{pc}(x) < \theta_*^{pr}(x), \quad i^{sb}(x) > i^{pc}(x) > i^{pr}(x).$$

The Performance Contract corrects the property-market externality through the observable access margin. When public funds are costless, the Pigouvian subsidy fully internalizes this externality and implements the second best. In fact, it can be shown that

$$(6.12) \quad s^*(x) = -\frac{\pi'(R(\theta_*^{sb}(x)))\dot{R}(\theta_*^{sb}(x))}{f(\theta_*^{sb}(x))} > 0.$$

To see the Pigouvian nature of this subsidy, notice that a marginal reduction in the access cut-off changes property-market rents by $\pi'(R(\theta_*))\dot{R}(\theta_*)d\theta_*$, while increasing the mass of residents served by $-f(\theta_*)d\theta_*$. The ratio in (6.12) is therefore the additional property-market rent generated by one more resident. The subsidy makes the developer internalize this otherwise missing return to broader access and thereby implements the second-best allocation.

When $\lambda > 0$, subsidization is itself costly, so the correction is only partial and the optimal allocation lies between the Private City and the second best.

6.4 Equity Contribution: Buying Observability of Infrastructure Quality

Under an *Equity Contribution*, the local government acquires a stake $k \in [0, 1]$ in a private developer and contributes an amount E , at social cost $(1 + \lambda)E$. We assume that the associated board representation and information rights make infrastructure quality observable and contractible. Equity therefore combines monitoring rights with a claim

on the developer's profits.¹⁵

PARTICIPATION AND THE EQUITY CONTRIBUTION. The developer's outside option is the Private City allocation of Section 6.2, which yields

$$(6.13) \quad \Pi^{pr} = \int_0^{\bar{x}} \left[\left(\theta_*^{pr}(x) + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*^{pr}(x)) - K - \tau x + i^{pr}(x) \right) (1 - F(\theta_*^{pr}(x))) - \psi(i^{pr}(x)) \right] n^{pr}(x) dx.$$

Under the equity agreement, the local government can specify access and quality and reimburse $\psi(i(x))$. Let gross access profits at the implemented allocation be

$$(6.14) \quad \hat{\Pi} = \int_0^{\bar{x}} \left(\theta_*(x) + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*(x)) - K - \tau x + i(x) \right) (1 - F(\theta_*(x))) n(x) dx.$$

The densities in (6.13) and (6.14) are evaluated at their respective allocations, while E is a single upfront payment.

The developer receives $E + (1 - k)\hat{\Pi}$ and participates whenever

$$(6.15) \quad E + (1 - k)\hat{\Pi} \geq \Pi^{pr}.$$

Since public funds are costly, the local government contributes no more than necessary. Whenever a positive contribution is required, the participation constraint therefore binds.

THE VALUE OF EQUITY. Once quality is observable, the hold-up problem disappears. With a binding participation constraint, the developer receives its outside option Π^{pr} regardless of how compensation is divided between retained profits and the upfront contribution. We focus on the case in which a positive contribution is required.

Proposition 7. *Suppose that the contribution required to implement the second-best allocation is positive:*

$$(6.16) \quad E^{sb} = \Pi^{pr} - (1 - k)\hat{\Pi}^{sb} \geq 0.$$

Then an Equity Contribution implements the second-best allocation of Proposition 2. Aggregate welfare within city limits is

$$(6.17) \quad \mathcal{W}^{ec} = N^{sb}(y_0 + H(r_0)) + (1 + \lambda)A^{sb} - \lambda\Pi^{pr},$$

¹⁵Observability could in principle be achieved through monitoring rights alone. In the case studied below, the equity stake itself does not affect welfare when the participation constraint binds: changes in k are exactly offset by changes in the required contribution E .

where second-best aggregate surplus is

(6.18)

$$A^{sb} = \int_0^{\bar{x}^{fb}} \left[\pi(R(\theta_*^{sb}(x))) + (\theta_*^{sb}(x) + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*^{sb}(x)) - K - \tau x + i^{sb}(x)) (1 - F(\theta_*^{sb}(x))) - \psi(i^{sb}(x)) \right] n^{sb}(x) dx$$

Equivalently, and for future reference, using the net welfare criterion (3.14), we may rewrite (6.17) as

$$\widehat{\mathcal{W}}^{ec} = (1 + \lambda)A^{sb} - \lambda\Pi^{pr}.$$

Condition (6.16) identifies the case in which the local government must inject funds; it is not necessary for second-best implementation. If it fails, the contribution is zero and the participation constraint may be slack, so the allocation can depend on the government's equity stake.

Proposition 7 highlights the main role of equity. By making quality observable, it eliminates the hold-up problem and allows the local government to implement the second best. When participation binds, the developer must still receive its outside option Π^{pr} , generating the fiscal cost $\lambda\Pi^{pr}$. The division of this compensation between retained profits and the upfront contribution is otherwise irrelevant for welfare.

6.5 Rights Transfer: Bundling Development Rights and Property Markets

Under a *Rights Transfer*, the local government grants a private developer the development rights over an urban area. The developer retains its access profits ($k = 0$) and acquires the residual claim on the property-market rents generated within the perimeter. In exchange, it pays an upfront franchise fee A to the local government.¹⁶

Bundling these rights eliminates the fragmentation of residual claims that distorts the Private City. The developer now internalizes both access revenues and the property-market rents generated by broader access and maximizes

$$(6.19) \quad \pi(R(\theta_*(x))) + (T(x) - K - \tau x)(1 - F(\theta_*(x))) - \psi(i(x)).$$

Using the access fee implied by residents' participation constraint, this objective coincides with the second-best objective. The developer therefore chooses second-best access and quality even though quality remains non-verifiable.

¹⁶This arrangement is closely related to the Coasian view that reallocating property rights can internalize externalities by aligning private and social returns (Coase, 1960) and reminiscent of Loeb and Magat (1979), where efficiency is restored by making the regulated firm residual claimant on the surplus generated by its decisions.

Proposition 8. *A Rights Transfer that bundles access revenues with the residual claim on property-market rents implements the second-best allocation of Proposition 2.*

Unlike an Equity Contribution, which makes quality contractible, a Rights Transfer leaves quality non-verifiable and instead aligns incentives by consolidating residual claims. The franchise fee affects only the division of surplus, not the allocation.

If the local government can exclude the developer, it can charge A^{sb} and extract the full second-best surplus. If the developer's outside option is the Private City, participation requires leaving it Π^{pr} , so the maximal franchise fee is

$$(6.20) \quad A^{rt} = A^{sb} - \Pi^{pr}.$$

The second-best allocation is implemented in either case; only the distribution of surplus differs.

Rights Transfer is particularly attractive when public funds are costly because it generates revenue rather than requiring a public transfer. Its limitation is financial: the developer must be able to finance the franchise fee upfront.¹⁷ Rights Transfer and Equity Contribution therefore face opposite financing constraints. The former requires financial capacity from the developer, the latter from the local government.

7 Comparing Urban Governance Modes

The governance arrangements studied above differ in their allocation of residual claims and therefore in the access they induce. Since a lower cut-off $\theta_*(x)$ means broader access, the main allocative comparisons can be summarized as

$$(7.1) \quad \theta_*^{fb}(x) \leq \theta_*^{sb}(x) \leq \theta_*^{pc}(x) \leq \theta_*^{pr}(x), \quad \theta_*^{sb}(x) \leq \theta_*^{pu}(x).$$

The Equity Contribution and the Rights Transfer both implement $\theta_*^{sb}(x)$.

The first best provides the broadest access. Without location-specific lump-sum taxation, access is restricted at the second best, and private ownership restricts it further because the developer does not internalize property-market rents. A Performance Contract partly corrects this distortion and implements the second best when public funds are costless. The Conventional City cannot generally be ranked relative to the Private City because its weaker investment incentives must be weighed against its greater internalization of urban rents.

A PARTIAL WELFARE RANKING. We now compare the governance arrangements in welfare terms. Remember that the relevant criterion we adopt is aggregate welfare net

¹⁷Martimort (2006) discusses this constraint in the broader context of privatization of public services.

of residents' outside option, namely $\widehat{\mathcal{W}}^g = \mathcal{W}^g - N^g(y_0 + H(r_0))$, defined in (3.14). The distinction between $\mathcal{W}^g$ and $\widehat{\mathcal{W}}^g$ matters here and is not a matter of normalization: because N^g varies across arrangements, the two criteria need not rank the arrangements in the same way. But importantly, it is the net magnitude that measures the surplus urban development creates. As in (3.13)–(3.14), the contributions of each location to welfare are also weighted by their equilibrium location density $n^g(x)$.

Proposition 9. *Suppose that all governance arrangements are feasible, that the Rights Transfer allows the local government to extract the full second-best surplus A^{sb} , that Condition (5.10) holds, and that Condition (6.16) holds for the Equity Contribution. Then, for all $\lambda \geq 0$,*

$$(7.2) \quad \widehat{\mathcal{W}}^{rt} \geq \widehat{\mathcal{W}}^{ec} \geq \widehat{\mathcal{W}}^{pc} \geq \widehat{\mathcal{W}}^{pr}, \quad \widehat{\mathcal{W}}^{pu} \leq \widehat{\mathcal{W}}^{rt}.$$

When $\lambda = 0$, the Rights Transfer, Equity Contribution, and Performance Contract all implement the second best, and therefore also support the same population within city limits, so that

$$\widehat{\mathcal{W}}^{rt} = \widehat{\mathcal{W}}^{ec} = \widehat{\mathcal{W}}^{pc} \quad \text{and} \quad \mathcal{W}^{rt} = \mathcal{W}^{ec} = \mathcal{W}^{pc}.$$

The ranking reflects both allocative efficiency and the fiscal cost of providing incentives. The Rights Transfer and Equity Contribution implement the second best, but differ in the division of surplus. Under the Rights Transfer, the local government extracts the surplus through the franchise fee. Under the Equity Contribution, the developer retains its outside option Π^{pr} , which entails a welfare cost $\lambda \Pi^{pr}$ when public funds are costly. If the same outside option must also be respected under the Rights Transfer, the two arrangements yield the same welfare and differ only in their financing requirements.

The Performance Contract improves on the Private City by subsidizing access and thereby raising quality investment. When public funds are costless, the Pigouvian subsidy implements the second best. When $\lambda > 0$, subsidies are costly and the correction is generally partial. The Performance Contract nevertheless weakly dominates the Private City, since a zero subsidy remains feasible.

Endogenous density does not alter these comparisons. Broader access raises property prices and equilibrium density, so that

$$n^{sb}(x) \geq n^{pc}(x) \geq n^{pr}(x).$$

Moreover, arrangements implementing the same second-best allocation have the same property prices and density.

The Conventional City cannot generally be ranked relative to the Private City: public ownership better internalizes urban rents but eliminates incentives for non-verifiable quality investment. Propositions 10 and 11 characterize this trade-off.

Finally, the ranking assumes financial feasibility. Rights Transfer requires the developer to finance an upfront franchise fee, whereas Equity Contribution requires public financing. Such constraints may therefore affect the preferred governance arrangement in practice.

ACCESS. The comparison of access under public and private ownership is ambiguous. Public ownership internalizes property-market rents and therefore favors broader access, whereas private ownership preserves incentives to improve infrastructure quality, which raises the value of access.

Proposition 10. *There is more access under private than under public ownership, i.e., $\theta_*^{pr}(x) \leq \theta_*^{pu}(x)$, when*

$$(7.3) \quad \varphi\left(1 - F(\theta_*^{pu}(x))\right) \geq \left[1 - \left(1 - \frac{r_0}{r^{pu}(x)}\right) \varepsilon(r^{pu}(x))\right] \frac{1 - F(\theta_*^{pu}(x))}{f(\theta_*^{pu}(x))}.$$

Condition (7.3) compares the quality advantage of private ownership with the property-rent advantage of public ownership. When the former is sufficiently strong, private ownership induces broader access despite the developer's narrower residual claim. This is more likely when property demand is elastic, so that the property rents ignored by the private developer are relatively small.¹⁸

WELFARE. We now compare welfare under public and private ownership. To isolate the incentive effects from the fiscal advantage of public ownership, we set $\lambda = 0$. At location x , the welfare difference can be decomposed as

$$(7.4) \quad \begin{aligned} \mathcal{W}^{pr}(x) - \mathcal{W}^{pu}(x) = & \underbrace{[\pi(R(\theta_*))]_{\theta_*^{pu}(x)}^{\theta_*^{pr}(x)}}_{A: \text{ change in property rents}} \\ & + \underbrace{\left[\left(\theta_* + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*) - K - \tau x \right) (1 - F(\theta_*)) \right]_{\theta_*^{pu}(x)}^{\theta_*^{pr}(x)}}_{B: \text{ change in access profits}} \\ & + \underbrace{i^{pr}(x)(1 - F(\theta_*^{pr}(x))) - \psi(i^{pr}(x))}_{C: \text{ surplus from private quality investment}}. \end{aligned} \quad .^{19}$$

The first two terms $A + B$ capture the effect of changing access, while the third one $C > 0$ is the surplus generated by private quality investment. The sign of A alone is ambiguous. Broader access raises property prices but need not raise property rents if prices exceed their profit-maximizing level. What matters is the sum $A + B$. The Conventional City chooses the cut-off that maximizes joint access and property-market

¹⁸Beyond this, the model could be used to analyze issues of equity and inequality among residents, as an additional angle to assess the desirability of specific governance modes.

¹⁹We use the notation $[f(z)]_a^b = f(b) - f(a)$.

surplus, so any departure from its cut-off weakly reduces $A + B$. Private ownership therefore trades an access-margin loss against a quality-investment gain.

For the formal comparison, define

$$(7.5) \quad J(\theta_*) \equiv \pi(R(\theta_*)) + \left(\theta_* + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*) - K - \tau x \right) (1 - F(\theta_*)).$$

The Conventional City chooses the cut-off θ_* at location x that maximizes J .

Proposition 11. *Suppose that $\lambda = 0$, that J is concave, and that private ownership broadens access, $\theta_*^{pr}(x) \leq \theta_*^{pu}(x)$. Then*

$$(7.6) \quad \mathcal{W}^{pr}(x) - \mathcal{W}^{pu}(x) \geq G(x) - L(x),$$

where

$$(7.7) \quad G(x) = i^{pr}(x) \left(1 - F(\theta_*^{pr}(x)) \right) - \psi \left(i^{pr}(x) \right) \geq 0$$

is the social value of private quality investment, and

$$(7.8) \quad L(x) = \left[f(\theta_*^{pr}(x)) \varphi \left(1 - F(\theta_*^{pr}(x)) \right) - \left(1 - \left(1 - \frac{r_0}{r^{pr}(x)} \right) \varepsilon(r^{pr}(x)) \right) \left(1 - F(\theta_*^{pr}(x)) \right) \right] \left(\theta_*^{pu}(x) - \theta_*^{pr}(x) \right) \geq 0$$

is an upper bound on the loss on the access margin. In particular, private ownership dominates whenever $G(x) \geq L(x)$.

Proposition 11 makes the trade-off explicit. Public ownership maximizes joint access and property-market surplus but provides no incentive for quality investment. Private ownership sacrifices some surplus on the access margin but generates the quality gain $G(x)$. Concavity of J implies that this access loss is bounded above by $L(x)$. Private ownership is therefore preferred when the quality gain exceeds this loss.

INTENSITY, NOT EXTENT. Governance affects the intensity of urban development, not the city boundary. All arrangements have the same boundary because the rents affected by governance vanish at the fringe, where the mass of residents served goes to zero. Governance instead changes access, the composition of residents, infrastructure quality, property prices, and density within the city.

8 Conclusion

This paper develops a theory of urban governance based on the allocation of residual claims over urban surplus. A developer chooses access and infrastructure quality, thereby

affecting productivity, property rents, and agglomeration benefits. Because the resulting surplus accrues to different actors, the allocation of residual claims shapes incentives when quality investment is non-verifiable.

Public and private ownership illustrate the basic trade-off. Under public ownership, the local government captures urban rents but weakens incentives for non-verifiable quality investment. Under private ownership, the developer has efficient investment incentives conditional on access, but does not internalize the property-market rents generated by broader access. It therefore restricts access, which also reduces equilibrium quality investment. Public ownership thus provides too little residual claim to the developer, whereas private ownership gives it too narrow a claim on urban surplus.

The hybrid arrangements studied in the paper address these distortions through different channels. A *Performance Contract* subsidizes observable access and thereby affects quality investment indirectly. An *Equity Contribution* makes quality observable and contractible through information and control rights. A *Rights Transfer* instead bundles access revenues and property-market rents in the developer's hands. Equity and Rights Transfer also differ in their financing requirements: the former requires public funds, whereas the latter requires the developer to finance an upfront payment.

These results provide a framework for interpreting the variety of institutions used in large-scale urban development, including public agencies, private developments, performance contracts, joint ventures, and transfers of development rights. Their relative performance depends not only on investment incentives but also on which urban rents they internalize and on the fiscal and financial constraints facing public and private actors.

Several extensions are natural. Dynamics could introduce investment timing, commitment, and city growth; political economy could replace the benevolent local government with governments subject to electoral or lobbying pressures; and competition among developers or jurisdictions could introduce competition for residents, firms, and human capital. These extensions would also provide additional links between the model and empirical variation in urban governance.

More broadly, urban development is not only a problem of infrastructure provision and land-use planning, but also one of institutional design. When investments are difficult to contract upon and their returns are dispersed across markets and actors, governance determines who controls development and who captures the value it creates. The allocation of these residual claims is therefore central to the organization and performance of urban development.

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Appendix A: Governance Arrangement Examples

Nusantara, Indonesia: conventional city. Nusantara is Indonesia’s planned new capital in East Kalimantan, established by law in 2022 and conceived as a sustainable “smart forest city.” The official development area covers about 2,561 square kilometers, although its built-up footprint remains small and implementation is expected to continue through 2045. The project is intended to host central-government institutions, foreign embassies, and international organizations while reducing the concentration of administrative and economic activity in Jakarta. Its plan combines government offices and housing with commercial uses, transport, utilities, renewable energy, and extensive forest retention.

Nusantara exemplifies the conventional city arrangement. As the main public actor, the Nusantara National Capital Authority leads land assembly, planning, infrastructure provision, investment promotion, and city management. Private firms participate through discrete contracts, public-private partnerships, land-use agreements, and investments in housing, retail, commercial facilities, energy, and selected infrastructure, supported by fiscal and regulatory incentives. The arrangement preserves public control over a nationally strategic project, but it also leaves the state bearing much of the coordination, financing, and implementation risk.

Waterfall City, South Africa: private city. Waterfall City is a 22-square-kilometer mixed-use development located between Johannesburg and Pretoria and planned for more than 100,000 residents. The development was conceptualized in 1997, and construction of its first residential estate began in 2006. Its master plan combines housing, offices, retail, logistics, health and education facilities, and leisure amenities. The site benefits from proximity to Sandton, major highways, Gautrain connections, and O.R. Tambo International Airport. Its development rests on an unusually large parcel assembled and retained under private control for decades, giving the private side both a long planning horizon and a strong capacity to capture increases in land value.

Waterfall City represents the private-city polar case. The Waterfall Investment Company and affiliated developers lead the master plan, internal infrastructure, property development,

business attraction, service delivery, and day-to-day management. Public authorities provide the wider metropolitan and regulatory framework and negotiated a “basket of rights” under which the private side financed connecting roads in exchange for considerable discretion over development and service provision. This concentration of control strengthens incentives to invest in infrastructure and amenities whose value can be recovered through long leases, property income, and user charges. It also raises concerns about social segregation, accountability, and the exercise of quasi-municipal authority by a private entity (Li and Rama, 2023).

Gu’an New Industry City, China: performance contract. Gu’an New Industry City was initiated in 2002 in Hebei Province, about 50 kilometers from Beijing, through a partnership between the Gu’an County Government and China Fortune Land Development. It has an official area of nearly 170 square kilometers. The development combines industrial parks, research and high-technology activities, housing, amenities, and urban infrastructure. The county government acquired and converted rural land and retained oversight through dedicated administrative committees. The developer undertook land consolidation, infrastructure construction, property and public-facility development, maintenance, and business attraction, helping transform the county into a diversified industrial hub.

Gu’an illustrates a performance-contract arrangement. Under long-term contracts, the private developer is reimbursed for specified infrastructure and service costs and receives returns tied to investment attraction and other agreed outputs. The mechanism preserves public ownership and strategic authority while rewarding unobservable or difficult-to-contract effort through observable development outcomes. At the same time, it places heavy demands on contract design, fiscal commitment, monitoring, and renegotiation; the developer’s later financial restructuring underscores the long-term risks when obligations and project finance become difficult to sustain (Li and Rama, 2023).

Suzhou Industrial Park, China: equity contribution. Suzhou Industrial Park was launched in 1994 as an intergovernmental initiative between China and Singapore. Located in eastern Suzhou, approximately 80 kilometers west of Shanghai, it covers about 280 square kilometers. It was designed as a modern industrial township combining advanced manufacturing and high-technology activities with commercial districts, housing, and urban amenities. The Suzhou government assembled and converted rural land, established a dedicated administrative committee, and provided external connections and regulatory support. Singapore contributed development expertise, international credibility, and access to investor networks. The park has since expanded into a major economic and innovation center with a large employment and resident base.

The governance mechanism is a case in point of an equity contribution. A Chinese consortium and the Singapore-Suzhou Township Development Company jointly established the development corporation, initially with the Singaporean side holding 65 percent and the Chinese side 35 percent. The joint venture coordinated infrastructure, property development, and business attraction, while the public authority retained land and regulatory powers and earned taxes as well as returns on equity. The arrangement aligned the partners through shared ownership and gave the private side a direct stake in the value created by its effort. Its later

renegotiation—reversing the equity shares in favor of the Chinese consortium—also illustrates the adaptability and bargaining challenges inherent in long-term urban joint ventures.

Batam, Indonesia: transfer of development rights. Batam began its modern transformation in 1973, when Indonesia placed the sparsely populated island under a dedicated development authority. Located across the strait from Singapore, the island covers about 715 square kilometers. Batam transformed into a major center for export-oriented manufacturing, shipbuilding, logistics, tourism, and digital activities largely through a strategic partnership between the governments of Indonesia and Singapore. Indonesia provided land administration, island-wide transport and utility infrastructure, investment approvals, and regulatory certainty, while Singapore and its government-linked companies contributed planning expertise, investor confidence, firm networks, and the development and marketing of well-serviced industrial parks.

Batam represents a rights-transfer arrangement. The state retained ultimate land authority but granted long-term build-and-use rights over designated sites and allowed private corporations to own and operate industrial parks. This delegation gave developers substantial autonomy over internal infrastructure, property, services, and business attraction, enabling them to capture more of the returns created by their investments. Public control was exercised mainly through land administration, external infrastructure, regulation, and the broader free-trade-zone framework. The arrangement supported rapid growth, but limited public capture of land-value gains, institutional overlap following decentralization, and housing pressures reveal the trade-offs associated with broad private development rights (Li and Rama, 2023).

Appendix B: Proofs

PROOF OF PROPOSITION 1. In the first-best environment, the developer's profit can be fully taxed away to relax the local government's budget constraint and investment is verifiable, so that its cost can be fully reimbursed by the local government. Under those conditions, the local government's objective function at location x rewrites as

$$\begin{aligned} \mathcal{W}(x) = & y_0 + \int_{\theta_*(x)}^{\bar{\theta}} (1 - F(\theta)) d\theta + H(r(x)) - t(x) \\ & + (1 + \lambda) \left(\pi(r(x)) + t(x) + (T(x) - K - \tau x)(1 - F(\theta_*(x))) - \psi(i(x)) \right). \end{aligned}$$

Using (3.3) to express the access fee $T(x)$ in terms of the cut-off $\theta_*(x)$ and (4.1) to write the tax $t(x)$ in terms of consumer surplus, this objective can finally be expressed as

$$\begin{aligned} \text{(B.1)} \quad \mathcal{W}(x) = & y_0 - \lambda H(r_0) + (1 + \lambda) \left(H(r(x)) + \pi(r(x)) + \int_{\theta_*(x)}^{\bar{\theta}} (1 - F(\theta)) d\theta \right. \\ & \left. + \left(\theta_*(x) + \beta \mathbb{E}_{\tilde{\theta}} \left(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*(x) \right) - K - \tau x + i(x) \right) (1 - F(\theta_*(x))) - \psi(i(x)) \right). \end{aligned}$$

Optimizing w.r.t. $i(x)$, $\theta_*(x)$, and $r(x)$ gives respectively the first-order conditions (4.2), (4.3) and (4.4). Inserting (4.2) into (4.3) yields that $\theta_*^{fb}(x)$, when interior, must solve

$$(B.2) \quad (1 + \beta)\theta_*^{fb}(x) + \varphi(1 - F(\theta_*^{fb}(x))) = K + \tau x.$$

Because (3.15) holds, the optimization problem with respect to $\theta_*(x)$, expressing $i(x)$ in terms of $\theta_*(x)$ through Condition (4.3), is quasi-concave. Conditions (4.2), (4.3) and (4.4) are thus also sufficient for an interior solution.

It remains to locate that solution. Define $\mathcal{L}_0(\theta) \equiv (1 + \beta)\theta + \varphi(1 - F(\theta))$ as the function on the left-hand side of (B.2). It is non-decreasing by (3.15) and satisfies $\mathcal{L}_0(0) = \varphi(1)$ and $\mathcal{L}_0(\bar{\theta}) = (1 + \beta)\bar{\theta}$, since $\varphi(0) = 0$. Equation (B.2) thus admits a solution $\theta_*^{fb}(x) \in [0, \bar{\theta}]$ when $K + \tau x$ lies between these two values, and this solution is interior with strict inequalities. The left inequality in (3.9) gives $\mathcal{L}_0(0) = \varphi(1) < K \leq K + \tau x$ for every $x \geq 0$. Hence, the lower corner is excluded at the center and, because $K + \tau x$ is increasing in x , at every location thereafter. The right inequality in (3.9) implies that (4.7) defines a city of strictly positive size $\bar{x}^{fb} = ((1 + \beta)\bar{\theta} - K)/\tau > 0$. For any $x < \bar{x}^{fb}$ we then have $K + \tau x < K + \tau \bar{x}^{fb} = (1 + \beta)\bar{\theta} = \mathcal{L}_0(\bar{\theta})$, so the upper corner is excluded as well and $\theta_*^{fb}(x) \in (0, \bar{\theta})$ is interior. By (4.2), $i^{fb}(x) = \varphi(1 - F(\theta_*^{fb}(x))) > 0$ is then interior too.

Interiority therefore holds on the half-open interval $[0, \bar{x}^{fb})$. At the fringe $x = \bar{x}^{fb}$ the upper constraint binds, and the first-best values $\theta_*^{fb}(\bar{x}^{fb}) = \bar{\theta}$ and $i^{fb}(\bar{x}^{fb}) = 0$ are obtained at a corner. Conditions (4.2) and (4.3) continue to hold with equality at $x = \bar{x}^{fb}$ since (4.3) reduces to (4.7), and (4.2) to $\psi'(0) = 0$. The statement of the proposition may thus be read on the closed interval $[0, \bar{x}^{fb}]$.

Finally, using (4.1), we immediately get the expression of the lump-sum tax that fully extracts resident surplus as (4.5). $\square$

PROOF OF COROLLARIES 1 AND 2. At the city limit $\bar{x}^{fb}$, (4.6) must hold.

Setting $r^{fb} = r_0$ as in (4.4) makes $\pi(r_0) = 0$ and turns the first two terms of (B.1) into $y_0 + H(r_0)$. Condition (4.6) therefore becomes

$$(B.3) \quad \int_{\theta_*^{fb}(\bar{x}^{fb})}^{\bar{\theta}} (1 - F(\theta)) d\theta + \left(\theta_*^{fb}(\bar{x}^{fb}) + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*^{fb}(\bar{x}^{fb})) - K - \tau \bar{x}^{fb} + i^{fb}(\bar{x}^{fb}) \right) (1 - F(\theta_*^{fb}(\bar{x}^{fb}))) - \psi(i^{fb}(\bar{x}^{fb})) = 0.$$

Using (4.3) to substitute for $K + \tau \bar{x}^{fb}$, the bracketed term in (B.3) reduces to

$$\beta (\mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*^{fb}(\bar{x}^{fb})) - \theta_*^{fb}(\bar{x}^{fb})).$$

Integrating by parts yields

$$(B.4) \quad (\mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*^{fb}(\bar{x}^{fb})) - \theta_*^{fb}(\bar{x}^{fb})) (1 - F(\theta_*^{fb}(\bar{x}^{fb}))) = \int_{\theta_*^{fb}(\bar{x}^{fb})}^{\bar{\theta}} \theta f(\theta) d\theta - \theta_*^{fb}(\bar{x}^{fb}) (1 - F(\theta_*^{fb}(\bar{x}^{fb})))$$

$$= \int_{\theta_*^{fb}(\bar{x}^{fb})}^{\bar{\theta}} (1 - F(\theta)) d\theta,$$

Condition (B.3) thus collapses to $\Phi(\theta_*^{fb}(\bar{x}^{fb})) = 0$, where

$$(B.5) \quad \Phi(\theta) \equiv (1 + \beta) \int_{\theta}^{\bar{\theta}} (1 - F(\tilde{\theta})) d\tilde{\theta} - \psi(\varphi(1 - F(\theta))),$$

the second term being $\psi(i^{fb}(\bar{x}^{fb}))$ once (4.2) is used to write $i^{fb}(\bar{x}^{fb}) = \varphi(1 - F(\theta_*^{fb}(\bar{x}^{fb})))$. Both terms of (B.5) vanish at $\theta = \bar{\theta}$, since $\varphi(0) = 0$ and $\psi(0) = 0$; hence $\Phi(\bar{\theta}) = 0$. Moreover,

$$(B.6) \quad \Phi'(\theta) = -(1 - F(\theta)) \left((1 + \beta) - f(\theta) \varphi'(1 - F(\theta)) \right),$$

which is non-positive precisely because (3.15) holds, and strictly negative for $\theta < \bar{\theta}$ when (3.15) holds strictly. The function Φ is therefore decreasing and vanishes only at $\bar{\theta}$, so $\theta_*^{fb}(\bar{x}^{fb}) = \bar{\theta}$ is the unique solution of (B.3).

Finally, (4.2) gives $i^{fb}(\bar{x}^{fb}) = \varphi(0) = 0$, and (4.3) evaluated at $\theta_*^{fb}(\bar{x}^{fb}) = \bar{\theta}$ then yields (4.7).

It remains to record why (4.6) has a single solution. Write $\Omega(x) \equiv \mathcal{W}(x) - y_0 - H(r_0)$ for net welfare at location x , evaluated at the allocation that maximizes $\mathcal{W}(x)$. Location enters (B.1) only through the provision cost, in the term $-(K + \tau x)(1 - F(\theta_*(x)))$; every other term depends on x solely through the allocation. Because that allocation is chosen optimally at each x , the envelope theorem applies and

$$(B.7) \quad \Omega'(x) = -(1 + \lambda) \tau (1 - F(\theta_*^{fb}(x))) < 0 \quad \text{whenever } 1 - F(\theta_*^{fb}(x)) > 0.$$

Net welfare therefore reaches zero at a unique location, which is $\bar{x}^{fb}$. The same argument delivers uniqueness of $\bar{x}^{sb}$ in Corollary 4, since (B.9) likewise depends on x only through $-(K + \tau x)(1 - F(\theta_*(x)))$ and the second-best allocation maximizes it location-wise.

It remains to establish the monotonicity properties. Condition (3.15) makes the left-hand side of (B.2) non-decreasing while the right-hand side $K + \tau x$ is increasing, so $\theta_*^{fb}(x)$ is non-decreasing; (4.2) then makes $i^{fb}(x)$ non-increasing. Together with (3.9), which places $\theta_*^{fb}(x)$ strictly inside $(0, \bar{\theta})$ for $x < \bar{x}^{fb}$, and with the corner values $\theta_*^{fb}(\bar{x}^{fb}) = \bar{\theta}$ and $i^{fb}(\bar{x}^{fb}) = 0$ established above, this yields the inequalities in (4.8) and (4.9), both of which hold weakly on the closed interval and strictly on its interior. $\square$

PROOF OF PROPOSITION 2. In the second-best environment, the only friction is that lump-sum taxation is not feasible. We also assume that the local government can fully appropriate the developer's profit (i.e., $k = 1$). Taking into account (5.2), the local government's objective function at location x writes as

$$(B.8) \quad \mathcal{W}(x) = y_0 + H(r_0) + (1 + \lambda) \left(\pi(R(\theta_*(x))) + (T(x) - K - \tau x)(1 - F(\theta_*(x))) - \psi(i(x)) \right).$$

Using again (3.3) to express the access fee $T(x)$ in terms of the cut-off $\theta_*(x)$, this objective can

finally be written as

$$(B.9) \quad \mathcal{W}(x) = y_0 + H(r_0) + (1 + \lambda) \left(\pi(R(\theta_*(x))) \right. \\ \left. + (\theta_*(x) + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*(x)) - K - \tau x + i(x))(1 - F(\theta_*(x))) - \psi(i(x)) \right).$$

Optimizing w.r.t. $\theta_*(x)$ and $i(x)$, taking into account $\pi'(r) = (r - r_0)D'(r) + D(r)$ and (5.3) gives the first-order conditions (5.4) and (5.5). The price for property services is then immediately deduced from (5.2). $\square$

PROOF OF COROLLARY 3. Inserting (5.4) into (5.5), $\theta_*^{sb}(x)$ must solve

$$(B.10) \quad (1 + \beta)\theta_*^{sb}(x) + \varphi(1 - F(\theta_*^{sb}(x))) - K - \tau x = \frac{1 - F(\theta_*^{sb}(x))}{f(\theta_*^{sb}(x))} \left(1 - \frac{r_0}{r^{sb}(x)} \right) \varepsilon(r^{sb}(x)).$$

Condition (5.2) implies that $r^{sb}(x) = R(\theta_*^{sb}(x)) \geq r_0$. Hence, $1 - \frac{r_0}{r^{sb}(x)} \geq 0$ and, since $\varepsilon(r^{sb}(x)) \geq 0$, the right-hand side of (B.10) is non-negative. It then follows that

$$(1 + \beta)\theta_*^{sb}(x) + \varphi(1 - F(\theta_*^{sb}(x))) \geq K + \tau x = (1 + \beta)\theta_*^{fb}(x) + \varphi(1 - F(\theta_*^{fb}(x))).$$

Because (3.15) holds, the first inequality in (5.7) follows. Then, it also follows from (5.4) that

$$\psi'(i^{fb}(x)) = 1 - F(\theta_*^{fb}(x)) \geq 1 - F(\theta_*^{sb}(x)) = \psi'(i^{sb}(x)),$$

which gives the second inequality in (5.7).

Finally, the monotonicity condition (3.16) together with (B.10) imply that $\theta_*^{sb}(x)$ is non-decreasing. Then (5.4) implies that $i^{sb}(x)$ is non-increasing. $\square$

PROOF OF COROLLARY 4. At the city limit $\bar{x}^{sb}$, we must again have

$$(B.11) \quad \mathcal{W}(\bar{x}^{sb}) = y_0 + H(r_0).$$

This equation has a unique solution $\bar{x}^{sb}$ by the monotonicity argument (B.7) established in the proof of Corollaries 1 and 2, which applies here unchanged: the second-best welfare (B.9) depends on x only through $-(K + \tau x)(1 - F(\theta_*(x)))$ and is maximized location-wise, so net welfare is strictly decreasing in x wherever development is active.

The relevant welfare expression is (B.9), established in the proof of Proposition 2.

Substituting (B.9) into (B.11), the boundary condition reads

$$(B.12) \quad \pi(R(\theta_*^{sb}(\bar{x}^{sb}))) + (\theta_*^{sb}(\bar{x}^{sb}) + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*^{sb}(\bar{x}^{sb})) - K - \tau \bar{x}^{sb} + i^{sb}(\bar{x}^{sb}))(1 - F(\theta_*^{sb}(\bar{x}^{sb}))) - \psi(i^{sb}(\bar{x}^{sb})) = 0.$$

Condition (5.5), evaluated at $x = \bar{x}^{sb}$, gives

$$(B.13) \quad \theta_*^{sb}(\bar{x}^{sb}) + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*^{sb}(\bar{x}^{sb})) - K - \tau \bar{x}^{sb} + i^{sb}(\bar{x}^{sb}) = \beta \left(\mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*^{sb}(\bar{x}^{sb})) - \theta_*^{sb}(\bar{x}^{sb}) \right)$$

$$+ \frac{1 - F(\theta_*^{sb}(\bar{x}^{sb}))}{f(\theta_*^{sb}(\bar{x}^{sb}))} \left(1 - \frac{r_0}{r^{sb}(\bar{x}^{sb})}\right) \varepsilon(r^{sb}(\bar{x}^{sb})),$$

Inserting (B.13) into (B.12) yields

$$(B.14) \quad \pi(R(\theta_*^{sb}(\bar{x}^{sb}))) + \beta \left(\mathbb{E}_{\tilde{\theta}} \left(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*^{sb}(\bar{x}^{sb}) \right) - \theta_*^{sb}(\bar{x}^{sb}) \right) (1 - F(\theta_*^{sb}(\bar{x}^{sb}))) \\ + \frac{(1 - F(\theta_*^{sb}(\bar{x}^{sb})))^2}{f(\theta_*^{sb}(\bar{x}^{sb}))} \left(1 - \frac{r_0}{r^{sb}(\bar{x}^{sb})}\right) \varepsilon(r^{sb}(\bar{x}^{sb})) - \psi(i^{sb}(\bar{x}^{sb})) = 0.$$

Every term in (B.14) vanishes at $\theta_*^{sb}(\bar{x}^{sb}) = \bar{\theta}$, which solves (B.14), and the strict monotonicity of net welfare in x recorded in (B.7) makes the associated boundary $\bar{x}^{sb}$ unique.

Evaluating (5.5) at $\theta_*^{sb}(\bar{x}^{sb}) = \bar{\theta}$ finally gives $(1 + \beta)\bar{\theta} = K + \tau\bar{x}^{sb}$, since both $i^{sb}(\bar{x}^{sb})$ and the right-hand side of (5.5) vanish there. Comparing with (4.7) yields (5.8). Note that the fiscal wedge disappears at the fringe precisely because it is proportional to $1 - F(\theta_*^{sb}(\bar{x}^{sb}))$: the boundary condition is therefore the same as in the first best, even though the allocation differs at every interior location. $\square$

PROOF OF COROLLARY 5. We first rewrite the local government's social welfare maximization problem, using (B.9) and (5.2), as

$$(B.15) \quad \max_{\theta_*(x), r(x), i(x)} y_0 + H(r_0) + (1 + \lambda) \left(\pi(r(x)) \right. \\ \left. + (\theta_*(x) + \beta \mathbb{E}_{\tilde{\theta}} \left(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*(x) \right) - K - \tau x + i(x)) (1 - F(\theta_*(x))) - \psi(i(x)) \right) \\ \text{subject to}$$

$$(B.16) \quad \int_{\theta_*(x)}^{\bar{\theta}} (1 - F(\theta)) d\theta = \int_{r_0}^{r(x)} D(\tilde{r}) d\tilde{r}.$$

In other words, instead of making explicit the dependence on $\theta_*(x)$ of $r(x) = R(\theta_*(x))$, we explicitly write the constraint linking those two variables. Moreover, we weaken constraint (B.16) and solve a relaxed maximization problem where it is replaced by

$$(B.17) \quad \int_{\theta_*(x)}^{\bar{\theta}} (1 - F(\theta)) d\theta \geq \int_{r_0}^{r(x)} D(\tilde{r}) d\tilde{r}.$$

Denote by μ the non-negative Lagrange multiplier for constraint (B.17). Forming the corresponding Lagrangean, the Karush–Kuhn–Tucker optimality conditions with respect to $i(x)$, $\theta_*(x)$ and $r(x)$ write respectively as (5.4) and

$$(B.18) \quad (1 + \beta)\theta_*^{sb}(x) + i^{sb}(x) - K - \tau x = \left(1 - \frac{\mu}{1 + \lambda}\right) \frac{1 - F(\theta_*^{sb}(x))}{f(\theta_*^{sb}(x))},$$

$$(B.19) \quad \left(1 - \frac{r_0}{r^{sb}(x)}\right) \varepsilon(r^{sb}(x)) = 1 - \frac{\mu}{1 + \lambda}.$$

Observe that, when (B.17) is slack, i.e., $\mu = 0$, $\theta_*^{sb}(x) = \theta_*^m(x)$ and $r^{sb}(x) = r^m$: at $\mu = 0$, (B.18) reduces to the first equation in (5.9) once (5.4) is used, and (B.19) reduces to $(1 - \frac{r_0}{r^{sb}(x)})\varepsilon(r^{sb}(x)) = 1$, which is precisely the definition of r^m in (5.9). This cannot be the case when Condition (5.10) holds: $\theta_*^{sb}(x) = \theta_*^m(x)$ together with $r^{sb}(x) = r^m$ would require the free-mobility condition (5.2) to hold with $\int_{\theta_*^m(x)}^{\bar{\theta}} (1 - F(\theta)) d\theta = \int_{r_0}^{r^m} D(\tilde{r}) d\tilde{r}$, whereas (5.10) and the monotonicity of $\theta_*^m(\cdot)$ give $\int_{\theta_*^m(x)}^{\bar{\theta}} (1 - F(\theta)) d\theta \leq \int_{\theta_*^m(0)}^{\bar{\theta}} (1 - F(\theta)) d\theta < \int_{r_0}^{r^m} D(\tilde{r}) d\tilde{r}$ at every location. Hence, $\mu > 0$ and, from (B.19), (5.11) holds at every x . $\square$

PROOF OF PROPOSITION 3. For a public firm, we have $k = 1$. Inserting into (3.10) and maximizing w.r.t. i yields (6.1). When lump-sum taxation is not feasible, welfare thus becomes

$$(B.20) \quad \mathcal{W}(x) = y_0 + H(r_0) + (1 + \lambda) \left(\pi(R(\theta_*(x))) + \left(\theta_*(x) + \beta \mathbb{E}_{\tilde{\theta}} \left(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*(x) \right) - K - \tau x \right) (1 - F(\theta_*(x))) \right).$$

Optimizing with respect to $\theta_*(x)$ now yields (6.2). Therefore, we get

$$(B.21) \quad (1 + \beta) \theta_*^{pu}(x) + \varphi(1 - F(\theta_*^{pu}(x))) - K - \tau x \geq \frac{1 - F(\theta_*^{pu}(x))}{f(\theta_*^{pu}(x))} \left(1 - \frac{r_0}{r^{pu}(x)} \right) \varepsilon(r^{pu}(x)).$$

Condition (3.16) then implies $\theta_*^{pu}(x) \geq \theta_*^{sb}(x)$. That $R(\cdot)$ is decreasing then implies (6.3). Finally, the optimal city size is again given by the condition

$$(B.22) \quad \theta_*^{pu}(\bar{x}) = \bar{\theta}.$$

There is a unique solution to this condition and it is still given by (5.8). $\square$

PROOF OF PROPOSITION 4. Using (3.3) to express the access fee $T(x)$ in terms of the cut-off $\theta_*(x)$ and inserting into (3.10) allows us to rewrite the developer's profit when the developer is private as

$$(B.23) \quad \left(\theta_*(x) + \beta \mathbb{E}_{\tilde{\theta}} \left(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*(x) \right) - K - \tau x + i(x) \right) (1 - F(\theta_*(x))) - \psi(i(x)).$$

Optimizing w.r.t. $i(x)$ and $\theta_*(x)$ yields the first-order conditions (6.4) and (6.5) that we can collect as

$$(B.24) \quad (1 + \beta) \theta_*^{pr}(x) + \varphi(1 - F(\theta_*^{pr}(x))) - K - \tau x = \frac{1 - F(\theta_*^{pr}(x))}{f(\theta_*^{pr}(x))}.$$

The price of property services is in turn obtained from the free-mobility condition (5.2).

To compare the private developer scenario with the second-best environment, observe that (B.10) and Corollary 5 together imply

$$(B.25) \quad (1 + \beta) \theta_*^{sb}(x) + \varphi(1 - F(\theta_*^{sb}(x))) - K - \tau x - \frac{1 - F(\theta_*^{sb}(x))}{f(\theta_*^{sb}(x))} \leq 0.$$

Gathering (B.24) and (B.25) and using the monotonicity Conditions (3.15) and (3.17) gives

(6.6).

□

PROOF OF PROPOSITION 5. For a given subsidy $s(x)$, the developer's choices of investment and access satisfy

$$(B.26) \quad 1 - F(\theta_*(x, s(x))) = \psi'(i(x, s(x))),$$

and

$$(B.27) \quad (1 + \beta)\theta_*(x, s(x)) + i(x, s(x)) - K - \tau x + s(x) = \frac{1 - F(\theta_*(x, s(x)))}{f(\theta_*(x, s(x)))}.$$

Using (B.26) to substitute for investment, the access condition becomes

$$(B.28) \quad (1 + \beta)\theta_*(x, s(x)) + \varphi(1 - F(\theta_*(x, s(x)))) - K - \tau x + s(x) = \frac{1 - F(\theta_*(x, s(x)))}{f(\theta_*(x, s(x)))}.$$

Equivalently,

$$\mathcal{L}(\theta_*(x, s(x))) + s(x) = K + \tau x$$

where $\mathcal{L}(\theta^*)$ denotes the function in (3.17). Under the strict monotonicity condition in footnote 8, $\mathcal{L}' > 0$, so the implicit function theorem yields

$$(B.29) \quad \frac{\partial \theta_*}{\partial s}(x, s(x)) = -\frac{1}{\mathcal{L}'(\theta_*(x, s(x)))} < 0, \quad \frac{\partial i}{\partial s}(x, s(x)) > 0.$$

Thus, a higher subsidy broadens access and, because access and quality are complementary, increases investment.

We now rewrite the local government's objective in this context with free mobility as defined in (5.2), no lump-sum taxation of residents, moral hazard, no appropriability of the firm's revenue ($k = 0$) and public subsidy, making the dependence of all variables on the subsidy $s(x)$ explicit as

$$\begin{aligned} \mathcal{W}(x, s(x)) = & y_0 + H(r_0) + (T(x, s(x)) - K - \tau x + s(x))(1 - F(\theta_*(x, s(x)))) - \psi(i(x, s(x))) \\ & + (1 + \lambda) \left(\pi(R(\theta_*(x, s(x)))) - s(x)(1 - F(\theta_*(x, s(x)))) \right). \end{aligned}$$

Using again (3.3) to express the access fee $T(x)$ in terms of the cut-off $\theta_*(x)$, this objective can finally be written as

$$(B.30) \quad \begin{aligned} \mathcal{W}(x, s(x)) = & y_0 + H(r_0) + (1 + \lambda) \left(\pi(R(\theta_*(x, s(x)))) - s(x)(1 - F(\theta_*(x, s(x)))) \right) - \psi(i(x, s(x))) \\ & + (\theta_*(x, s(x)) + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*(x, s(x))) - K - \tau x + i(x, s(x)) + s(x))(1 - F(\theta_*(x, s(x)))). \end{aligned}$$

We now differentiate with respect to $s(x)$. The last term of (B.30) is the developer's payoff; since $\theta_*(x, s(x))$ and $i(x, s(x))$ maximize it, the terms multiplying $\frac{\partial \theta_*}{\partial s}$ and $\frac{\partial i}{\partial s}$ in its derivative vanish by (B.26) and (B.27) (envelope theorem), leaving only the direct effect $1 - F(\theta_*(x, s(x)))$.

Collecting the remaining terms, which stem from the budget items weighted by $1 + \lambda$, yields

$$(B.31) \quad \frac{\partial \mathcal{W}}{\partial s}(x, s(x)) = (1 + \lambda) \left(\pi'(R(\theta_*(x, s(x)))) \dot{R}(\theta_*(x, s(x))) + s(x) f(\theta_*(x, s(x))) \right) \frac{\partial \theta_*}{\partial s}(x, s(x)) - \lambda(1 - F(\theta_*(x, s(x)))).$$

Evaluating at $s(x) = 0$ yields

$$(B.32) \quad \frac{\partial \mathcal{W}}{\partial s}(x, 0) = (1 + \lambda) \pi'(R(\theta_*(x, 0))) \dot{R}(\theta_*(x, 0)) \frac{\partial \theta_*}{\partial s}(x, 0) - \lambda(1 - F(\theta_*(x, 0))).$$

Using $\pi'(r) = (r - r_0)D'(r) + D(r)$ and (5.3), we have $\pi'(R(\theta_*))\dot{R}(\theta_*) = -(1 - F(\theta_*))(1 - (1 - \frac{r_0}{R(\theta_*)})\varepsilon(R(\theta_*)))$, so that, with $\frac{\partial \theta_*}{\partial s}(x, 0) < 0$, (B.32) rewrites as

$$(B.33) \quad \frac{\partial \mathcal{W}}{\partial s}(x, 0) = (1 - F(\theta_*(x, 0))) \left((1 + \lambda) \left(1 - \left(1 - \frac{r_0}{R(\theta_*(x, 0))} \right) \varepsilon(R(\theta_*(x, 0))) \right) \left| \frac{\partial \theta_*}{\partial s}(x, 0) \right| - \lambda \right).$$

When (6.10) holds, we thus have

$$(B.34) \quad \frac{\partial \mathcal{W}}{\partial s}(x, 0) > 0,$$

which ends the proof. Note finally that (B.28) can be written $\mathcal{L}(\theta_*(x, s)) + s = K + \tau x$, with $\mathcal{L}$ as in (3.17). Under the strict form of (3.17) (footnote 8), $\mathcal{L}$ is continuously differentiable with $\mathcal{L}' > 0$, so the implicit function theorem yields

$$(B.35) \quad \frac{\partial \theta_*}{\partial s}(x, s) = -\frac{1}{\mathcal{L}'(\theta_*(x, s))} < 0.$$

Raising the subsidy $s(x)$ increases access and investment as pointed out. Condition (6.10) is thus easier to satisfy when access responds strongly to the subsidy. $\square$

PROOF OF PROPOSITION 6. Under the strict form of (3.17) (footnote 8), (B.28) defines a strictly decreasing one-to-one mapping between the subsidy level and the cut-off it induces at location x . The local government may thus be viewed as choosing the cut-off θ^* directly and paying the subsidy $\sigma(\theta^*, x)$ that supports it,

$$(B.36) \quad \sigma(\theta^*, x) = \frac{1 - F(\theta^*)}{f(\theta^*)} - (1 + \beta)\theta^* - \varphi(1 - F(\theta^*)) + K + \tau x.$$

From (B.26), the corresponding quality is

$$(B.37) \quad i(\theta^*) = \varphi(1 - F(\theta^*)).$$

Differentiating (B.36) with respect to θ^* yields

$$(B.38) \quad \frac{\partial \sigma}{\partial \theta^*}(\theta^*, x) = \frac{d}{d\theta^*} \left(\frac{1 - F(\theta^*)}{f(\theta^*)} \right) - \left[(1 + \beta) - \varphi'(1 - F(\theta^*))f(\theta^*) \right] = -\mathcal{L}'(\theta^*) < 0,$$

where the right-hand side inequality follows from the fact that the first term is non-positive by (3.17) while the bracket is non-negative by (3.15), the sum being strictly negative under the strict form of (3.17) (footnote 8).

Substituting the subsidy level $s = \sigma(\theta^*, x)$ and the induced quality $i(\theta^*) = \varphi(1 - F(\theta^*))$ into (B.30) re-parametrizes the local government's objective by the cut-off θ^* it induces. Accordingly, we define welfare at location x in terms of θ^* as

$$(B.39) \quad \widetilde{\mathcal{W}}(\theta^*, x) \equiv y_0 + H(r_0) + (1 + \lambda) \left(\pi(R(\theta^*)) - \sigma(\theta^*, x)(1 - F(\theta^*)) \right) + \widetilde{\Pi}(\theta^*, x),$$

where

$$\widetilde{\Pi}(\theta^*, x) \equiv \left(\theta^* + \beta \mathbb{E}_{\tilde{\theta}} \left(\tilde{\theta} \mid \tilde{\theta} \geq \theta^* \right) - K - \tau x + \varphi(1 - F(\theta^*)) + \sigma(\theta^*, x) \right) (1 - F(\theta^*)) - \psi \left(\varphi(1 - F(\theta^*)) \right).$$

The term $\widetilde{\Pi}(\theta^*, x)$ is the developer's profit at location x . It is exactly the private developer's profit (B.23), augmented by the subsidy receipt $\sigma(\theta^*, x)(1 - F(\theta^*))$ and evaluated at the pair $(\theta^*, \varphi(1 - F(\theta^*)))$.

By construction of $\sigma(\cdot)$, it is a *maximized* profit since the pair $(\theta^*, \varphi(1 - F(\theta^*)))$ satisfies the developer's first-order conditions (B.26) and (B.28). The envelope theorem gives

$$(B.40) \quad \frac{\partial \widetilde{\Pi}}{\partial \theta^*}(\theta^*, x) = (1 - F(\theta^*)) \frac{\partial \sigma}{\partial \theta^*}(\theta^*, x).$$

Differentiating the remaining terms of (B.39) directly, with $\frac{\partial}{\partial \theta^*} [\sigma(\theta^*, x)(1 - F(\theta^*))] = \frac{\partial \sigma}{\partial \theta^*}(\theta^*, x)(1 - F(\theta^*)) - \sigma(\theta^*, x)f(\theta^*)$ and, from $\pi'(r) = (r - r_0)D'(r) + D(r)$ together with (5.3), $\pi'(R(\theta^*))\dot{R}(\theta^*) = -(1 - F(\theta^*))(1 - z(\theta^*))$, we obtain

$$(B.41) \quad \frac{\partial \widetilde{\mathcal{W}}}{\partial \theta^*}(\theta^*, x) = -(1 + \lambda)(1 - F(\theta^*))(1 - z(\theta^*)) + (1 + \lambda) \sigma(\theta^*, x)f(\theta^*) - \lambda \frac{\partial \sigma}{\partial \theta^*}(\theta^*, x)(1 - F(\theta^*)),$$

where $z(\theta^*) \equiv (1 - \frac{r_0}{R(\theta^*)})\varepsilon(R(\theta^*))$. An interior optimum $\theta_*^{pc}(x)$ thus satisfies

$$(B.42) \quad s^*(x) = \sigma(\theta_*^{pc}(x), x) = \frac{1 - F(\theta_*^{pc}(x))}{f(\theta_*^{pc}(x))} (1 - z(\theta_*^{pc}(x))) + \frac{\lambda}{1 + \lambda} \frac{\partial \sigma}{\partial \theta^*}(\theta_*^{pc}(x), x) \frac{1 - F(\theta_*^{pc}(x))}{f(\theta_*^{pc}(x))}.$$

Since $\frac{\partial \sigma}{\partial \theta^*}(\theta^*, x) \leq 0$, (B.36) and (B.42) give

$$(1 + \beta)\theta_*^{pc}(x) + \varphi(1 - F(\theta_*^{pc}(x))) - K - \tau x = \frac{1 - F(\theta_*^{pc}(x))}{f(\theta_*^{pc}(x))} - s^*(x) \geq \frac{1 - F(\theta_*^{pc}(x))}{f(\theta_*^{pc}(x))} z(\theta_*^{pc}(x)),$$

and the comparison with (B.10), under Condition (3.16), yields $\theta_*^{pc}(x) \geq \theta_*^{sb}(x)$. When a positive subsidy is valuable at the margin (Proposition 5) and the problem is quasi-concave in s , we get $s^*(x) > 0$ and, since $\theta_*(x, \cdot)$ is decreasing, $\theta_*^{pc}(x) < \theta_*(x, 0) = \theta_*^{pr}(x)$. The comparisons of infrastructure quality follow from (5.4), (6.4) and (B.26).

When $\lambda = 0$, (B.42) reduces to

$$s^*(x) = \frac{1 - F(\theta_*^{pc}(x))}{f(\theta_*^{pc}(x))} (1 - z(\theta_*^{pc}(x)));$$

substituting into (B.28) gives

$$(1 + \beta)\theta_*^{pc}(x) + \varphi(1 - F(\theta_*^{pc}(x))) - K - \tau x = \frac{1 - F(\theta_*^{pc}(x))}{f(\theta_*^{pc}(x))} z(\theta_*^{pc}(x)),$$

which is exactly (B.10). Uniqueness under (3.16) yields $\theta_*^{pc}(x) = \theta_*^{sb}(x)$, hence (6.11), whose sign follows from Corollary 5. Moreover, by (5.3),

$$\frac{1 - F(\theta_*)}{f(\theta_*)} (1 - z(\theta_*)) = -\frac{\pi'(R(\theta_*))\dot{R}(\theta_*)}{f(\theta_*)}.$$

The subsidy equals the property-market profit created by the marginal admitted resident. Finally, suppose $\lambda > 0$. At an interior optimum with $s^*(x) > 0$, the second term on the right-hand side of (B.42) is strictly negative, since $\frac{\partial \sigma}{\partial \theta^*} < 0$ by (B.38) under the strict form of (3.17) (footnote 8) and $1 - F(\theta_*^{pc}(x)) > 0$ within city limits. The optimal subsidy therefore falls strictly short of the Pigouvian level evaluated at the implemented cut-off. Because $\sigma(\cdot, x)$ is strictly decreasing, a subsidy strictly below the one that supports $\theta_*^{sb}(x)$ implements a cut-off strictly above it, so $\theta_*^{pc}(x) > \theta_*^{sb}(x)$; and $s^*(x) > 0$ gives $\theta_*^{pc}(x) < \theta_*^{pr}(x)$ by the same monotonicity, since $s = 0$ supports $\theta_*^{pr}(x)$. The investment ordering follows from (B.37). □

PROOF OF PROPOSITION 7. At location x , welfare under the Equity Contribution is

$$(B.43) \quad \mathcal{W}(x) = y_0 + H(r_0) + (1 + \lambda) \left[\pi(R(\theta_*(x))) - \psi(i(x)) + k a(x) - E(x) \right] \\ + (1 - k)a(x) + E(x),$$

where, for notational convenience,

$$a(x) = (\theta_*(x) + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*(x)) - K - \tau x + i(x))(1 - F(\theta_*(x))).$$

Expression (B.43) is a welfare density, so aggregating it over the city weights each location by the population it supports. Writing $n(x)$ for the density at the implemented allocation and $N = \int_0^{\bar{x}} n(x) dx$ for the city's population, and denoting $\hat{\Pi} = \int_0^{\bar{x}} a(x) n(x) dx$ as in (6.14), this gives

$$(B.44) \quad \mathcal{W}^{ec} = N(y_0 + H(r_0)) + (1 + \lambda) \int_0^{\bar{x}} \left[\pi(R(\theta_*(x))) - \psi(i(x)) \right] n(x) dx \\ + (1 + \lambda k) \hat{\Pi} - \lambda E.$$

The upfront contribution E is a lump sum and carries no density: it is paid once, not once per resident. Since public funds are costly at the margin, the participation constraint (6.15) binds

whenever $E > 0$. Hence

$$E = \Pi^{pr} - (1 - k)\hat{\Pi}.$$

Substituting into (B.44) yields

$$(B.45) \quad \begin{aligned} \mathcal{W}^{ec} = & N(y_0 + H(r_0)) - \lambda \Pi^{pr} \\ & + (1 + \lambda) \left\{ \int_0^{\bar{x}} \left[\pi(R(\theta_*(x))) - \psi(i(x)) \right] n(x) dx + \hat{\Pi} \right\}. \end{aligned}$$

The term $-\lambda \Pi^{pr}$ is independent of the implemented allocation. The remaining expression is, up to the positive factor $1 + \lambda$, precisely the objective defining the second-best allocation in Proposition 2. The Equity Contribution therefore implements $(\theta_*^{sb}, i^{sb}, r^{sb})$.

Evaluating (B.45) at that allocation gives

$$\mathcal{W}^{ec} = N^{sb}(y_0 + H(r_0)) + (1 + \lambda)A^{sb} - \lambda \Pi^{pr},$$

which is (6.17). Equivalently $\widehat{\mathcal{W}}^{ec} = (1 + \lambda)A^{sb} - \lambda \Pi^{pr}$ once the outside option is netted out as in (3.14). Condition (6.16) ensures that the required contribution

$$E^{sb} = \Pi^{pr} - (1 - k)\hat{\Pi}^{sb}$$

is non-negative, as maintained. $\square$

PROOF OF PROPOSITION 8. That the developer's maximization of (6.19) leads to the second-best level of investment $i^{sb}(x)$, access $\theta_*^{sb}(x)$ and property prices $R(\theta_*^{sb}(x))$ is immediate. The expression of A^{sb} is just the overall profit (6.19) over the whole urban area, each location weighted by the population $n^{sb}(x)$ it supports, as in (6.18): the developer collects access revenues and property rents from every resident, so the aggregate it can be charged for is the density-weighted one. By paying A^{sb} upfront, the developer makes zero ex ante profit and all gains of the second-best policy are passed to the local government. $\square$

PROOF OF PROPOSITION 9. For any governance mode g , let

$$\begin{aligned} A^g = \int_0^{\bar{x}} & \left(\pi(R(\theta_*^g(x))) + (\theta_*^g(x) + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta_*^g(x)) - K - \tau x + i^g(x))(1 - F(\theta_*^g(x))) \right. \\ & \left. - \psi(i^g(x)) \right) n^g(x) dx \end{aligned}$$

denote the aggregate urban surplus it generates, each location being weighted by the population $n^g(x)$ that the arrangement supports there, and let $\Pi^g = \int_0^{\bar{x}} \pi_d^g(x) n^g(x) dx \geq 0$ be the rent it leaves to the developer, net of any upfront payment. In particular, A^{sb} is given by (6.18).

Two observations settle the comparison of aggregate surpluses. First, the second-best allocation maximizes the welfare *density* location by location, by (B.9), so the integrand above is largest under $g = sb$ at every x . Second, by (3.7) density is decreasing in the cut-off, and every arrangement has $\theta_*^g(x) \geq \theta_*^{sb}(x)$ by Propositions 3, 4 and 6, so $n^g(x) \leq n^{sb}(x)$ at every x as well. The two effects point the same way, and therefore $A^g \leq A^{sb}$ for all g , with a wider margin

than at a common density.

Because the city's population $N^g = \int_0^{\bar{x}} n^g(x) dx$ differs across arrangements (the economy's total population being fixed, but the share of it that the city draws in depending on the access policy), the comparison is drawn on welfare net of the outside option, as in (3.14). Rearranging (B.30), aggregating over locations with weights $n^g(x)$, and subtracting $N^g(y_0 + H(r_0))$, welfare under any arrangement takes the common form

$$(B.46) \quad \widehat{\mathcal{W}}^g = (1 + \lambda)A^g - \lambda \Pi^g.$$

The outside-option term disappears from the comparison rather than needing to be held constant across arrangements, and the four comparisons follow from (B.46) by pairing off the two remaining terms. All four are stated in terms of $\widehat{\mathcal{W}}^g$, which is the criterion (3.14); the gross magnitude $\mathcal{W}^g$ is recovered by adding $N^g(y_0 + H(r_0))$, and is not used below.

Rights Transfer against Equity Contribution. Under full extraction $\Pi^{rt} = 0$, so $\widehat{\mathcal{W}}^{rt} = (1 + \lambda)A^{sb}$. Under Condition (6.16) the Equity Contribution implements the second best and holds the developer to Π^{pr} by Proposition 7, so

$$\widehat{\mathcal{W}}^{ec} = (1 + \lambda)A^{sb} - \lambda \Pi^{pr}.$$

The two generate the same surplus and differ only in the rent conceded:

$$\widehat{\mathcal{W}}^{rt} - \widehat{\mathcal{W}}^{ec} = \lambda \Pi^{pr} \geq 0.$$

Equity Contribution against Performance Contract. By the envelope theorem, the developer's maximized profit at location x is non-decreasing in the subsidy (its derivative w.r.t. the subsidy is $1 - F(\theta_*(x, s(x))) \geq 0$), so the fact that the optimal subsidy is non-negative under a Performance Contract (i.e., $s^*(x) \geq 0$) implies $\Pi^{pc} \geq \Pi^{pr}$ since Π^{pr} is reached at zero subsidy. The aggregation reinforces this: $\theta_*^{pc}(x) \leq \theta_*^{pr}(x)$ gives $n^{pc}(x) \geq n^{pr}(x)$ by (3.7), so the larger per-resident rent is earned from a larger population. The Performance Contract is thus worse on both counts. It generates weakly less surplus, $A^{pc} \leq A^{sb}$, and concedes weakly more rent. Hence

$$\widehat{\mathcal{W}}^{pc} \leq (1 + \lambda)A^{sb} - \lambda \Pi^{pr} = \widehat{\mathcal{W}}^{ec}.$$

Performance Contract against Private City. Since $s \equiv 0$ is feasible,

$$\widehat{\mathcal{W}}^{pc} \geq (1 + \lambda)A^{pr} - \lambda \Pi^{pr} = \widehat{\mathcal{W}}^{pr}.$$

Conventional City. The developer-agency earns no profit, so

$$\widehat{\mathcal{W}}^{pu} = (1 + \lambda)A^{pu} \leq (1 + \lambda)A^{sb} = \widehat{\mathcal{W}}^{rt}.$$

This completes (7.2).

Finally, let $\lambda = 0$. The rent term in (B.46) drops out and welfare reduces to A^g : the rent conceded to the developer is then a pure transfer. The three arrangements that implement

the second-best allocation—the Rights Transfer by Proposition 8, the Equity Contribution by Proposition 7, and the Performance Contract by Proposition 6, whose Pigouvian subsidy is exactly corrective at $\lambda = 0$ —therefore deliver the same welfare A^{sb} . They also support the same population, since they implement the same cut-off, so the equality holds for $\mathcal{W}^g$ as well as for $\widehat{\mathcal{W}}^g$. $\square$

PROOF OF PROPOSITION 10. Combining the private developer's two first-order conditions (6.4) and (6.5), the private cut-off is characterized by

$$(B.47) \quad \mathcal{L}(\theta_*^{pr}(x)) = K + \tau x.$$

Since $\mathcal{L}$ is non-decreasing, $\theta_*^{pr}(x) \leq \theta_*^{pu}(x)$ therefore holds whenever

$$(B.48) \quad \mathcal{L}(\theta_*^{pu}(x)) \geq K + \tau x.$$

It remains to express (B.48) in primitives. The public cut-off satisfies (6.2), that is,

$$(B.49) \quad K + \tau x = (1 + \beta)\theta_*^{pu}(x) - \frac{1 - F(\theta_*^{pu}(x))}{f(\theta_*^{pu}(x))} \left(1 - \frac{r_0}{r^{pu}(x)}\right) \varepsilon(r^{pu}(x)),$$

where the factor $(1 - \frac{r_0}{r^{pu}(x)})$ must be retained. Substituting (B.49) into (B.48) and canceling $(1 + \beta)\theta_*^{pu}(x)$ on both sides gives

$$\varphi(1 - F(\theta_*^{pu}(x))) - \frac{1 - F(\theta_*^{pu}(x))}{f(\theta_*^{pu}(x))} \geq -\frac{1 - F(\theta_*^{pu}(x))}{f(\theta_*^{pu}(x))} \left(1 - \frac{r_0}{r^{pu}(x)}\right) \varepsilon(r^{pu}(x)),$$

which rearranges into (7.3). $\square$

PROOF OF PROPOSITION 11. When $\lambda = 0$, the Conventional City improves no quality, so by Proposition 3 welfare under public ownership is

$$(B.50) \quad \mathcal{W}^{pu}(x) = y_0 + H(r_0) + J(\theta_*^{pu}(x)),$$

with $\theta_*^{pu}(x) = \arg \max_{\theta} J(\theta)$, whereas under private ownership

$$(B.51) \quad \mathcal{W}^{pr}(x) = y_0 + H(r_0) + J(\theta_*^{pr}(x)) + i^{pr}(x)(1 - F(\theta_*^{pr}(x))) - \psi(i^{pr}(x)),$$

the last two terms being the social value $G(x)$ of the quality improvement. Subtracting,

$$(B.52) \quad \mathcal{W}^{pr}(x) - \mathcal{W}^{pu}(x) = \underbrace{J(\theta_*^{pr}(x)) - J(\theta_*^{pu}(x))}_{\text{access-margin loss}} + \underbrace{G(x)}_{\text{quality gain}}.$$

The first term is non-positive because $\theta_*^{pu}(x)$ maximizes J ; this requires no assumption beyond Proposition 3. The second is non-negative: convexity of ψ with $\psi(0) = 0$ gives $\psi(i) \leq i \psi'(i)$, and $\psi'(i^{pr}) = 1 - F(\theta_*^{pr})$ by (6.4), so $G(x) \geq 0$. The proposition therefore amounts to bounding the loss.

Since J is concave, $J(\theta_*^{pu}) \leq J(\theta_*^{pr}) + J'(\theta_*^{pr})(\theta_*^{pu} - \theta_*^{pr})$, so that

$$(B.53) \quad J(\theta_*^{pu}(x)) - J(\theta_*^{pr}(x)) \leq J'(\theta_*^{pr}(x)) (\theta_*^{pu}(x) - \theta_*^{pr}(x)).$$

It remains to evaluate J' at the private cut-off. Differentiating (7.5), using $\frac{d}{d\theta}[(\theta + \beta \mathbb{E}_{\tilde{\theta}}(\tilde{\theta} \mid \tilde{\theta} \geq \theta) - K - \tau x)(1 - F(\theta))] = (1 - F(\theta)) - f(\theta)[(1 + \beta)\theta - K - \tau x]$ and $\pi'(R(\theta))\dot{R}(\theta) = -(1 - F(\theta))(1 - z(\theta))$ from (5.3), gives

$$(B.54) \quad J'(\theta) = (1 - F(\theta))z(\theta) - f(\theta)[(1 + \beta)\theta - K - \tau x].$$

The private developer's first-order condition (6.5) reads $(1 + \beta)\theta_*^{pr} + i^{pr} - K - \tau x = \frac{1 - F(\theta_*^{pr})}{f(\theta_*^{pr})}$ with $i^{pr} = \varphi(1 - F(\theta_*^{pr}))$ by (6.4). Substituting into (B.54),

$$(B.55) \quad J'(\theta_*^{pr}(x)) = f(\theta_*^{pr}(x)) \varphi(1 - F(\theta_*^{pr}(x))) - (1 - z(\theta_*^{pr}(x)))(1 - F(\theta_*^{pr}(x))),$$

which is the bracket in (7.8). Combining with (B.53) and (B.52) yields (7.6). Finally, $L(x) \geq 0$: concavity of J and $J'(\theta_*^{pu}) = 0$ imply $J'(\theta_*^{pr}) \geq 0$ whenever $\theta_*^{pr} \leq \theta_*^{pu}$, and the access gap is non-negative by hypothesis. Hence $G(x) \geq L(x)$ suffices for $\mathcal{W}^{pr}(x) \geq \mathcal{W}^{pu}(x)$. $\square$