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Pricing the Receipt, Not the Invention: Why Royalties Misread the Value of Public Technology

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Abstract

Royalty income is the standard measure of technology-transfer performance, on the presumption that licence prices reflect technological value. We find that, in public R&D, they largely reflect the rules. Innovation research holds that the value of R&D collaboration depends on the technology field, but this evidence comes from knowledge creation, not from the pricing of public technology. We distinguish two tiers of the transfer stage, contract design (how a licence is paid) and price formation (how much is paid), and propose institutional price anchoring: prices attach to the inputs that fee rules make salient rather than to the technology. Korean administrative records spanning a governance reform allow a comparative test: 2,252 licensing contracts executed under the Joint Regulations and 18,534 university and institute participations in 2024 consortia formed under the 2021 National R&D Innovation Act. We report three findings. First, field differences do not reach price; they relocate into contract design, with biotechnology licences 20 percentage points more likely to be sales-linked. Second, the government contribution named in fee rules is priced where formulas require it, never where price follows sales, and in negotiated deals only when government research institutes sell, a pattern a value-proxy account cannot explain. Third, after the reform, programme design explains 52% of the variance in commercialization-role assignment and organizational type 0.2%. Public technology is priced on its receipt, not its invention. Royalty income therefore mixes rule-driven and value-driven revenue, and reforms of fee rules change what transfer metrics measure before they change what transfer achieves.

JEL classification: O32; O34; O38; L24; D86

1. Introduction

Universities and public research institutes are under growing pressure to show what their research is worth, and the figure most often offered in reply is royalty income. Licensing revenue is used to rank technology transfer offices (TTOs) (Chapple et al., 2005; Heisey & Adelman, 2011; Hülsbeck et al., 2013), it feeds into how governments evaluate and fund public R&D programmes, and researchers commonly treat it as a market signal of the commercial value of public science (Thursby et al., 2001; Siegel et al., 2003). Collaboration policy follows a similar logic. Because the value of domestic and foreign R&D partners depends on a field's technological regime (Pavitt, 1984; Malerba, 2002; Belderbos et al., 2004; Nieto et al., 2024), governments tailor collaboration incentives by field and expect the payoff to surface in commercialization returns. Both practices take for granted that licence prices reflect the value created upstream, an assumption we call the transitivity assumption.

To our knowledge, this assumption has not been tested. Evidence that collaboration value varies by field comes mostly from studies of knowledge creation in firms, which capture value on their own terms. Technology-transfer research explains licensing income with TTO characteristics (Lach & Schankerman, 2008; Bozeman et al., 2015) but seldom observes the licensed technology or how the licence is paid (Table 1). This matters because public licensing is not a free negotiation. It takes place under national fee rules that can set prices themselves, and these rules change. If prices follow the rules rather than the

technology, royalty income measures something other than commercial value, and a rule change alters the measure even when performance does not.

The purpose of this study is to determine whether public technology is priced by its value or by the rules under which it is transferred, and whether the governance of transfer persists when those rules change. We address four research questions: (1) Does the field contingency of collaboration value survive into the price at which public technology is licensed? (2) If not, does it relocate into contract design, that is, into how a licence is paid? (3) Is price set by the value of the technology or by inputs that fee rules make salient, and does the answer depend on the licensor? (4) When the rules are consolidated, does the governance of transfer shift from rules and programmes to organizations?

To address these questions, we develop a two-tier account of the transfer stage and test it in a comparative design. The first tier, contract design, is the choice among a formula fee, a negotiated lump sum and sales-linked royalties (Gallini & Wright, 1990; Jensen & Thursby, 2001; Crama et al., 2008). For the second, price formation, we propose institutional price anchoring, meaning that prices attach to the inputs that fee rules make visible. Anchoring is codified when a rule sets the price as a share of the government contribution, and discretionary when negotiators use that contribution as a starting point (Schelling, 1960; Galinsky & Mussweiler, 2001). We compare Korea's two regimes of public R&D governance, the Joint Regulations and the 2021 National R&D Innovation Act, using records of 2,252 licensing contracts from the first and 18,534 consortium participations by universities and government research institutes (GRIs) from the second.

Our approach differs from earlier work in three respects. We observe the technology, the contract and the price together, so transitivity can be examined where value is captured rather than inferred from where it is created. We also separate anchoring from the scale–quality explanation common in studies of licensing income (Heisey & Adelman, 2011), by looking at sales-linked contracts, where a real value proxy should matter most, by comparing similar contracts with overlap weights, and by using a placebo input that fee rules do not mention. Finally, we treat the rules of transfer as something that varies, comparing where governance sits before and after a reform.

In brief, we find no detectable field differences in price but clear differences in contract form: biotechnology licences are 20 percentage points more likely than IT licences to be tied to sales. The government contribution affects royalties only where fee rules refer to it, not where payment follows sales, and in negotiated deals only when a GRI is the seller. After the reform, programme design accounts for 52% of the variance in who is given the commercialization role, and organizational type for 0.2%. These results suggest that the licensing contract is a boundary condition for sectoral-contingency theory (Busse et al., 2017), identify institutional price anchoring as a mechanism of price formation, add a licensor dimension to the contingent effectiveness model (Bozeman, 2000; Bozeman et al., 2015; Intarakumnerd & Goto, 2018), and fit theories of institutional layering (Streeck & Thelen, 2005; Mahoney & Thelen, 2010). Put simply, public technology is priced on its receipt rather than its invention.

Section 2 describes the institutional context, reviews the literature and develops the hypotheses. Section 3 covers data and methods, Section 4 the results, and Section 5 the contributions, implications and limitations.

Table 1
Prior research streams and the gap addressed

Stream (illustrative studies)	Outcome examined	Stage	Unit / price formation	Field contingency?
Sectoral regimes (Pavitt, 1984; Malerba, 2002; Castellacci, 2008)	Sources and patterns of innovation	Knowledge creation	Industry; market	Yes (theorized)
R&D cooperation heterogeneity (Belderbos et al., 2004; Lin & Yang, 2020)	Productivity, innovative sales	Knowledge creation	Firm surveys; market	Yes
International R&D collaboration (Sampson, 2007; Lavie & Miller, 2008; Nieto et al., 2024)	Patents, radical vs. incremental innovation	Knowledge creation	Alliances; market	Yes, via technological regime
TTO performance (Siegel et al., 2003; Chapple et al., 2005; Heisey & Adelman, 2011)	Licence counts, licensing income	Transfer (organization level)	University/TTO; bargaining	Rarely examined
Licensing contracts (Jensen & Thursby, 2001; Mendi, 2005; Sakakibara, 2010)	Payment structure, royalty rates	Transfer (contract level)	Bilateral bargaining	Not theorized
This study	Pricing regime, royalty income and transfer-role allocation	Transfer (contract and consortium level)	Public R&D under two governance regimes; university vs. GRI licensors	Tested at two tiers and across two regimes

2. Institutional Context, Literature Review and Hypotheses

2.1 Institutional context: two regimes of public R&D governance

Since the Technology Transfer Promotion Act of 2000, which, like Bayh–Dole, gave performing organizations ownership of publicly funded results (Mowery et al., 2001; Grimaldi et al., 2011), Korean

universities and GRIs have run TTOs under common national fee rules. Government-led catch-up (Kim, 1997; Lee, 2013) produced a mature IT sector built around domestic supply chains and younger biotechnology (BT) and nanotechnology (NT) bases that were encouraged to find international partners. Field differences at the research stage are therefore large, while the rules for capturing value are the same for all fields. Over our study period, these rules were organized under two regimes (Table 2).

Until 2020, projects were governed by the Regulations on the Management of National R&D Projects (the Joint Regulations), a presidential decree, and by the Technology Transfer and Commercialization Promotion Act. A participant that used the results itself paid a fixed fee set as a share of the government contribution, and the share rose with firm size. When universities and GRIs licensed to others, they agreed a lump sum or a running royalty within common rules and model agreements. The contribution was thus written into the fee for some contracts and known to both sides in the rest. In January 2021 the National R&D Innovation Act replaced the Joint Regulations and the ministries' separate rules with one statute; fees now fall under Article 18 of the Act and Articles 38–41 of its decree. The reform unified the rules, but programmes kept control of consortium design, including who joins as a joint or consigned researcher and who handles transfer and commercialization.

Table 2
Two regimes of public-R&D governance compared

Dimension	**Regime I: Joint Regulations**	**Regime II: National R&D Innovation Act**
Legal form	Presidential decree, with ministry-specific management rules	Statute (in force January 2021) and enforcement decree
Fee provisions	Joint Regulations; Technology Transfer and Commercialization Promotion Act	Act Art. 18; Enforcement Decree Arts. 38–41; ministry guidance
Reference input for codified fees	Government contribution (fixed share rising with firm size)	Government support remains the reference for fee obligations and their limits
Discretion over consortium roles	Programme and project agreements	Retained at programme level
Observed in this paper	2,252 licensing contracts, royalties accrued in 2016	18,534 university and GRI participations in 2024 consortia
Outcome observed	Pricing regime and royalty level	Participation type and commercialization-role assignment

Our comparison is therefore not a before–after estimate of one outcome but a look at where governance lies in each regime. If consolidation had shifted governance toward organizations, organizational type should explain more of the variation after the reform. If governance is layered and stable, the finest unit applying the rules should dominate in both periods. The hypotheses below spell out what each account predicts.

2.2 Sectoral contingency and the value of R&D collaboration in licensing

Sectoral-systems research argues that technological regimes shape who innovates, how and with whom (Pavitt, 1984; Breschi et al., 2000; Malerba, 2002). Because tacit knowledge is costly to move across distance (Kogut & Zander, 1993) and the benefit of diverse partners depends on technological distance (Sampson, 2007), returns to international collaboration should vary with the technology (Lavie & Miller, 2008; Nieto et al., 2024). The link between collaboration and performance indeed differs across industries and channels (Belderbos et al., 2004; Bekkers & Bodas Freitas, 2008; Lin & Yang, 2020). As Table 1 shows, though, this evidence concerns creating value, not capturing it. Profiting from an innovation depends on appropriability and complementary assets that are separate from the process that produced it (Teece, 1986), and markets for ideas have their own logic (Gans & Stern, 2003; Arora & Gambardella, 2010). Transfer studies explain licensing income with TTO characteristics (Siegel et al., 2003; Chapple et al., 2005; Caldera & Debande, 2010) but rarely ask which research-stage differences reach licensing returns.

For licensing, this literature implies that collaboration raises returns. Joint research lets the user absorb knowledge during development (Cohen & Levinthal, 1990; Zahra & George, 2002), and a partner involved early is more likely to become, or find, the licensee, easing the information problems that depress licence value (Jensen & Thursby, 2001; Agrawal, 2006; Hagedoorn et al., 2009). Domestic partners ease coordination (Boschma, 2005); foreign partners bring knowledge unavailable at home (Keller, 2004; Ervits, 2024) but face the liability of foreignness (Zaheer, 1995). Joint research is among the most consistent predictors of transfer output (Perkmann et al., 2013; Min et al., 2019). We therefore take the collaboration premia as a baseline and ask whether they vary by field.

If sectoral contingency carries over to licensing, field differences in collaboration value should appear in prices. Foreign partners should matter more in science-based fields such as BT, domestic partners in IT, whose modular knowledge spreads through domestic supply chains (Gawer, 2014; Ervits, 2024). An institutional view expects otherwise. Technology markets are thin, early-stage value is hard to judge, and full disclosure to a buyer risks giving the idea away (Arora et al., 2001; Gans & Stern, 2003), so negotiators look for reference points (Tversky & Kahneman, 1974). In public R&D these come from national fee rules, model agreements and shared TTO evaluation criteria (Bozeman, 2000; Mowery et al., 2001), and organizations under the same pressures adopt similar routines (DiMaggio & Powell, 1983; Scott, 2014); even decentralized markets use conventions such as the “25 per cent rule” (Goldscheider et al., 2002). Anchoring would compress field differences, though collaboration could still raise royalties through field-neutral channels such as project size. As a non-significant interaction cannot show that effects are equal, we state the sectoral prediction as the hypothesis and assess the alternative with equivalence and power tests.

Hypothesis 1

(H1, sectoral transitivity). *The associations of domestic and foreign collaboration with royalty income differ across technology fields.*

2.3 Contract design, institutional price anchoring and licensor logic

Both views treat price as one number, but licensing involves two decisions: how the licence is paid and how much. The first, contract design, matters because licences bundle several payment terms. When the licensee's valuation is private or the value uncertain, output-based royalties screen licensees and share risk, while fixed fees leave the risk with the licensee (Gallini & Wright, 1990; Bousquet et al., 1998). Universities use royalties because their inventions are usually embryonic (Jensen & Thursby, 2001; Dechenaux et al., 2011), and the choice between up-front payments and royalties depends on development risk (Crama et al., 2008; Mendi, 2005; Vishwasrao, 2007). Field differences may therefore show up in the form of the contract even if they do not reach price levels.

Hypothesis 2

(H2, contract-form contingency). *The pricing regime of a licence varies with its technology field and technological uncertainty: sales-linked royalties are more likely for science-based, long-cycle fields (BT) and for technologies early in their life cycle.*

The second decision, price formation, concerns which input sets the price once the contract form is chosen. Under codified anchoring, a rule makes the price a function of an administrative input, here the government contribution in contracts where a participant uses the results itself. Under discretionary anchoring, no rule fixes the price, but the input named in the rules is visible to both sides and can act as a focal point (Schelling, 1960). Under value-linked pricing, royalties follow the licensee's sales. Because pass-through under a formula is partly built into the rule, it cannot separate the two accounts. If the contribution proxies technical and commercial value, as the scale–quality account holds (Heisey & Adelman, 2011), its link with royalties should persist, or even strengthen, where price follows sales, and appear among comparable contracts in every regime. Under anchoring, it should be strongest where rules refer to it and absent where price follows sales.

Hypothesis 3

(H3, institutional anchoring). *The elasticity of royalty income with respect to the government contribution is greatest in formula-priced contracts and, in sales-linked contracts, falls below the smallest elasticity consistent with a value-based account of pricing.*

Whether the contribution becomes a focal point depends on the licensor. The contingent effectiveness model holds that transfer outcomes reflect the agent's mission and environment (Bozeman, 2000; Bozeman et al., 2015), and publicness, the degree to which an organization answers to political rather than market authority, shapes laboratory behaviour (Bozeman & Crow, 1990; Crow & Bozeman, 1998).

GRIs are owned, funded and audited by the state and must show a return on specific public investments (Intarakumnerd & Goto, 2018), so for their licensing officers the contribution is the easiest figure to defend in a negotiation. University TTOs follow the same rules, but in an academic setting where inventors, licensee identity and the perceived promise of an invention weigh more on price (Thursby & Thursby, 2004; Macho-Stadler et al., 2007; Belenzon & Schankerman, 2009).

Hypothesis 4

(H4, licensor logic). *In negotiated lump-sum contracts, the elasticity of royalty income with respect to the government contribution is greater for GRI licensors than for university licensors.*

2.4 Institutional change and the governance of technology transfer

Two further implications follow. First, as a corollary of H1 and H2, field differences in price should reappear where anchoring is weakest, in sales-linked contracts, where price tracks field-specific demand (Teece, 1986). The second concerns institutional change. Programme rules decide which organization is in a position to transfer a technology before it is priced. An organizational-mission account holds that missions steer GRIs toward commercialization and universities toward research (Bozeman & Crow, 1990; Intarakumnerd & Goto, 2018), so unifying the rules should make such differences clearer. A layered-governance account notes that reforms often consolidate formal rules while leaving lower-level discretion intact (Streeck & Thelen, 2005; Mahoney & Thelen, 2010). Since the Act left consortium design to programmes, it predicts that programmes will keep allocating transfer roles.

Proposition 1

(P1, persistence of the governance locus). *Under both regimes, the most granular rule-applying unit (the licensor under the Joint Regulations; the programme under the Innovation Act) accounts for more of the variation in transfer outcomes than technology field or organizational type.*

We call P1 a proposition because the regimes are observed through different outcomes, so the comparison speaks to orders of magnitude only. Figure 1 summarizes the model; we judge the accounts by the overall pattern of results.

3. Data and Methods

3.1 Data

To address these questions, we use data from Korea's National Science and Technology Information Service (NTIS). The analysis has two parts. Licensing contracts from the Joint Regulations period (Regime I) are used to test H1–H4, and consortium records from after the Innovation Act (Regime II) to examine P1. Regime I. NTIS records every licence of a publicly funded technology with its payment

terms. We took the licences under which royalties accrued in 2016 (90% were also signed that year); Online Resource 1 (Tables S1–S2) details the sample construction and variable definitions. Of 3,235 records, we dropped 133 with zero royalty and 6 without pricing information, and kept the four 6T fields large enough for field-level estimates: IT (n = 1,118), BT (581), NT (178) and environmental technology, ET (375). This leaves 2,252 contracts from 1,026 projects and 368 licensors (universities 1,163; GRIs 652; participating firms 332; others 105). The outcome, ln_royalty, is the log royalty received by the owner, excluding the government's share. Two dummies mark joint research with a domestic partner (co_do) or a foreign research organization (co_fr); IT is the reference field. We control for log project funding, patent status, research stage, researchers and year. Using the NTIS payment codes, we coded each contract as a formula fee (629, 27.9%), negotiated lump sum (1,108, 49.2%) or sales-linked royalty (515, 22.9%), and noted whether results were used by a participant (836), a co-developer (569) or a third party (847). The fee-relevant government contribution (ln_gov) is recorded for 740 contracts.

Regime II. From NTIS records of all joint and consigned partners in 2024 national R&D projects (41,929 records), we take 14,942 university participations (310 universities) and 3,592 GRI participations (68 GRIs). Outcomes are consigned rather than joint status, log research budget and, for joint partners, being named for commercialization.

3.2 Estimation

Our baseline specification follows a long line of work on licensing income. Studies of university and TTO performance commonly regress the logarithm of licensing income on log research inputs and institutional characteristics (Siegel et al., 2003; Chapple et al., 2005; Lach & Schankerman, 2008; Heisey & Adelman, 2011). Two reasons are usually given for the log form. Licensing income is highly skewed, with a few large licences accounting for much of the total, and in logs the coefficients on log inputs can be read as elasticities. Heisey and Adelman (2011), for instance, relate licensing revenue to past research expenditure in this way, and it is this scale–quality reading of the input–income link that our anchoring tests take up.

We apply the same model at the level of the individual contract. Coefficients on the logged continuous variables, ln_rd and ln_gov, are elasticities, while a coefficient β on a dummy implies a proportional difference of exp(β) − 1; the foreign premium of 0.615 reported below, for example, corresponds to royalties about 85% higher. The log-linear model has two known weaknesses. It cannot handle zero royalties, which is why the 133 zero-royalty records are excluded, and its estimates can be biased when errors are heteroskedastic (Santos Silva & Tenreyro, 2006). We therefore also estimate the collaboration model by Poisson pseudo-maximum likelihood (PPML) on royalty levels (Section 4.8). For the choice of pricing regime, we follow studies that treat the decision between fixed fees and royalties as a discrete choice (Mendi, 2005; Vishwasrao, 2007) and extend it to three outcomes.

H1. Eq. (1) applies this model to collaboration and technology field, adding their interactions:

$$ln_royalty_i = \beta_0 + \beta_1\, co_do_i + \beta_2\, co_fr_i + \Sigma_f\, \lambda_f\, Field_{fi} + \Sigma_f\, \theta_f\, (co_do_i \times Field_{fi}) + \Sigma_f\, \varphi_f\, (co_fr_i \times Field_{fi}) + X_i'\gamma + \varepsilon_i \quad (1)$$

The interactions are tested jointly rather than by comparing p-values across fields (Gelman & Stern, 2006). Errors are clustered by project, since one project may yield several licences (Cameron & Miller, 2015), and, with only 39 foreign contracts, we add wild cluster bootstrap p-values (Cameron et al., 2008; Webb, 2023). Because a null interaction does not prove equality, we also run equivalence tests at ± 0.20 log points (Lakens et al., 2018), report detectable effects at 80% power (Aguinis et al., 2005) and use a Gelbach (2016) decomposition.

H2. The pricing regime is modelled as a multinomial logit (base: lump sum):

$$Pr(Regime_i = r) = exp(Z_i'\alpha_r) \,/\, \Sigma_s\, exp(Z_i'\alpha_s) \quad (2)$$

where Z holds technology variables (field, stage, life cycle, patent), administrative variables (mode, licensor type) and controls. We report average marginal effects and nested pseudo-R^2.

H3 and H4. For the 740 contracts with a recorded contribution:

$$ln_royalty_i = \Sigma_r\, \pi_r\, (ln_gov_i \times Regime_{ri}) + \Sigma_r\, \mu_r\, Regime_{ri} + \kappa_1\, co_do_i + \kappa_2\, co_fr_i + \Sigma_f\, \lambda_f\, Field_{fi} + X_i'\gamma + \varepsilon_i \quad (3)$$

where π is the contribution elasticity in each regime. H3 needs the elasticity to fall across regimes and, in sales-linked contracts, to lie below a value benchmark, so we test H0: π(sales) ≥ δ for δ = 0.10 (half the pooled funding elasticity) and 0.16 (the funding elasticity in sales-linked contracts). Regimes are not randomly assigned, so we do three things. Licensor fixed effects absorb TTO capability, bargaining power and portfolio quality. Overlap weights from Eq. (2) (Li et al., 2018; Li & Li, 2019) keep the comparison to contracts that could have been priced under any regime. And, as a placebo, total project funding, which measures scale as well as the contribution but is absent from fee rules, replaces the contribution. For H4, each elasticity is interacted with a GRI dummy in the 370 university and GRI contracts. Variance and P1. For Regime I we split adjusted R^2 into Shapley shares for five blocks (Shorrocks, 2013) and re-estimate field effects within each regime. For Regime II we regress each outcome on a university dummy with controls for partners, consortium size, location and foreign members, adding sub-programme, ministry or project fixed effects (errors clustered by upper-level project), and compare each block's R^2 with Regime I.

The estimation routines were coded with the assistance of a large language model (Claude, Anthropic); all code and results were verified by the author.

4. Empirical Results

This section reports the evidence on our central question, namely whether public technology is priced according to its value or according to the rules under which it is licensed. We start with the contracts signed under the Joint Regulations. After describing the sample (Section 4.1), we examine whether

collaboration premia differ by field (H1), whether field differences appear instead in the way licences are paid (H2), whether the government contribution is priced only where fee rules refer to it (H3), and whether GRIs anchor negotiated prices more than universities do (H4) (Sections 4.2–4.6). We then use the 2024 consortium records to ask whether, after the reform, programmes rather than organizational types still decide who takes on transfer roles (P1), and compare the two regimes (Sections 4.7–4.8).

4.1 Sample

Domestic collaboration is most common in IT (53.8%) and least in BT (16.2%); foreign collaboration is rare (1.7%) (Table 3). Sales-linked royalties appear in 34.4% of BT contracts but 15.7–19.3% elsewhere. Licensors differ more: firms price 93.7% of contracts by formula, universities mostly use lump sums (68.4%), and GRIs split evenly between lump sums and sales-linked royalties (38.5% each).

Table 3
Regime I sample by technology field

Field	N	Domestic collab., n (%)	Foreign collab., n (%)	Mean royalty (KRW mil.)	Mean ln(royalty)	Formula / lump sum / sales-linked (%)
IT	1,118	601 (53.8)	25 (2.2)	32.0	16.51	27.7 / 53.0 / 19.3
BT	581	94 (16.2)	6 (1.0)	47.8	16.22	15.5 / 50.1 / 34.4
NT	178	55 (30.9)	1 (0.6)	39.0	16.71	33.1 / 51.1 / 15.7
ET	375	162 (43.2)	7 (1.9)	41.0	16.70	45.3 / 35.7 / 18.9
Total	2,252	912 (40.5)	39 (1.7)	37.5	16.53	27.9 / 49.2 / 22.9

Note. 844 records in residual fields (ST, CT and non-6T projects) are excluded. Licensors: universities 1,163; GRIs 652; participating firms 332; other 105. Median royalty: formula KRW 22.0 mil., lump sum 11.0 mil., sales-linked 23.0 mil.

4.2 Field contingency does not reach price (H1)

Foreign collaboration carries a royalty premium (β = 0.615, p = .011; wild bootstrap p = .039), while the domestic estimate is small and imprecise (β = 0.136, p = .294) (Table 4). With HC3 errors it would be marginally significant (p = .070), a reminder of how much clustering matters in contract data. Project funding is the strongest predictor (β = 0.202, p = .002); patents have no effect. No collaboration × field interaction is significant, whether domestic ($F(3, 1025) = 0.58$, p = .630) or foreign, excluding the NT term that rests on one contract ($F(2, 921) = 0.38$, p = .685). H1 is not supported.

Table 4
Collaboration premia and collaboration × field interactions

Variable	(1) Pooled: β (SE)	p	(2) Interaction: β (SE)	p
Domestic collab. (co_do) [in (2): IT]	0.136 (0.130)	.294	0.216 (0.174)	.215
Domestic collab. × BT			−0.185 (0.315)	.558
Domestic collab. × NT			−0.323 (0.256)	.208
Domestic collab. × ET			−0.215 (0.237)	.365
Foreign collab. (co_fr) [in (2): IT]	0.615* (0.241)	.011	0.531+ (0.286)	.063
Foreign collab. × BT			0.202 (0.852)	.813
Foreign collab. × NT (n = 1)			not interpretable	—
Foreign collab. × ET			0.385 (0.450)	.393
ln(project funding)	0.202** (0.065)	.002	0.202** (0.066)	.002
Patent applied/registered	−0.071 (0.139)	.609	−0.070 (0.135)	.606
Field, research-stage, researcher and year controls	Included		Included	
R^2	.086		.087	
Wild cluster bootstrap p: co_fr / co_do	.039 / .329			

Note. N = 2,252. Dependent variable: ln_royalty. Standard errors clustered by R&D project (G = 1,026). The foreign × NT term is identified by a single contract. **p < .01, *p < .05, +p < .10.

These nulls do not show that the premia are equal. Equivalence with IT cannot be established (TOST p = .481–.684), and the tests could detect only differences of 0.67 (domestic) and 1.32 (foreign) log points (Online Resource 1, Table S3). They do rule out what the sectoral account most obviously predicts, a smaller foreign premium in science-based fields: the implied premia in BT (0.733) and ET (0.916) are, if anything, above IT's (0.531). About a third of the raw premia works through project funding, whose elasticity is similar across fields (p = .699). Since a scale–quality account predicts this too, Section 4.4 reports the tests that tell them apart.

4.3 Field contingency relocates into contract design (H2)

Field strongly predicts how a licence is paid (Table 5; field $\chi^2(6) = 45.2$, $p < .001$). Holding licensor, mode, scale and collaboration constant, BT licences are 20.5 percentage points more likely than IT licences to be sales-linked and 21.8 points less likely to be lump sums. Introduction- and growth-stage technologies are 9.9 and 11.5 points more likely to be sales-linked (uncertainty block $\chi^2(10) = 45.5$, $p < .001$). H2 is supported for field and partly for life cycle; as contract theory expects, payment follows sales where development is long and uncertain. Administrative factors matter as much. Direct implementation raises

the probability of formula pricing by 20.2 points, and universities are 18.1 points less likely than GRIs to use sales-linked royalties. The administrative block raises pseudo-R^2 from 0.245 to 0.341, the technology block to 0.328. Transfer institutions do not remove field differences; they turn them into differences in contract type.

Table 5
Determinants of the pricing regime: average marginal effects (multinomial logit)

Variable (reference)	Lump sum	Formula fixed fee	Sales-linked royalty
BT (IT)	−0.218*** (0.036)	0.013 (0.027)	0.205*** (0.041)
NT (IT)	−0.032	0.041	−0.010
ET (IT)	−0.072	0.069	0.003
Life cycle: introduction (mature)	−0.002 (0.057)	−0.097+ (0.050)	0.099 (0.065)
Life cycle: growth (mature)	−0.075 (0.056)	−0.039 (0.048)	0.115+ (0.066)
Applied research (development)	0.132	−0.076	−0.056
Mode: direct implementation (third party)	−0.217*** (0.051)	0.202*** (0.049)	0.015 (0.053)
Mode: co-developing licensee (third party)	−0.080* (0.035)	−0.044 (0.031)	0.124*** (0.036)
Licensor: university (GRI)	0.242*** (0.043)	−0.061 (0.038)	−0.181*** (0.041)
Domestic collaboration	−0.141** (0.048)	0.118** (0.037)	0.024 (0.045)

Note. N = 2,252 contracts, 1,026 project clusters. Base outcome: negotiated lump sum. Joint cluster-robust Wald tests: field $\chi^2(6) = 45.2$, uncertainty (stage and life cycle) $\chi^2(10) = 45.5$, licensing mode $\chi^2(4) = 57.5$, licensor type $\chi^2(6) = 49.8$, all $p < .001$. McFadden pseudo-R^2: controls only 0.245; controls + technology block 0.328; controls + administrative block 0.341; full model 0.398. Average marginal effects of moving each indicator from 0 to 1; project-bootstrap standard errors (200 draws) in parentheses where reported. The model also controls for basic research, life cycle not classified, patent status, firm and other licensors, foreign collaboration, ln(project funding), researchers and year. ***p < .001, **p < .01, *p < .05, +p < .10.

4.4 The government contribution is anchored, not valued (H3)

In formula-priced contracts, a 1% higher government contribution is associated with 0.53% higher royalties (Table 6), almost unchanged when total funding is added (0.511); within this regime the input named in the rule, not project size, carries the price. The elasticity falls to 0.11 for lump sums and − 0.07 for sales-linked contracts, and equality is rejected ($F(2, 442) = 20.50$, $p < .001$). The key test rejects a sales-linked elasticity of 0.10 or more (one-sided $p = .040$) and of 0.16 or more ($p = .009$). A value proxy should not vanish in the very contracts priced on commercial success.

The gradient survives licensor fixed effects (0.463, 0.165, − 0.066). Overlap weights cut the largest standardized differences between regimes from 1.77 to 0.33 or less, and among these comparable contracts the contribution is priced in no regime (− 0.04, 0.01, − 0.10; equality p = .855). Pass-through is limited to contracts the formula covers, and the sales-linked elasticity is never positive.

Table 6
Pass-through of the government contribution to royalties by pricing regime (H3)

Formula fixed fee: π (SE)	**(1) Baseline**	**(2) + licensing mode**	**(3) Licensor fixed effects**	**(4) Overlap-weighted**
	0.529* (0.066)**	**0.540*** (0.062)**	**0.463*** (0.119)**	**−0.042 (0.112)**
Negotiated lump sum: π (SE)	0.114 (0.075)	0.126+ (0.073)	0.165 (0.113)	0.007 (0.095)
Sales-linked royalty: π (SE)	−0.074 (0.099)	−0.071 (0.104)	−0.066 (0.137)	−0.101 (0.176)
Equality across regimes, F(2, 442)	20.50***	20.99***	4.22*	0.16
Formula − sales-linked (SE)	0.604*** (0.117)	0.611*** (0.120)	0.529** (0.190)	0.058 (0.190)
H3 inferiority, H0: $\pi_{sales} \geq 0.10$ (one-sided p)	.040	.050	.112	.127
H3 inferiority, H0: $\pi_{sales} \geq 0.16$ (one-sided p)	.009	.013	.050	.069

Note. N = 740 contracts with a recorded government contribution (formula 435; lump sum 172; sales-linked 133); standard errors clustered by project (G = 443). All models include regime fixed effects, co_do, co_fr, field fixed effects and patent, research-stage, researcher and year controls. (3) absorbs 285 licensor fixed effects. (4) uses generalized overlap weights from the multinomial model of Table 5 re-estimated on the 740 contracts (effective sample size 122). δ = 0.10 is half the pooled funding elasticity; δ = 0.16 is the funding elasticity within all 515 sales-linked contracts; neither bound was pre-specified. ***p < .001, **p < .01, *p < .05, +p < .10.

4.5 GRIs anchor negotiated prices (H4)

The weak average for lump sums hides a large licensor difference (Table 7; Fig. 2, Panel B): the elasticity is 0.29 for GRIs and − 0.11 for universities. The gap of 0.39 (p = .001; wild bootstrap p = .030) supports H4 and holds with controls for mode and funding, without the largest royalties and with clustering by licensor. Within licensors the GRI elasticity stays at 0.35, but the gap becomes imprecise. The placebo separates anchoring from scale: GRI lump sums are unrelated to total funding, and with both included, the contribution is priced and funding is not.

Table 7
Pass-through by licensor type: universities vs. GRIs (H4)

Pricing regime	University π (SE)	GRI π (SE)	GRI − university (SE)	p
Formula fixed fee	0.267 (0.202)	0.320*** (0.085)	0.053 (0.220)	.809
Negotiated lump sum	−0.108 (0.103)	0.285*** (0.074)	0.393** (0.121)	.001
Sales-linked royalty	−0.052 (0.185)	−0.068 (0.085)	−0.015 (0.206)	.941
Joint test of GRI differences			F(3, 235) = 3.57*	.015
Robustness of the lump-sum difference				
+ licensing mode	−0.097	0.280***	0.377** (0.122)	.002
+ licensing mode and ln(project funding)	0.013	0.323***	0.311* (0.130)	.018
Top 1% of royalties excluded	−0.147	0.292***	0.439*** (0.121)	< .001
Clustered by licensor (G = 91)	−0.108	0.285***	0.393** (0.120)	.002
Licensor fixed effects	0.089	0.347**	0.258 (0.180)	.153
Wild cluster bootstrap (1,999 draws)				.030
Placebo: total project funding instead of government contribution				
Negotiated lump sum	−0.378** (0.114)	−0.010 (0.263)	0.368 (0.274)	.181
Note. N = 370 university and GRI contracts with a recorded government contribution (universities: formula 34, lump sum 108, sales-linked 43; GRIs: 56, 51, 78), 236 project clusters. Controls as in Table 6. ***p < .001, **p < .01, *p < .05.				
4.6 Where royalty variance lies				

Licensor identity accounts for 20.3 of the 27.2 points of explained variance, about thirty times more than field (0.65 points) (Table 8, Panel A). As licensor effects also absorb portfolio quality, this shows where variation lies, not that TTO routines cause it. In line with the corollary, field dummies are insignificant within formula and lump-sum contracts but significant within sales-linked contracts (p = .024), where the domestic premium in IT reaches 0.56 log points (Panel B). Field differences return where price follows the market.

Table 8
Variance decomposition and within-regime field contingency (Regime I) *Panel A. Shapley decomposition of adjusted R² (N = 2,252)*

Block	Contribution	Share of explained variance	Adjusted R² alone
Licensor identity (368 fixed effects)	0.203	74.9%	0.259
Project inputs (funding, researchers, stage, patent, year)	0.029	10.8%	0.076
Transfer governance (pricing regime, licensing mode)	0.023	8.5%	0.065
Collaboration (domestic, foreign)	0.010	3.6%	0.034
Technology field	0.007	2.4%	0.012
Total	0.272	100%	

Panel B. Within-regime tests

Field dummies, joint F (p)	Formula fixed fee (n = 629)	Negotiated lump sum (n = 1,108)	Sales-linked (n = 515)
	0.30 (.827)	**1.51 (.210)**	**3.20 (.024)**
Incremental R² of field and domestic × field terms	0.003	0.014	0.018
Domestic × field, joint F (p)	0.21 (.889)	0.79 (.502)	1.20 (.312)
Domestic premium in IT, β (SE)	−0.237 (0.257)	0.117 (0.249)	0.564* (0.286)

Note. Panel A: Shapley values average each block's marginal contribution to adjusted R² over all 120 orderings (Shorrocks, 2013). Panel B: within-regime models of ln_royalty on co_do, co_fr, ln(project funding) and patent, research-stage, researcher and year controls; standard errors clustered by project. *p < .05.

4.7 Transfer-role allocation after the reform (P1)

At first glance, universities and GRIs behave differently under the Innovation Act (Table 9, Panel A): 24.6% of university participations are consigned against 11.6% of GRI participations, and 9.7% of university joint participants hold the commercialization role against 6.7% of GRIs. The gap runs opposite to what the mission account expects. Within sub-programmes, most of it disappears. The commercialization-role gap falls from 3.1 to 0.7 percentage points (p = .069), and to 0.85 points within the same project; the consigned gap falls from 13.0 to 5.6 points. Organizational type alone explains 0.2% of the variance in role designation, ministry 6.9% and sub-programme 52.3% (Panel C), and the university effect is significant only in Ministry of Science and ICT programmes. The apparent organizational differences mostly reflect which programmes universities and GRIs join. P1 is supported.

Table 9
Regime II: universities vs. GRIs in national R&D consortia, 2024

Panel A. Descriptives (university / GRI)	**Consigned participation**	**ln(joint-research budget)**	**Commercialization role (joint participants)**
Share or median	24.6% / 11.6%	KRW 80.7 / 137.0 mil.	9.7% / 6.7%
Panel B. University (reference: GRI)			
LPM, sub-programme FE	0.056*** (0.007)	−0.516*** (0.017)	0.007+ (0.004)
Logit, ministry FE (AME)	0.122*** (0.012)	—	0.012+ (0.006)
Project FE (same project)	0.068*** (0.015)	—	0.008* (0.004)
University × firm in project	—	—	0.001 (0.010)
N (LPM) / project clusters	18,448 / 10,471	13,833 / 7,496	14,342 / 7,828
Mean of dependent variable	0.221	18.36	0.090
Panel C. R^2 of each block entered alone			
Organizational type (university/GRI)	0.015	—	0.002
Ministry	0.351	—	0.069
Sub-programme	0.673	—	0.523

Note. 2024 NTIS records of joint and consigned participants in national R&D projects (41,929 records); estimation samples are university and GRI participations. Controls: firm in project, other public research actor in project, ln(consortium size), capital region, Daejeon and foreign participant. Standard errors clustered by upper-level project. Singleton groups (LPM) and groups without outcome variation (logit) are dropped, so N differs across models. Participation type is not recorded for consigned participants. ***p < .01, *p < .05, +p < .10.

4.8 Comparing the two regimes

Under the Joint Regulations, licensor identity alone explains 38.0% of the variance in royalties, licensor type 6.8% and field 1.3%; under the Innovation Act, sub-programme explains 52.3% of role designation and organizational type 0.2% (Table 10; Fig. 3). In both periods the unit applying the rules explains at least ten times more than technology or organizational category. Such units are numerous, so their R^2 is mechanically higher than a single dummy's, and the comparison should be read in orders of magnitude;

the within-programme estimates, which avoid this problem, agree. The reform changed where the rules come from, not who governs transfer.

Table 10
The locus of governance across the two regimes

Transfer outcome	**Regime I: Joint Regulations**	**Regime II: Innovation Act**
	Royalty level (ln royalty)	**Commercialization-role designation**
Technology field, R^2 alone	0.013	not applicable
Organizational type (university vs. GRI), R^2 alone	0.068	0.002
Rule-applying unit, R^2 alone	Licensor identity: 0.380	Sub-programme: 0.523
Rule-setting attributes, R^2 alone	Pricing regime and licensing mode: 0.067	Ministry: 0.069
Ratio of rule-applying unit to organizational type	≈ 6 : 1	> 100 : 1
Note. Unadjusted R^2 of each block entered alone, as in Fig. 3. Regime I: 2,252 licensing contracts; Regime II: university and GRI joint participations (commercialization role).		

Several robustness checks support these results. The foreign premium holds with clustering by licensor ($p = .004$), with regime and mode fixed effects ($\beta = 0.525$, $p = .027$) and for arm's-length third-party licences ($\beta = 0.902$, $p = .010$). It weakens within licensors ($\beta = 0.353$, $p = .073$) and in levels (PPML; Santos Silva & Tenreyro, 2006; $p = .116$). In the 2024 data the university effect is similar across linear, logit and same-project models (0.007–0.012) and does not depend on firm participation (0.001, SE = 0.010). Details of these and further checks are given in Online Resource 1 (Tables S4–S6).

5. Discussion and Conclusion

We set out to ask what the royalties earned on public technology actually price. The question matters because royalty income is widely read as a measure of commercial value, and because the case for field-specific collaboration incentives rests on the belief that value created during research carries through to licensing returns. Our results give little support to that belief. Across the four research questions, the evidence fits an institutional account better than a sectoral one: field differences reach the form of the contract but not its price, the government contribution is priced where the rules require it and hardly anywhere else, and the governance of transfer stayed with programmes after a major reform. In what follows we discuss what these findings add to theory, what they mean for how transfer performance is measured and supported, and where our design reaches its limits.

5.1 Theoretical contributions

Sectoral contingency is relocated, not eliminated. Where research-stage field differences are large, we cannot find them in price, yet field strongly shapes how a licence is paid, and field differences in price return in sales-linked contracts. Transfer thus acts as a two-step filter: upstream differences pass into contract form, while pricing rules compress them unless price follows the market. The boundary of sectoral-contingency theory (Busse et al., 2017) runs through the licensing contract, so studies that infer commercial value from knowledge-creation outcomes, or treat royalties as a uniform measure of success, should model contract form and price separately.

Public licensing prices are institutionally anchored. Licensing research sees payment terms and royalty rates as the outcome of two-party bargaining (Mendi, 2005; Sakakibara, 2010; Kani & Motohashi, 2012). In public R&D, the institutional setting supplies the reference point. The input named in the rules is priced where rules require it and nowhere else, the opposite of what the scale–quality account (Heisey & Adelman, 2011) predicts.

Licensor logic conditions discretionary anchoring. Only GRIs tie negotiated prices to the contribution, and to that input rather than to project size. When a licensor must account to a ministry for the return on an investment, that investment becomes the natural reference for price. This adds a licensor dimension to the contingent effectiveness model (Bozeman et al., 2015) and links it to work on publicness (Bozeman & Crow, 1990).

Institutional change consolidates rules without relocating governance. Transfer research usually treats reforms such as Bayh–Dole as incentive changes that alter what organizations do (Mowery et al., 2001; Grimaldi et al., 2011). Our comparison suggests another possibility. Korea's 2021 reform unified the formal rules, yet programmes still allocate transfer roles and organizational category explains almost none of this, as theories of institutional layering would expect (Streeck & Thelen, 2005; Mahoney & Thelen, 2010). Organizational logic matters, as H4 shows, but mostly in the room that programme and fee design leave open. Finally, the foreign premium is robust and similar across fields, consistent with field-specific advantages being realized in the knowledge produced but priced by a national system common to all fields (cf. Audretsch et al., 2014; Kalantaridis et al., 2017).

5.2 Implications for measuring transfer performance

If prices are anchored to rule-named inputs, any change in fee rules alters the make-up of royalty income, and so what the metric measures, even when commercial performance is unchanged. This has three implications. First, comparing total royalties before and after a reform says little about performance unless the figures are split by pricing regime; under formula pricing, which covers over a quarter of contracts, royalties reward public spending as well as output. Second, sales-linked income, the only component in which field and collaboration effects respond to the market, is the best indicator of commercial value and should be reported separately. Third, since programmes rather than organizational categories allocate transfer roles, university–GRI comparisons that ignore programmes credit organizations with what programme design produced.

5.3 Implications for policy and practice

Report transfer performance by pricing regime. Reporting royalties separately for formula, lump-sum and sales-linked contracts, with sales-linked income as the main indicator of commercial value, would make performance measures more informative at little cost and let reforms such as the 2021 Act be judged on the part of income that reflects value.

Treat fee rules as instruments of technology governance. Formulas that price technology by the public money spent on it leave field-specific value unpriced. Options include more sales-linked or milestone royalties in long-cycle fields such as BT, limiting formula pricing to direct implementation, and regular evaluation of how fee-rule changes affect the pricing of public technology.

Differentiate support by licensor and programme, not by field or organizational label. For GRIs, valuation guidelines that move negotiated prices toward market references, such as comparable deals and sales forecasts, could bring price closer to value. For universities, the priority is the capacity to use sales-linked terms when uncertainty is high. We see no basis for varying incentives for foreign and domestic partners by field. And since programme design allocates transfer roles, managers can assign them on partners' licensing records instead of assuming that GRIs are the natural commercialization partners.

5.4 Limitations and future research

The study has several limitations. The licensing data are cross-sectional, collaboration is not randomly assigned, and only licensed technologies are observed. The foreign subsample is small, the moderation tests detect only large differences, and the overlap sample (effective size 122) and the GRI lump-sum result (51 contracts) rest on few cases. The main limitation lies in the comparison. Because the regimes are observed through different outcomes, it shows that the locus of governance persisted after the reform, not that pricing patterns did, and it does not identify a causal effect of the reform. Post-reform contract data would allow a direct before–after test, and a difference-in-differences design using programmes whose fee provisions changed at different times could identify how rule changes affect royalty composition. The findings should apply most directly to coordinated systems with centralized programmes and licensing registries, such as Taiwan (Hsu et al., 2015); in decentralized systems such as the United States, anchoring theory predicts that field differences reappear in price. Future work could test whether field differences at the value-capture stage shrink as more licences are anchored, whether discretionary anchoring rises with licensor publicness, and whether changing the input named in fee rules alters royalty composition before commercialization.

5.5 Concluding remarks

This study began from a question that the literature has tended to take for granted. When a public laboratory licenses a technology, is it paid for what the technology is worth, or for what the rules tell the parties to count? Using Korean administrative records that span two governance regimes, licensing contracts from the first and consortium records from the second, we find that the answer lies largely with the rules. Field differences in collaboration value survive the transfer stage, but only in altered form. They shape how technologies are paid for rather than how much they earn, except where the price is allowed to follow sales. Fee rules and the licensor's own logic weigh more on the price of public

technology than the technology itself, and a major reform of public R&D governance left programmes, not organizational categories, in charge of who transfers it.

What sets the study apart is less any single estimate than the angle it takes. By observing the technology, the contract and the price together, and by following the same governance question across an institutional reform, it brings into view a part of technology transfer that is usually treated as background. Public technology, in short, is priced on its receipt rather than its invention. We hope that future research will treat the institutions that set these prices, and the ways in which they change, as a central object of study.

Declarations

Competing interests.

The author has no competing interests to declare.

Use of generative AI.

The author used Claude (Anthropic) to improve the language and structure of the manuscript and to assist with coding the estimation routines, and takes full responsibility for all content and analyses.

Author Contribution

The author was responsible for all aspects of this paper, including its conception, data acquisition, analysis, writing, and the collection of supplementary materials.

Data availability.

The licensing and participation records were obtained from the National Science and Technology Information Service (NTIS) of Korea under the provider's access conditions and cannot be redistributed by the author; researchers can apply to NTIS for access. Estimation code is available from the corresponding author on request; supplementary tests are reported in Online Resource 1.

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Figures

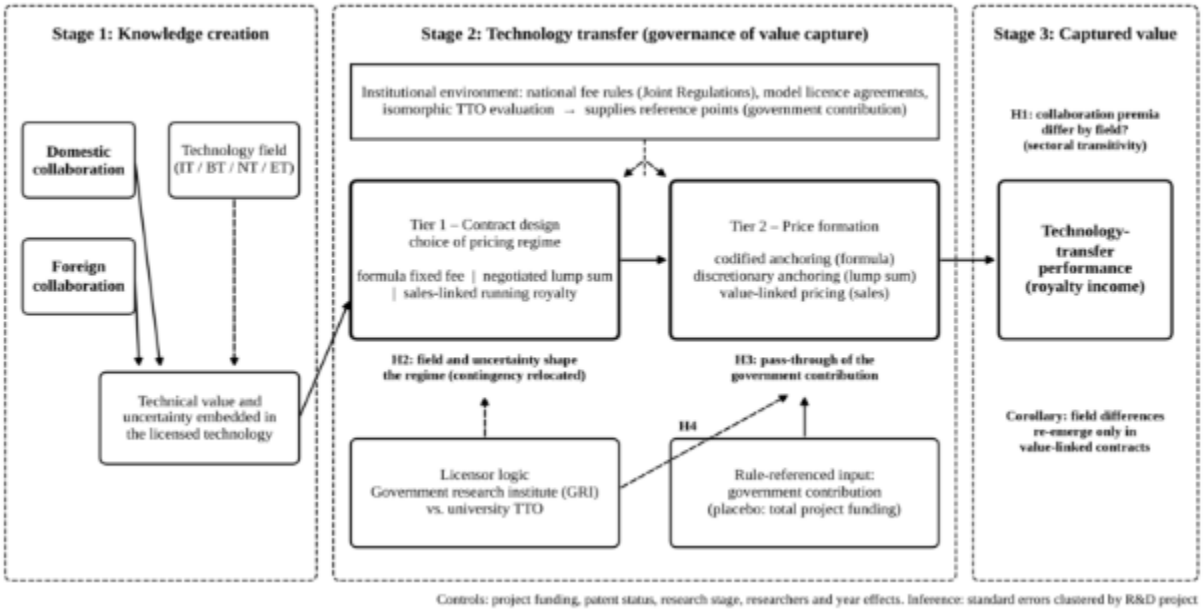


Figure 1

Two-tier model of the technology-transfer stage: contract design, price formation and licensor logic

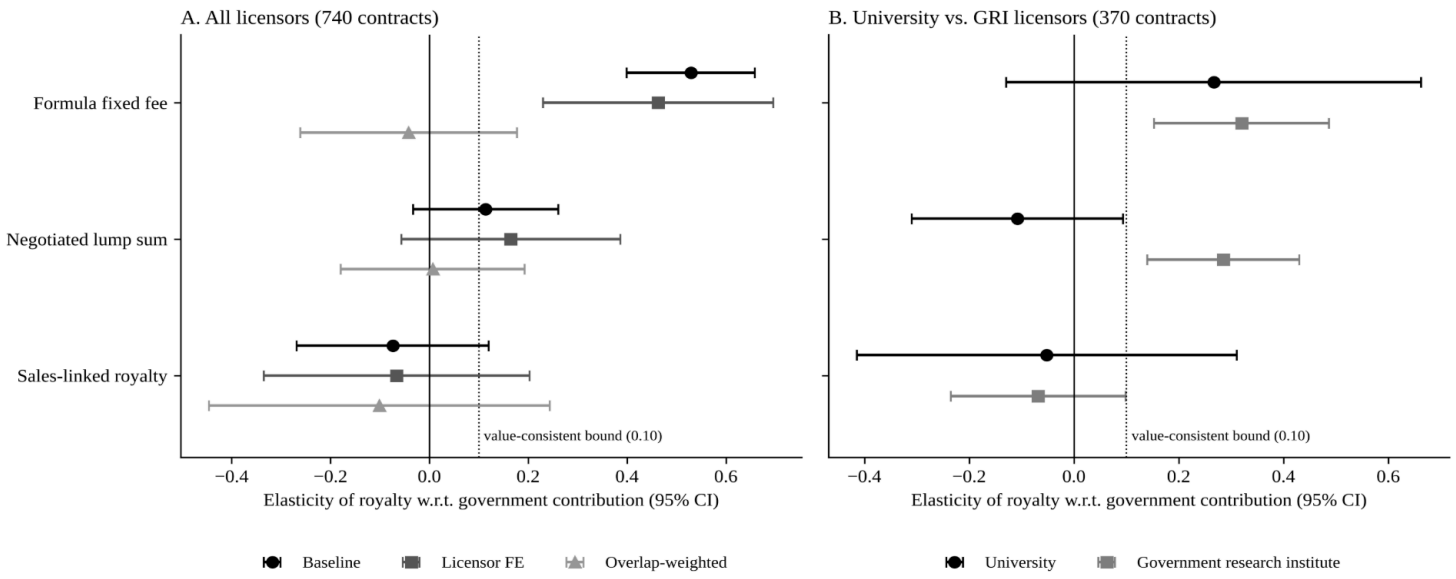


Figure 2

Elasticity of royalties with respect to the government contribution, by pricing regime (Panel A) and by licensor type (Panel B), with 95% confidence intervals

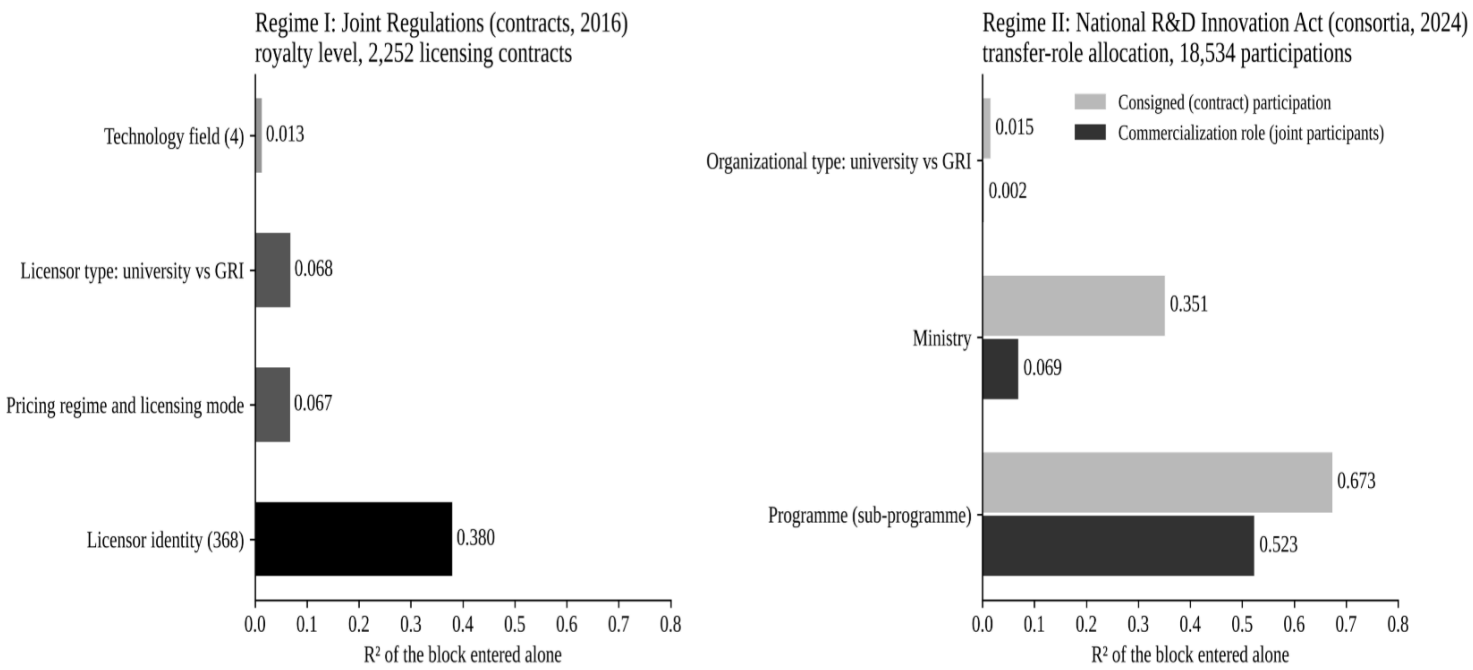


Figure 3

The locus of governance across two regimes: royalty levels under the Joint Regulations (left) and transfer-role allocation under the National R&D Innovation Act (right). Bars show the R^2 of each block of variables entered alone