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Design Right Commercialization by Public Technology Transfer Organizations: Disseminating design knowledge in regional innovation systems[1]

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Abstract

This study examines the commercialization of design rights owned by Japan's public technology centers, Kohsetsushi, focusing on the factors associated with their subsequent implementation by firms. This study conceptualizes commercialization as a translation process in which protected designs are converted into executable specifications and realized through firm implementation. Using an unbalanced panel of Kohsetsushi, the empirical analysis incorporates regional industrial conditions and treats consultation activity as a key explanatory factor. Because consultation may be endogenous to local demand conditions, this study applies a two-stage control-function approach that first relates consultation intensity to organizational resources and local industrial conditions and then estimates its association with implementation outcomes. The results indicate that consultation is positively associated with subsequent implementation in many industries, although the strength of this association varies across sectors. They also show that industrial agglomeration matters: denser ecosystems tend to raise baseline implementation capacity but often weaken the marginal association of consultation, likely because firms can rely on alternative coordination and problem-solving channels. These findings suggest that public support for design right commercialization is likely to be more effective when consultation capacity is allocated selectively and organized through functional specialization.

Keywords: design rights, technology transfer, consultation, innovation intermediaries, regional innovation systems, industrial agglomeration
JEL classification: O31; O34; O38; R11; L52

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1. Introduction

Design is increasingly central to competition, yet the economic returns to design protection are not automatic. Design rights secure legal exclusivity over visual and form-related features, but they do not by themselves ensure that a protected design becomes an implementable product, process, or market offering (Andersson et al., 2023; Montresor & Vezzani, 2020; Prendeville & Koria, 2022). Compared with technical inventions, designs are often more embodied and context dependent. Implementation therefore typically requires interpretation, iterative refinement, and coordination with manufacturing constraints, suppliers, and downstream partners. This implies a central role for innovation intermediaries that reduce ambiguity, frame problems, and orchestrate coordination across heterogeneous actors through prototyping, testing, and production-related adjustments (Caloffi et al., 2023; Zhang & Liu, 2024; Noviaristanti et al., 2024). Against this backdrop, this study examines a less explored case: design rights associated with public-sector technology intermediaries and the intermediation processes that connect protection to firm implementation.

Japan's Kohsetsushi (public technology centers) are regionally embedded public innovation intermediaries that function as technology transfer organizations (TTOs) in a broad sense. Viewing Kohsetsushi through a TTO lens clarifies the mechanism of interest: translation-oriented intermediation that links protected designs to firm implementation through consultation and facility-based support (Pittelko et al., 2023). In practice, this translation work elicits production and sourcing constraints, converts protected forms into executable specifications, and coordinates iterative adjustments with relevant partners. Prior work links Kohsetsushi to technology transfer outcomes and firm performance, but design-related channels and sectoral boundary conditions remain under-theorized (Fukugawa, 2024). This study therefore treats consultation as a translation mechanism through which repeated interaction converts dispersed needs into actionable problem definitions and executable specifications, increasing the likelihood that protected designs are implemented by firms.

Intermediation is also shaped by local production ecosystems. Because industrial agglomeration can either enhance execution capacity or provide substitutes for public problem-solving, the marginal effect of consultation on design implementation may vary with local industrial density and across industries. This study therefore evaluates consultation effects conditional on agglomeration.

Empirically, this study constructs an unbalanced panel of Japan's Kohsetsushi covering 2000–2024 and estimates a two-stage framework that addresses endogeneity in consultation activity. The first stage uses variation in organizational resources (including budget

allocation) to predict consultation, reflecting the view that organizational capacity is a core driver of intermediation activity. The second stage explains subsequent implementation outcomes and evaluates how industrial agglomeration conditions consultation effects. To ensure that findings are not an artifact of the survey-administration change and the associated shift in reporting units, the empirical design allows key slopes to differ across data periods via data-period interactions, and it assesses sensitivity to alternative constructions of the agglomeration series.

This study contributes in three ways. First, it advances a translation-based interpretation of design right commercialization that links implementation to relational intermediation rather than to legal protection alone. Second, it provides sector-by-sector evidence that local industrial density most often attenuates consultation's marginal effect on implementation—consistent with agglomeration acting as a substitute channel—while also identifying the industries and periods in which density instead complements consultation. Third, it strengthens credibility by directly testing robustness to survey-regime differences through period-varying coefficients with a clear measurement rationale, and by evaluating whether the main interaction pattern persists when agglomeration is measured only in benchmark years.

The remainder of the paper is structured as follows. Section 2 develops the theoretical framework by clarifying consultation as the core intermediation mechanism and proposing hypotheses on consultation and agglomeration as conditioning context. Section 3 describes the data and empirical strategy. Section 4 reports estimation results, Section 5 discusses implications for theory and policy, and Section 6 concludes.

2. Theoretical framework and hypotheses

2.1. Design right commercialization as a translation problem

This study conceptualizes the commercialization of design rights as a translation process in which protected designs are converted into executable specifications and realized through subsequent implementation by firms. Because designs are often embodied, symbolic, and context dependent, their economic value depends on how aesthetic and functional attributes are interpreted, aligned with manufacturing constraints, and adjusted through iterative feedback. Design rights can remain unused when firms cannot connect protected forms to feasible production, marketing, and supply-chain execution (Schartinger, 2023; Hur et al., 2024; Prendeville & Koria, 2022).

This translation view aligns with research on knowledge boundaries: when actors hold different interpretations and interests, effective transfer requires translating meanings and, at times, transforming practices through iterative coordination (Carlile, 2004). In regional innovation systems, such coordination is often provided by intermediary organizations that bridge informational, capability, and incentive gaps (Caloffi et al., 2023; Feser, 2023; Cosenz et al., 2023; Kitagawa et al., 2025). Japan's Kohsetsushi are particularly relevant

intermediaries because they combine proximity to local firms with access to technical facilities and accumulated problem-solving routines, and prior work characterizes public technology centers as important actors in regional and sectoral innovation systems for small-firm support and knowledge dissemination (Fukugawa, 2016; Pittelko et al., 2023).

This perspective implies heterogeneity across industries. Where design tasks are tightly coupled with production processes, translation may require deeper technical iteration; where design tasks are more modular and separable, such as packaging and labeling, translation may rely more on coordination with external suppliers (Nakamura & Matsumoto, 2009; Lee, 2020), consistent with the logic that modular architectures reshape where coordination burdens sit and how tasks can be partitioned (Baldwin & Clark, 2000). As a result, the same intermediary activity can have different marginal effects across sectors.

Taken together, this perspective implies that intermediation in design right commercialization is less about information transfer than about translation work that renders context-dependent design knowledge executable. Intermediaries reduce boundary frictions by aligning meanings and functional requirements, incorporating manufacturing and sourcing constraints into specifications, and enabling iterative coordination across actors, thereby opening pathways to implementation. Because the burden and locus of this translation work vary with sectoral conditions—such as modularity, coupling with production, and dependence on complementary resources—the marginal effect of intermediation should differ across industries.

2.2. Consultation as relational infrastructure for translation

Consultation is the primary channel of Kohsetsushi intermediation because it is the recurring interface through which tacit constraints are surfaced, options are specified, and partners are coordinated (Fukugawa & Goto, 2016). Importantly, consultation is not limited to downstream troubleshooting after rights are obtained (Fukugawa, 2009): by specifying implementability requirements upstream, it can steer search and design choices toward feasible options and thereby shape what ultimately gets protected into more implementable design rights. Through iterative interaction, consultation clarifies otherwise tacit requirements and coordination needs and helps translate design ideas into executable, partner-compatible specifications, thereby raising subsequent implementation. Accordingly, more intensive consultation should raise subsequent implementation by making protected designs more executable and coordination-ready.

Hypothesis 1 (H1): Kohsetsushi with more active consultation achieve greater design right commercialization (that is, more subsequent implementation).

2.3. Design activity as a flow that generates implementable opportunities

In addition to translation capacity, commercialization also depends on the availability of design opportunities that can enter an implementation pipeline. This study therefore treats

design activity as a flow rather than a stock. Annual design right applications capture contemporaneous design search and project initiation, arising from interactions with local firms as well as Kohsetsushi's own exploratory efforts (Ikeuchi & Motohashi, 2020). Higher application flows expand the set of current projects that consultation can screen and specify for implementation, and upstream consultation can also shift the composition of this flow toward more implementable projects by shaping early problem definition and constraint recognition.

This framing clarifies why stock-based measures can be less informative for outcomes tied to current implementation: accumulated rights may include dormant or obsolete designs and may primarily reflect past rather than ongoing design search (Schartinger, 2023; Schartinger & Barber, 2025). By contrast, application flows more directly capture current design activity and are therefore a more appropriate measure of the contemporaneous pipeline from which implementation can emerge.

2.4. Agglomeration as a boundary condition: complementarity versus substitution

Differences in local industrial agglomeration can change not only the intensity but also the content of consultation, shifting requests from feasibility and manufacturing translation to partner search and coordination. Accordingly, this study treats agglomeration as a boundary condition that moderates the consultation–implementation relationship: local industrial density can strengthen or weaken the marginal effect of consultation on subsequent implementation, and the direction of moderation is expected to vary across industries.

Local industrial agglomeration can condition translation and implementation through two competing channels. First, agglomeration can complement consultation by expanding execution capacity: dense local ecosystems provide accessible subcontractors, prototyping partners, specialized suppliers, and experienced labor. In such contexts, consultation can mobilize local resources more readily, accelerate iteration, and reduce search frictions, increasing the marginal effect of consultation on implementation. This logic aligns with micro-foundations of agglomeration based on sharing, matching, and learning mechanisms (Duranton & Puga, 2004; Bolter & Robey, 2020; Grover et al., 2023).

Second, agglomeration can substitute for consultation or attenuate its marginal contribution. Thick ecosystems can support alternative diffusion and coordination channels—such as repeated transactions within buyer–supplier networks and the presence of specialized private service providers—that reduce the need for public intermediary coordination (Kawakubo & Suzuki, 2025; Selviaridis & Spring, 2025). Agglomeration may also generate congestion and other density-related costs, raising coordination costs and diminishing the incremental value of consultation (Duranton & Puga, 2004; Koster & Thisse, 2024). Which channel dominates is expected to vary across industries, depending on sectoral conditions that shape where coordination burdens sit—such as the degree of modularity versus tight coupling with production and the reliance on external complementary resources—and on

whether innovation relies more on interactive, practice-based learning versus more formalized knowledge production (Hädrich, Reher, & Thomä, 2024). Accordingly, the consultation–agglomeration interaction is not expected to be uniformly positive; it can amplify or dampen consultation's marginal effect, producing sectoral heterogeneity.

Hypothesis 2 (H2): Industrial agglomeration moderates the effect of consultation on commercialization, with the direction of the interaction depending on sectoral conditions.

3. Method

Data

This study constructs a panel of technology transfer activities of Kohsetsushi covering 2000–2009 and 2012–2024. The data span a single survey-regime change that simultaneously altered both survey governance and reporting practice: the AIST-administered surveys for 2000–2009 include many branch-level reports and also cover non-industrial public research centers (agriculture, forestry, fisheries, and environmental health), whereas the 2012–2024 surveys administered by the Council of Directors of Public Industrial Research Institutes largely report at the headquarters level and focus on industrial centers only. The survey was not conducted in 2010–2011, so the data are missing for those years.

Chow tests detect no statistically significant breaks for equipment expenditures or design rights but indicate significant differences for operating expenditures, patents, consultation activity, employment, and several other variables. This pattern suggests that the survey-regime change may affect the measurement and comparability of some variables—especially consultation—given the concurrent shift from branch-level reporting to headquarters-consolidated reporting. Accordingly, the empirical strategy explicitly accounts for this regime change and assesses robustness to potential measurement inconsistency, as described in the Model and Robustness checks subsections.

Establishment-based agglomeration measures are constructed from benchmark years in the Census of Manufacture for the full-coverage rounds (2000, 2003, 2005, 2008) and from the Economic Census for Business Activity (2012, 2016, 2021) for later benchmark years. Because these benchmarks are widely spaced, intercensal years are populated using a stepwise (piecewise-constant) function that carries forward the most recent benchmark value.

Variables

A main explanatory variable is the flow of newly registered design rights for each

Kohsetsushi (the annual count of newly registered design rights), rather than a stock measure. This choice reflects the time-sensitive nature of design-right commercialization: if a design right is not licensed or transferred soon after registration, its commercial value can erode as similar designs diffuse in the market. Recent additions are therefore more informative than long-accumulated stocks for capturing near-term implementation linkages.

Consultation activity is measured by the number of problems consulted with each Kohsetsushi. Design-specific consultation counts are not available at the Kohsetsushi level, so this study uses total consultations as a proxy for consultation capacity and engagement. Prior research suggests that design-related cases account for only about 7% of problems brought to Kohsetsushi (Fukugawa & Goto, 2016), implying that this proxy contains substantial non-design activity.

Regional industrial agglomeration is measured by the number of establishments in each sector and prefecture. Establishment counts capture local industry scale, reflecting both the thickness of the potential client base and channels for labor pooling, learning, and transaction-based spillovers. Establishment counts are preferable to employee- or sales-based measures in this setting because the latter tend to overweight large firms, even though large firms are not necessarily the primary users of Kohsetsushi services. By contrast, establishment counts better represent the breadth of the local SME population—the core client base for Kohsetsushi—thereby aligning the agglomeration proxy with the institutional reach and demand structure of public consultation and testing services.

Organizational size is measured by technical staff employment, and an incorporation dummy indicates whether the Kohsetsushi is organized as a local independent administrative agency (time-varying because incorporation is discretionary for local governments).

Consultation activity is potentially endogenous because it responds to local industrial demand conditions that may also affect commercialization outcomes. This study instruments consultation using the Kohsetsushi's annual budget allocation earmarked for technology transfer activities (e.g., consultation, training, and workshops). The empirical analysis implements a two-stage control-function (2SRI) approach. Specifically, consultation is first predicted using the instrument and controls, and the residual component is then included in the outcome equation to correct for endogeneity.

To map hypotheses to estimation, H1 is tested by the marginal effect of consultation on the one-period-ahead number of design rights currently being implemented. H2 is tested by the interaction term (Consultation × Agglomeration), which captures whether local industrial density amplifies or attenuates the marginal effect of consultation, with inference based on the control-function correction.

Model

The outcome is a count variable with substantial overdispersion, so this study estimates fixed-effects negative binomial models, identifying effects from within-Kohsetsushi variation over time. To examine whether consultation translates local industrial agglomeration into realized commercialization, the specification includes an interaction between consultation and the sector-specific agglomeration measure (Consultation × Agglomeration). Because consultation is treated as endogenous, the control-function correction is extended to this interaction structure by including the first-stage residual and its interaction with agglomeration in the outcome equation.

Robustness checks

To address measurement concerns arising from the survey-regime and reporting-unit change around 2012, this study re-estimates the second-stage specification allowing period-varying slopes by fully interacting a post-2012 indicator with consultation, agglomeration, their interaction, and the corresponding control-function residual terms (Table 4). The triple interaction (post-2012 × Consultation × Agglomeration) directly tests whether the consultation–agglomeration moderation pattern changes after the regime shift.

To assess whether the core interaction results are sensitive to the construction of the agglomeration series, the study re-estimates the second-stage models using only benchmark years with observed establishment counts (i.e., without assigning values to intercensal years; Table 5). This benchmark-year-only design provides a direct check that the estimated consultation–agglomeration moderation pattern is not mechanically driven by interpolation or post-benchmark extensions. Because restricting the sample reduces the usable observations, these estimates are expected to be less precise.

Descriptive statistics for all variables are reported in Table 1.

Table 1

4. Results

First-stage results (Table 2)

Table 2 reports first-stage regressions linking institutional resources and regional industrial structure to Kohsetsushi consultation activity. Across industries, the budget allocation for technology transfer is positive and statistically significant. This uniform pattern indicates that consultation is strongly resource-driven: better-funded centers can sustain staffing, outreach, and follow-up, and therefore generate a higher volume of consultation engagements.

Design-related activity and organizational scale also exhibit broadly positive associations with consultation, although the strength of evidence varies across industries. Design right applications are positive in most industries and are statistically significant in many, with a small number of sectors in which the association is weaker or not statistically

distinguishable from zero. Technical staff employment is likewise positive and statistically significant in several industries, while remaining imprecisely estimated in others, indicating that staffing scale contributes to consultation volume but does not fully account for its cross-sector variation.

Regional industrial agglomeration, measured by establishment counts, shows clear sectoral heterogeneity in the first stage. These patterns are informative about both the correlates of consultation intensity and a suggestive pathway through which local industrial structure may shape subsequent implementation by affecting consultation activity (agglomeration → consultation → implementation), even though the core empirical tests focus on moderation in the second stage (the consultation–agglomeration interaction). In ceramics, agglomeration is strongly and positively associated with consultation, consistent with the idea that a thick local production base generates recurring practical problems and more opportunities for intermediary support. A similar positive association appears in textiles, where dense producer and subcontractor networks can generate frequent incremental modification needs that are suited to consultation-based support. In contrast, rubber shows a negative and statistically significant agglomeration coefficient, consistent with substitution mechanisms in dense clusters—such as established supplier relations, in-house troubleshooting, and diffusion of practical know-how within tightly connected local networks. In several other industries, agglomeration coefficients are comparatively small and often statistically weak, indicating that density does not uniformly translate into higher consultation volume and that sector-specific problem structures and alternative channels matter.

Instrument diagnostics indicate that excluded-instrument F statistics are generally around 7–9, with p-values below conventional significance thresholds. Because these first-stage F statistics fall below the common rule-of-thumb threshold of 10, the study interprets subsequent causal estimates with caution and places greater weight on robustness checks. Overall, Table 2 indicates that consultation is anchored primarily in institutional resources, while the agglomeration–consultation link differs meaningfully across industries.

Table 2

Second-stage results (Table 3)

Table 3 reports industry-by-industry second-stage estimates for one-period-ahead implementation of Kohsetsushi design rights. The coefficient on consultation is positive and statistically significant in most industries, indicating that higher consultation activity is associated with stronger subsequent implementation outcomes, although the magnitude varies substantially across sectors. The estimated association is especially large in foods and ceramics and is also sizeable in several machinery-related industries. In contrast, the consultation coefficient is statistically indistinguishable from zero in textiles, leather, and ICT, underscoring meaningful cross-industry heterogeneity in how intermediary support

translates into implementation.

Agglomeration, captured by establishment-based scale, is positively and statistically significantly associated with baseline implementation in most industries, consistent with the idea that denser production environments provide thicker supply chains and complementary capabilities that facilitate implementation. At the same time, the Consultation × Agglomeration interaction is negative and statistically significant in most sectors, implying that the marginal association between consultation and implementation tends to weaken as local industrial density increases. This pattern is consistent with substitution and saturation mechanisms: in more agglomerated regions, alternative problem-solving and diffusion channels—such as established supplier networks, lead-firm coordination, specialized private services, and informal learning—may reduce the incremental contribution of public consultation at the margin, and congestion or coordination costs in dense settings may further limit marginal gains.

The control-function terms indicate that accounting for endogenous consultation matters in several industries. The residual from the first-stage consultation equation (Uhat) is negative and statistically significant in many sectors, suggesting that "unexpectedly high" consultation intensity (relative to what is predicted by the instrument and controls) is associated with lower subsequent implementation. This pattern is consistent with selection into consultation, in which more difficult projects or more constrained environments demand more support yet are less likely to succeed. Meanwhile, the Uhat × Agglomeration interaction is positive and statistically significant in many industries, suggesting that dense regional capabilities partially mitigate this difficulty-related selection and help challenging cases translate into implementation when local ecosystems are sufficiently thick to absorb and operationalize intermediary inputs. In industries where Uhat and its interaction are imprecisely estimated (e.g., leather, textiles, and ICT), the data provide less precise evidence on the role of selection into consultation.

Among controls, design right applications are positive and highly significant across all industries, and technical staff employment is broadly positive and significant, highlighting the importance of contemporaneous design activity and internal technical capacity. The incorporation indicator is positive across industries and statistically significant in most, consistent with stronger organizational readiness and execution capacity after incorporation.

Overall, Table 3 supports H1 in a sector-contingent sense: consultation appears to operate as translation capacity, but its relevance is not universal across industries. For H2, the evidence is broadly consistent with agglomeration acting primarily as a boundary condition that often attenuates the marginal role of consultation, while still leaving room for sector-specific deviations that reflect differences in alternative coordination infrastructures and

complementary local assets.

Table 3

Robustness to survey-regime change (Table 4)

Table 4 examines whether the second-stage relationships are sensitive to the survey-regime and reporting-unit change around 2012. The specification introduces a post-2012 indicator (dataperiod) and fully interacts it with consultation, agglomeration (establishments), and their interaction (Consultation × Agglomeration). Consistent with the 2SRI design, the same post-2012 interaction structure is also applied to the residual-based correction terms, allowing selection patterns and their interaction with agglomeration to differ across periods. Across industries, the dataperiod main effect is generally imprecise with extremely large standard errors, indicating that the regime change does not manifest as a common level shift in implementation outcomes. Period dependence instead appears primarily through slope changes—changes in how consultation and agglomeration relate to implementation after 2012.

The post-2012 slope shift in consultation (dataperiod × consultation) is statistically significant in only a limited subset of industries and is not uniform in sign. It is positive and significant in beverage, foods, petroleum, lumber, and ceramics, indicating a stronger consultation–implementation association in the later period for these sectors, whereas it is negative and significant in electronic components, indicating a weaker association after 2012 in that sector. In many other industries, the interaction is statistically weak, suggesting limited evidence of a systematic regime shift in the consultation slope.

For agglomeration, the post-2012 slope shift (dataperiod × est) is negative and statistically significant in several industries, including leather, ICT, petroleum, and electronic machinery, implying that the baseline density–implementation association becomes weaker in the later period in these sectors. In most remaining industries, the estimates are imprecise, again pointing to the absence of a uniform post-2012 pattern across the economy.

Most importantly, the triple interaction (dataperiod × consultation × est) tests whether the moderation pattern itself changes after 2012—namely, whether agglomeration becomes more or less likely to attenuate the marginal association between consultation and implementation. The triple interaction is positive and statistically significant in leather and ICT, implying that the attenuation effect becomes weaker (i.e., the interaction becomes less negative) in the later period in these industries. In contrast, the triple interaction is negative and statistically significant in beverage, petroleum, lumber, and ceramics, implying that agglomeration more strongly attenuates the marginal association between consultation and implementation after 2012 in these sectors. For most other industries, the triple interaction is not statistically distinguishable from zero, indicating no clear evidence that the moderation pattern changed with the regime shift.

Finally, the post-2012 interaction involving the residual-based correction term (dataperiod × uhat × est) is statistically significant in only a subset of industries—most clearly leather, textiles, and nonferrous—suggesting that selection into consultation, and its dependence on agglomeration, may differ across periods in some sectors but does not shift uniformly.

Overall, Table 4 indicates that the main findings are not driven by a simple pre-2012 versus post-2012 discontinuity in outcome levels. Instead, the regime change is associated with industry-specific slope shifts, including changes in (i) the consultation–implementation relationship, (ii) the baseline agglomeration–implementation association, and (iii) how agglomeration conditions the marginal association between consultation and implementation. This supports the interpretation that the role of consultation and agglomeration in design-right implementation is fundamentally sector dependent rather than an artifact of a single regime break.

Table 4

Robustness to non-interpolated agglomeration (Table 5)
Table 5 re-estimates the second-stage models using non-interpolated agglomeration measures and restricts the sample to benchmark years with observed establishment counts. In the baseline specification (Table 3), benchmark values are carried forward to intercensal years; Table 5 instead uses only years in which establishment data are directly observed. This restriction sharply reduces the usable sample and, as expected, lowers, with larger standard errors and less uniform statistical significance across industries.

Despite the loss of precision, the central moderation pattern remains consistent with the baseline results. The coefficient on the consultation–agglomeration interaction (Consultation × Establishments) is negative in every industry reported in Table 5, indicating that the marginal association between consultation and implementation is weaker in more agglomerated local industrial environments. The negative interaction is statistically significant in several industries, and it is particularly pronounced in high-effect sectors such as ceramics, foods, and petroleum.

The main effect of consultation is also broadly aligned with the baseline, although estimates are less precise. Consultation remains positive and relatively large in publishing, foods, petroleum, and ceramics, while in several industries where consultation is statistically significant in Table 3, the corresponding coefficients in Table 5 become statistically weaker. Given the substantial reduction in sample size, this attenuation is consistent with reduced statistical power rather than a reversal in the underlying relationship.

Overall, Table 5 supports the interpretation that the key conclusion from Table 3—consultation is positively associated with implementation, but its marginal association is

attenuated in more agglomerated settings—does not hinge on interpolating establishment counts or extending benchmark values to intercensal years.

Table 5

5. Discussion

This study reframes design right commercialization as a translation problem and conceptualizes a public intermediary's consultation as relational infrastructure that renders protected forms executable under production, sourcing, and coordination constraints (relevant to H1). In this framing, the bottleneck lies less in protection per se and more in the boundary work required to convert protected form into implementable specifications across heterogeneous actors. This translation lens links design protection to intermediation research by specifying a micro-mechanism—constraint elicitation, problem stabilization, and iterative coordination—through which public intermediaries can affect commercialization even when the protected object is primarily form-related.

A second implication is that agglomeration is best treated as a boundary condition on the marginal returns to intermediation, not only a determinant of baseline feasibility (relevant to H2). Dense ecosystems can simultaneously expand complementary assets and provide alternative coordination infrastructures that perform similar translation functions, thereby weakening the incremental contribution of public consultation at the margin. Distinguishing these enabling and substitutive roles clarifies why regional thickness can support implementation while attenuating measured consultation effects, without implying that intermediaries "do not matter" in dense regions.

These findings motivate cautious program-design hypotheses. If agglomeration can reduce the marginal payoff to consultation scale, uniform expansion of consultation volume is unlikely to be efficient. A more defensible implication is targeting and specialization: in thinner ecosystems, consultation is more plausibly deployed to relax binding coordination constraints where alternatives are limited, whereas in denser ecosystems incremental gains are more likely to come from specializing consultation content toward high-complexity tasks (e.g., testing and validation, compatibility work, and partner matching) rather than increasing case volume. For managers of public and hybrid intermediaries, the practical decision is how to allocate scarce consultation capacity across service lines and ecosystems, using the translation lens to prioritize bottlenecks where intermediary input is most consequential.

6. Conclusion

This study's contribution is conceptual and managerial. It advances a translation-based view of design right commercialization in which the central challenge is rendering protected forms executable under real production and coordination constraints, and it positions public consultation as relational infrastructure that performs boundary work across actors rather

than as generic "support intensity." By separating translation from protection, and marginal intermediation returns from baseline feasibility, the framework provides an operational vocabulary for engineering management: consultation can be managed as a scarce translation capability that is allocated and specialized according to ecosystem conditions, rather than scaled mechanically as an activity target.

This study also has limitations that motivate next-step research. First, consultation is measured as an aggregate proxy and cannot distinguish case mix, difficulty, or translation stage; future work should use case-linked data that records triage, specification, prototyping and testing, and partner coordination to test translation mechanisms directly. Second, the data do not observe licensee breadth, which may be more informative than agreement counts in diffusion-oriented industries; future datasets should distinguish licensing agreements from the number and type of adopters. Third, prefecture-level establishment counts are a coarse ecosystem proxy; future research should incorporate finer measures of complementary assets and coordination infrastructures (buyer–supplier structure, lead-firm presence, skills, and private design-service availability) to identify which components substitute for or complement public consultation. Fourth, while the control-function design addresses endogeneity, instrument strength is moderate in some sectors; complementary designs using policy shocks, quasi-experimental variation, and administrative linkage from consultation to implementation outcomes would strengthen causal claims.

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Table 1 Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Design right implemented	2,070	0.308	1.239	0.000	15.000
Log consultation	2,245	7.509	1.789	0.000	11.861
Log design right application	2,012	0.039	0.205	0.000	2.773
Log technical staff	2,265	3.325	0.912	0.000	5.591
Incorporation	2,296	0.060	0.237	0.000	1.000
Agglomeration index (Log establishments)					
Rubber	2,293	3.558	1.361	0.000	6.203
Other	2,293	5.105	0.879	3.219	7.818
Leather	2,293	2.648	1.497	0.000	6.608
Pulp	2,293	4.715	1.094	1.946	7.017
Plastic	2,293	5.348	1.206	2.944	7.661
Publishing	2,293	5.464	0.995	3.332	8.462
Beverage	2,293	4.520	0.617	2.773	6.711
Chemicals	2,293	4.311	0.981	1.609	7.107
Furniture	2,293	5.038	0.883	2.773	6.757
Metal	2,293	6.212	1.029	4.263	8.578
ICT	2,293	3.109	1.307	0.000	6.045
Foods	2,293	6.475	0.619	4.997	7.818
Petroleum	2,293	3.052	0.626	1.609	4.905
Textiles	2,293	4.896	1.350	1.386	7.573
Steel	2,293	4.216	1.032	1.946	6.641
Electrical machinery	2,293	5.052	1.127	2.197	7.351
Electronics components	2,293	4.325	1.110	0.000	6.653
Nonferrous	2,293	3.645	1.278	0.000	6.028
Lumber	2,293	5.130	0.787	2.079	6.407
Transportation	2,293	5.070	1.284	2.079	7.820
Ceramics	2,293	5.597	0.707	3.367	7.294

Notes

Log of establishments by industry.

Number of observations varies due to missing years 2010–2011 and item nonresponse.

Table 2. First-stage estimation results: determinants of consultation activity

industry	TT budget	Design right application	Technical staff	Incorporation	est	_cons	N	Adj_R2	F (excluded IV)	p-value (excluded IV)
Rubber	0.152***	0.131*	0.393*	0.047	-0.406**	5.690***	2222	0.8	7.592	0.007
	(0.055)	(0.068)	(0.221)	(0.205)	(0.167)	(1.007)				
Other	0.159***	0.124*	0.371*	0.059	-0.274	5.648***	2222	0.799	8.167	0.005
	(0.056)	(0.063)	(0.222)	(0.208)	(0.277)	(1.821)				
Leather	0.154***	0.127**	0.378*	0.057	-0.005	4.263***	2222	0.799	7.002	0.009
	(0.058)	(0.062)	(0.227)	(0.209)	(0.114)	(1.197)				
Pulp	0.154***	0.131**	0.379*	0.063	0.179	3.372	2222	0.799	7.302	0.008
	(0.057)	(0.061)	(0.224)	(0.207)	(0.366)	(2.226)				
Plastic	0.177***	0.130**	0.360	0.104	0.968**	-1.190	2222	0.8	9.364	0.003
	(0.058)	(0.059)	(0.222)	(0.219)	(0.439)	(2.724)				
Publishing	0.154***	0.120**	0.375*	0.048	-0.218	5.488*	2222	0.799	7.421	0.007
	(0.057)	(0.059)	(0.225)	(0.210)	(0.478)	(2.890)				
Beverage	0.154***	0.128**	0.379*	0.057	0.032	4.096**	2222	0.799	7.313	0.008
	(0.057)	(0.065)	(0.224)	(0.208)	(0.277)	(1.730)				
Chemicals	0.156***	0.124*	0.377*	0.047	-0.306	5.537***	2222	0.799	7.427	0.007
	(0.057)	(0.065)	(0.223)	(0.207)	(0.267)	(1.557)				
Furniture	0.155***	0.122**	0.377*	0.041	-0.147	5.011***	2222	0.799	7.444	0.007
	(0.057)	(0.060)	(0.223)	(0.215)	(0.265)	(1.816)				
Metal	0.152***	0.146**	0.367*	0.097	0.720*	-0.236	2222	0.799	7.038	0.009
	(0.057)	(0.059)	(0.221)	(0.218)	(0.416)	(2.862)				
ICT	0.153***	0.128**	0.380*	0.055	-0.025	4.331***	2222	0.799	7.275	0.008
	(0.057)	(0.063)	(0.225)	(0.209)	(0.109)	(1.010)				
Foods	0.154***	0.127**	0.379*	0.057	-0.021	4.378*	2222	0.799	7.299	0.008
	(0.057)	(0.062)	(0.225)	(0.210)	(0.346)	(2.568)				
Petroleum	0.157***	0.133**	0.380*	0.073	0.309	3.257***	2222	0.799	7.537	0.007
	(0.057)	(0.063)	(0.225)	(0.208)	(0.189)	(1.127)				
Textiles	0.166***	0.103	0.374*	-0.019	0.208**	3.177***	2222	0.8	9.485	0.002
	(0.054)	(0.064)	(0.220)	(0.205)	(0.083)	(1.107)				
Steel	0.151***	0.121*	0.379*	0.052	-0.199	5.107***	2222	0.799	7.167	0.008
	(0.056)	(0.064)	(0.223)	(0.210)	(0.251)	(1.592)				
Electrical machinery	0.154***	0.123*	0.376*	0.054	-0.165	5.105***	2222	0.799	7.446	0.007
	(0.057)	(0.066)	(0.223)	(0.208)	(0.338)	(1.938)				
Electronics components	0.152***	0.128*	0.370	0.051	-0.120	4.818***	2222	0.799	7.354	0.008
	(0.056)	(0.065)	(0.224)	(0.207)	(0.178)	(1.321)				
Nonferrous	0.153***	0.129**	0.380*	0.060	-0.045	4.411***	2222	0.799	7.052	0.009
	(0.058)	(0.063)	(0.224)	(0.212)	(0.198)	(1.276)				

industry	TT budget	Design right application	Technical staff	Incorporation	est	_cons	N	Adj_R2	F (excluded IV)	p-value (excluded IV)
Lumber	0.157*** (0.056)	0.153** (0.066)	0.384* (0.223)	0.048 (0.207)	0.502 (0.329)	1.476 (2.106)	2222	0.799	7.854	0.006
Transportation	0.154*** (0.056)	0.125* (0.067)	0.363 (0.227)	0.040 (0.205)	-0.167 (0.259)	5.137*** (1.916)	2222	0.799	7.4	0.007
Ceramics	0.167*** (0.056)	0.127** (0.053)	0.352 (0.216)	0.064 (0.207)	1.394*** (0.399)	-3.855 (2.498)	2222	0.801	8.887	0.003

Notes

Dependent variable is log consultation (log of the number of problems consulted with each Kohsetsushi).

Key explanatory variable is the technology transfer (TT) budget: the Kohsetsushi's annual budget allocation earmarked for technology transfer activities (e.g., consultation, training, workshops).

Agglomeration (Est.) is measured by the number of establishments in the relevant sector and prefecture.

Standard errors are clustered at the Kohsetsushi level and reported in parentheses.

Statistical significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 3. Second-stage estimation results: consultation, agglomeration, and design-right implementation (control-function)

industry	consult	est	consult_x_est	uhat	uhat_x_est	Design app	Tech staff	incorporation	_cons	N	LogLik	chi2
Rubber	1.588***	3.794***	-0.447***	-1.540**	0.407**	0.578***	1.119**	0.653**	-20.064***	581	-559.84	108.9
	(0.579)	(1.369)	(0.139)	(0.754)	(0.195)	(0.117)	(0.453)	(0.260)	(4.722)			
Other	2.565***	3.248**	-0.457***	-2.761**	0.474**	0.467***	1.190**	0.727***	-25.367***	581	-556.52	115.69
	(0.874)	(1.297)	(0.138)	(1.134)	(0.198)	(0.119)	(0.473)	(0.275)	(6.809)			
Leather	0.638	2.059***	-0.249***	-0.119	0.023	0.580***	1.236***	0.807***	-12.472***	581	-557.92	113.36
	(0.414)	(0.690)	(0.077)	(0.513)	(0.132)	(0.121)	(0.454)	(0.267)	(2.746)			
Pulp	2.096***	3.313***	-0.426***	-2.042*	0.397*	0.492***	1.367***	0.686**	-23.829***	581	-557.51	122.25
	(0.735)	(1.224)	(0.128)	(1.100)	(0.216)	(0.114)	(0.468)	(0.271)	(5.830)			
Plastic	2.076***	3.745***	-0.445***	-1.988*	0.413**	0.560***	1.521***	0.698***	-25.794***	581	-557.78	116.57
	(0.705)	(1.069)	(0.114)	(1.086)	(0.190)	(0.113)	(0.450)	(0.263)	(5.707)			
Publishing	2.073**	2.549**	-0.348***	-2.044*	0.327**	0.503***	1.218**	0.834***	-22.364***	581	-557	111.58
	(0.817)	(1.024)	(0.108)	(1.096)	(0.164)	(0.121)	(0.508)	(0.279)	(6.157)			
Beverage	2.001**	2.792*	-0.396**	-4.144***	0.808***	0.437***	1.512***	0.714***	-22.477***	581	-558.56	153.4
	(1.000)	(1.576)	(0.174)	(1.134)	(0.212)	(0.109)	(0.503)	(0.275)	(7.770)			
Chemicals	1.772***	3.403***	-0.423***	-1.413	0.322	0.584***	1.179***	0.746***	-21.327***	581	-560.95	110.54
	(0.647)	(1.151)	(0.127)	(0.953)	(0.200)	(0.115)	(0.410)	(0.264)	(5.254)			
Furniture	2.507***	3.470***	-0.461***	-3.271***	0.575***	0.432***	1.215***	0.767***	-25.979***	581	-556.28	136.53
	(0.712)	(0.983)	(0.109)	(0.897)	(0.148)	(0.108)	(0.468)	(0.272)	(5.297)			
Metal	2.262**	2.982**	-0.390***	-2.184*	0.365*	0.518***	1.555***	0.796***	-25.702***	581	-557.98	117.47
	(0.950)	(1.164)	(0.125)	(1.309)	(0.188)	(0.116)	(0.477)	(0.275)	(7.530)			
ICT	0.727	1.867**	-0.276***	-0.804	0.266	0.595***	1.616***	0.754***	-13.442***	581	-558.6	110.55
	(0.479)	(0.780)	(0.090)	(0.622)	(0.167)	(0.116)	(0.501)	(0.269)	(3.212)			
Foods	5.325***	6.141***	-0.781***	-5.543***	0.797***	0.414***	0.979**	0.789***	-48.056***	581	-557.21	137.93
	(1.286)	(1.451)	(0.175)	(1.465)	(0.203)	(0.113)	(0.494)	(0.273)	(9.647)			
Petroleum	2.245***	5.145***	-0.707***	-3.134***	0.916***	0.477***	1.489***	0.986***	-24.632***	581	-560.5	140.94
	(0.841)	(1.733)	(0.213)	(0.990)	(0.267)	(0.110)	(0.455)	(0.277)	(5.955)			
Textiles	0.169	0.372	-0.074	-0.123	0.033	0.580***	1.712***	0.846***	-9.658***	581	-566.68	114.12
	(0.502)	(0.448)	(0.053)	(0.564)	(0.091)	(0.126)	(0.513)	(0.284)	(3.578)			
Steel	2.586***	3.946***	-0.512***	-2.858***	0.551***	0.444***	1.195**	0.762***	-26.687***	581	-555.6	144.76
	(0.692)	(1.203)	(0.129)	(0.930)	(0.195)	(0.104)	(0.509)	(0.280)	(5.180)			
Electrical machinery	3.193***	7.431***	-0.778***	-3.522***	0.827***	0.680***	1.634***	0.601**	-39.570***	581	-558.49	119.59
	(0.935)	(1.925)	(0.191)	(1.116)	(0.229)	(0.118)	(0.517)	(0.260)	(8.807)			
Electronics components	2.163***	3.881***	-0.505***	-2.058*	0.456*	0.546***	1.479***	0.725***	-24.643***	581	-557.01	116.64
	(0.698)	(1.170)	(0.132)	(1.093)	(0.255)	(0.116)	(0.488)	(0.273)	(5.496)			
Nonferrous	2.032***	5.743***	-0.652***	-2.330***	0.715***	0.591***	1.554***	0.596**	-25.852***	581	-552.72	123.92
	(0.617)	(1.479)	(0.152)	(0.768)	(0.212)	(0.120)	(0.573)	(0.278)	(4.732)			
Lumber	2.234***	3.292***	-0.426***	-2.512**	0.457***	0.408***	1.380***	0.794***	-25.021***	581	-554.02	153.7
	(0.748)	(0.995)	(0.103)	(1.045)	(0.159)	(0.114)	(0.513)	(0.277)	(5.552)			
Transportation	3.038***	4.570***	-0.567***	-2.756***	0.492***	0.458***	1.159**	0.664**	-30.958***	581	-556.08	132.81
	(0.788)	(1.286)	(0.139)	(0.940)	(0.174)	(0.107)	(0.495)	(0.262)	(6.264)			

industry	consult	est	consult_x_est	uhat	uhat_x_est	Design app	Tech staff	incorporation	_cons	N	LogLik	chi2
Ceramics	5.225*** (1.145)	6.572*** (1.531)	-0.918*** (0.193)	-5.688*** (1.386)	0.976*** (0.235)	0.375*** (0.108)	1.201*** (0.368)	0.815*** (0.280)	-44.554*** (8.715)	581	-555.72	140.13

Notes

Dependent variable is the one-period-ahead annual count of design rights reported as “currently being implemented” (lead specification to enforce temporal ordering).

Endogeneity in consultation is addressed using a two-stage control-function (2SRI) approach: the first-stage residual (Uhat) and its interaction with agglomeration are included in the second stage; the interaction structure is extended consistently to the residual terms.

Standard errors are clustered at the Kohsetsushi level and reported in parentheses.

Statistical significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 4. Robustness to survey-regime change: period-varying slopes and interactions

industry	consult	dataperiod	dataperiod_x_consult	est	consult_x_est	dataperiod_x_est	dataperiod_x_consult_x_est	uhat	uhat_x_est	dataperiod_x_uhat_x_est	Design app	Tech staff	Incorporation	_cons	N	LogLik	chi2
Rubber	1.958***	18.643	-0.245	5.218***	-0.574***	-1.269	0.143	-1.611**	0.446**	-0.079	0.488***	0.862*	0.518*	-36.328	570	-538.76	106.03
	(0.691)	(719.901)	(0.403)	(1.702)	(0.179)	(0.846)	(0.094)	(0.793)	(0.215)	(0.067)	(0.118)	(0.505)	(0.276)	(719.917)			
Other	3.466***	18.589	-0.484	4.748***	-0.623***	-0.483	0.099	-2.983**	0.515**	-0.021	0.414***	1.143**	0.529*	-46.184	570	-536.45	112.92
	(1.035)	(778.754)	(0.604)	(1.558)	(0.174)	(0.938)	(0.106)	(1.177)	(0.208)	(0.045)	(0.116)	(0.557)	(0.284)	(778.781)			
Leather	0.801	19.251	-0.306	2.689***	-0.279**	-2.637***	0.261***	0.213	-0.119	-0.249**	0.347***	0.651	0.700**	-25.298	570	-527.96	124.2
	(0.542)	(582.560)	(0.314)	(1.028)	(0.122)	(0.677)	(0.076)	(0.570)	(0.143)	(0.109)	(0.121)	(0.515)	(0.294)	(582.564)			
Pulp	2.892***	20.938	-0.731	4.562***	-0.579***	-0.809	0.138	-1.750	0.322	0.010	0.451***	1.413**	0.471*	-43.531	570	-537.1	116
	(0.913)	(803.871)	(0.581)	(1.524)	(0.167)	(0.926)	(0.106)	(1.155)	(0.224)	(0.059)	(0.113)	(0.603)	(0.283)	(803.891)			
Plastic	2.795***	22.456	-0.852	4.744***	-0.569***	-1.260	0.167	-1.335	0.278	-0.006	0.506***	1.497***	0.572**	-44.158	570	-538.6	106.12
	(0.908)	(641.732)	(0.622)	(1.347)	(0.152)	(0.943)	(0.107)	(1.127)	(0.198)	(0.049)	(0.115)	(0.513)	(0.272)	(641.754)			
Publishing	3.202***	20.950	-0.469	3.933***	-0.506***	-0.160	0.064	-2.407*	0.362*	-0.012	0.433***	1.094*	0.513*	-47.188	570	-535.95	113.17
	(1.122)	(3083.149)	(0.615)	(1.440)	(0.159)	(0.841)	(0.094)	(1.322)	(0.199)	(0.047)	(0.117)	(0.640)	(0.294)	(3083.156)			
Beverage	-0.803	-10.219	2.941**	-2.381	0.179	5.661**	-0.618**	-3.782***	0.697**	0.062	0.407***	1.756***	0.611**	-11.911	570	-532.94	150.49
	(1.527)	(830.037)	(1.232)	(2.537)	(0.307)	(2.256)	(0.280)	(1.403)	(0.277)	(0.061)	(0.114)	(0.618)	(0.284)	(830.060)			
Chemicals	2.523***	18.592	-0.381	4.570***	-0.563***	-0.990	0.136	-1.522	0.327	-0.090*	0.445***	1.164**	0.702**	-40.136	570	-538.58	119.36
	(0.840)	(686.929)	(0.572)	(1.474)	(0.175)	(1.011)	(0.116)	(1.010)	(0.213)	(0.046)	(0.111)	(0.502)	(0.274)	(686.946)			
Furniture	3.494***	16.503	-0.412	4.897***	-0.633***	0.053	0.054	-4.022***	0.702***	0.023	0.409***	1.248**	0.536**	-46.548	570	-534.08	139.82
	(0.990)	(542.179)	(0.796)	(1.466)	(0.174)	(1.132)	(0.138)	(1.031)	(0.179)	(0.048)	(0.104)	(0.538)	(0.271)	(542.198)			
Metal	2.967**	17.997	-0.434	3.809***	-0.485***	-0.458	0.076	-2.046	0.332*	-0.019	0.464***	1.421***	0.655**	-43.354	570	-540.21	110.99
	(1.153)	(496.547)	(0.734)	(1.428)	(0.161)	(0.928)	(0.107)	(1.391)	(0.201)	(0.039)	(0.116)	(0.537)	(0.286)	(496.597)			
ICT	0.752	19.635	-0.307	2.229**	-0.301**	-1.934**	0.184**	-0.252	0.085	-0.091	0.522***	1.428***	0.783***	-26.692	570	-535.9	109.43
	(0.594)	(776.560)	(0.371)	(1.014)	(0.124)	(0.755)	(0.086)	(0.672)	(0.178)	(0.101)	(0.130)	(0.528)	(0.279)	(776.564)			
Foods	3.875**	-6.115	2.497*	4.557**	-0.550**	2.908**	-0.347*	-4.704**	0.647**	-0.038	0.345***	0.534	0.710**	-48.308	570	-536.88	138.37
	(1.802)	(398.592)	(1.331)	(2.070)	(0.262)	(1.483)	(0.191)	(1.970)	(0.281)	(0.041)	(0.112)	(0.566)	(0.301)	(398.694)			
Petroleum	1.078	1.561	1.765**	2.436	-0.346	3.889**	-0.467**	-3.271***	0.894***	-0.025	0.392***	1.060**	0.918***	-27.375	570	-539.31	131.54
	(1.070)	(737.112)	(0.760)	(2.312)	(0.294)	(1.816)	(0.231)	(1.088)	(0.293)	(0.074)	(0.114)	(0.526)	(0.324)	(737.128)			
Textiles	1.399**	7.194	1.013*	2.891***	-0.365***	0.569	-0.044	-1.119	0.265*	-0.101*	0.414***	1.441**	0.496*	-32.072	570	-537.47	136.85
	(0.597)	(805.894)	(0.554)	(0.885)	(0.108)	(1.025)	(0.109)	(0.691)	(0.142)	(0.057)	(0.103)	(0.562)	(0.291)	(805.888)			
Steel	2.721***	12.637	0.361	4.052***	-0.520***	0.340	-0.028	-2.979***	0.551***	-0.047	0.363***	0.730	0.667**	-39.194	570	-536.51	135.52
	(0.900)	(768.333)	(0.573)	(1.505)	(0.172)	(1.004)	(0.120)	(0.972)	(0.194)	(0.050)	(0.106)	(0.604)	(0.305)	(768.348)			
Electrical machinery	3.865***	26.312	-0.907	8.733***	-0.907***	-2.039**	0.226**	-3.349***	0.779***	-0.045	0.574***	1.439**	0.322	-59.325	570	-538.18	115.13
	(1.191)	(1147.625)	(0.570)	(2.320)	(0.239)	(0.899)	(0.101)	(1.218)	(0.246)	(0.059)	(0.121)	(0.576)	(0.282)	(1147.666)			
Electronics components	2.615***	25.447	-1.102*	4.405***	-0.574***	-2.557**	0.288**	-0.385	-0.013	-0.002	0.449***	1.179**	0.766***	-39.908	570	-535.29	114.11
	(0.945)	(653.504)	(0.649)	(1.559)	(0.186)	(1.104)	(0.131)	(1.218)	(0.277)	(0.075)	(0.119)	(0.488)	(0.293)	(653.525)			
Nonferrous	4.177***	20.184	-0.474	10.591***	-1.110***	-2.353**	0.269***	-3.770***	0.966***	-0.159**	0.341**	0.301	0.046	-52.980	570	-528.56	157.24
	(1.119)	(648.895)	(0.410)	(2.052)	(0.218)	(0.914)	(0.104)	(1.091)	(0.227)	(0.073)	(0.135)	(0.703)	(0.302)	(648.931)			
Lumber	0.100	-8.756	3.027***	0.123	0.016	4.468***	-0.571***	-2.993**	0.440**	0.075	0.353***	0.720	0.763***	-19.511	570	-531.22	138.68
	(1.329)	(442.036)	(1.148)	(1.868)	(0.233)	(1.649)	(0.215)	(1.308)	(0.212)	(0.064)	(0.117)	(0.548)	(0.290)	(442.065)			
Transportation	2.626***	22.635	-0.604	4.274***	-0.503***	-2.096*	0.195	-1.460	0.247	-0.069	0.372***	0.738	0.650**	-39.667	570	-533.88	126.54
	(0.999)	(525.313)	(0.743)	(1.479)	(0.172)	(1.172)	(0.137)	(1.131)	(0.207)	(0.053)	(0.111)	(0.533)	(0.284)	(525.330)			

industry	consult	dataperiod	dataperiod_x_consult	est	consult_x_est	dataperiod_x_est	dataperiod_x_consult_x_est	uhat	uhat_x_est	dataperiod_x_uhat_x_est	Design app	Tech staff	Incorporation	_cons	N	LogLik	chi2
Ceramics	4.398** (1.876)	-11.519 (438.303)	3.165** (1.532)	5.524** (2.418)	-0.751** (0.325)	4.711** (2.077)	-0.571** (0.266)	-5.852*** (2.095)	0.966*** (0.354)	0.003 (0.060)	0.339*** (0.110)	0.810* (0.417)	0.891*** (0.300)	-50.140 (438.362)	570	-534.11	137.4

Notes

This table re-estimates the second-stage specification allowing coefficients to differ across data periods by interacting a post-period indicator (dataperiod) with consultation, agglomeration, and their interaction (including corresponding interactions for the control-function residual terms). The triple interaction (dataperiod × consultation × agglomeration) tests whether the moderation pattern changes after the regime shift.

Standard errors are clustered at the Kohsetsushi level and reported in parentheses.

Statistical significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 5. Robustness to non-interpolated agglomeration: benchmark-year-only estimation

industry	consult	est	consult_x_ est	uhat	uhat_x_ est	Design app	Tech staff	incorporation	_cons	N	LogLik	chi2
Rubber	2.108	6.387**	-0.693**	-0.649	0.035	0.797**	0.414	1.748**	-21.928**	104	-79.68	27.88
	(1.306)	(2.830)	(0.300)	(2.131)	(0.513)	(0.330)	(1.203)	(0.781)	(10.577)			
Other	6.376**	6.524*	-0.928**	-2.836	-0.002	0.850***	-1.983	2.542***	-37.904*	104	-79.14	30.76
	(3.126)	(3.745)	(0.426)	(4.509)	(0.751)	(0.322)	(1.859)	(0.867)	(20.435)			
Leather	1.217	5.108***	-0.585***	-0.539	-0.027	0.830**	1.015	2.370***	-15.374**	104	-77.52	28.66
	(1.153)	(1.885)	(0.217)	(1.647)	(0.350)	(0.350)	(1.402)	(0.864)	(7.445)			
Pulp	4.728	6.776	-0.825*	-2.710	0.152	0.654*	-1.005	1.976**	-34.533*	104	-80.82	29.57
	(3.001)	(4.140)	(0.462)	(3.765)	(0.644)	(0.334)	(1.897)	(0.782)	(19.837)			
Plastic	1.571	2.801	-0.380	2.390	-0.584	0.874***	0.719	2.031***	-14.860	104	-79.59	32.24
	(2.181)	(3.307)	(0.341)	(3.263)	(0.562)	(0.313)	(1.141)	(0.773)	(17.870)			
Publishing	7.159***	6.565***	-0.874***	-4.804	0.199	0.760**	-2.824*	2.825***	-42.952***	104	-79.13	28.47
	(2.504)	(2.480)	(0.295)	(3.281)	(0.473)	(0.326)	(1.667)	(0.971)	(14.967)			
Beverage	3.818	4.362	-0.547	-1.796	-0.148	0.700***	-1.009	1.631**	-26.705	104	-83.94	38.56
	(2.773)	(3.788)	(0.435)	(4.949)	(1.068)	(0.265)	(1.941)	(0.727)	(18.924)			
Chemicals	1.736	4.789	-0.530	0.323	-0.132	0.955***	0.511	1.741**	-18.891	104	-81.33	26.81
	(1.858)	(2.952)	(0.326)	(3.252)	(0.601)	(0.320)	(1.288)	(0.726)	(13.816)			
Furniture	3.290	5.518**	-0.714**	0.839	-0.340	0.604*	0.701	1.961**	-28.521**	104	-78.57	38.92
	(2.108)	(2.742)	(0.302)	(3.254)	(0.550)	(0.327)	(1.711)	(0.778)	(14.407)			
Metal	5.193	5.791*	-0.706*	-2.120	0.027	0.703**	-1.144	2.021**	-38.057*	104	-80.47	34.31
	(3.767)	(3.248)	(0.385)	(4.901)	(0.583)	(0.351)	(2.480)	(0.806)	(21.468)			
ICT	1.092	4.450**	-0.555**	0.104	-0.123	0.781**	1.357	2.164***	-14.582*	104	-81.41	25.45
	(1.034)	(2.067)	(0.243)	(1.655)	(0.431)	(0.338)	(1.342)	(0.827)	(7.485)			
Foods	11.239***	12.099**	-1.535***	-4.233	0.257	0.483*	-1.757	2.164**	-81.738***	104	-79.86	40.97
	(3.884)	(4.720)	(0.562)	(5.061)	(0.743)	(0.288)	(1.747)	(1.093)	(28.527)			
Petroleum	7.154***	11.983***	-1.566***	-5.694*	0.802	0.774***	-2.640	2.655***	-44.447***	104	-81.59	44.49
	(2.555)	(4.592)	(0.585)	(2.975)	(0.796)	(0.225)	(1.609)	(0.930)	(15.176)			
Textiles	-0.125	0.320	-0.054	1.191	-0.303	0.947***	0.456	1.490*	-1.331	104	-84.25	27.98
	(1.112)	(1.084)	(0.133)	(1.913)	(0.318)	(0.281)	(1.114)	(0.776)	(6.415)			
Steel	2.965	3.657	-0.477	-1.280	-0.076	0.609**	-0.604	1.933**	-20.768	104	-81.96	38
	(2.308)	(3.138)	(0.354)	(2.784)	(0.503)	(0.302)	(1.766)	(0.803)	(14.784)			
Electrical machinery	1.829	3.012	-0.414	1.174	-0.384	0.926***	0.530	2.133***	-15.836	104	-80.86	28.81
	(2.297)	(3.943)	(0.396)	(3.244)	(0.576)	(0.330)	(1.251)	(0.798)	(19.432)			
Electronics components	2.100	2.618	-0.433	-2.499	0.319	0.828**	0.489	1.621**	-15.976	104	-81.7	28.53
	(1.656)	(2.701)	(0.311)	(2.547)	(0.555)	(0.330)	(1.146)	(0.701)	(12.313)			
Nonferrous	0.966	2.802	-0.355	0.692	-0.315	0.829**	0.463	1.808**	-10.113	104	-82.03	28.56
	(1.773)	(2.865)	(0.311)	(2.503)	(0.516)	(0.330)	(1.365)	(0.795)	(11.618)			
Lumber	5.011*	6.692**	-0.863**	1.055	-0.556	0.025	-0.039	1.737**	-39.029**	104	-79.48	38.28
	(3.026)	(2.747)	(0.343)	(4.343)	(0.685)	(0.375)	(2.280)	(0.811)	(16.179)			
Transportation	4.341*	7.341**	-0.855**	-0.448	-0.146	0.646*	-0.032	1.792**	-37.196**	104	-77.99	38.45
	(2.284)	(3.434)	(0.370)	(3.825)	(0.676)	(0.337)	(1.730)	(0.757)	(16.585)			

industry	consult	est	consult_x_ est	uhat	uhat_x_ est	Design app	Tech staff	incorporation	_cons	N	LogLik	chi2
Ceramics	13.621*** (4.429)	18.999*** (5.333)	-2.386*** (0.668)	-0.768 (5.204)	-0.291 (0.859)	0.343 (0.284)	-0.170 (2.647)	2.285*** (0.883)	-108.212*** (29.465)	104	-74.45	44.18

Notes

This table re-estimates the second-stage specification using non-interpolated agglomeration, restricting the sample to benchmark years with observed establishment counts (no values assigned to intercensal years).

Standard errors are clustered at the Kohsetsushi level and reported in parentheses.

Statistical significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.