BooKang Seol
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September 15, 2026

The Microeconomics of Growth Miracles
Social Ties and Economic Integration

Dear Professors Breza, Viviano, and Chandrasekhar,

I am applying to the Workshop on Development Economics and Networks for Early-Career Researchers at the NBER on December 5, 2026. I am a Postdoctoral Fellow in the Department of International Development at the London School of Economics and Political Science and received my Ph.D. in Economics from Columbia University in 2023.

I study growth miracles one country or industry at a time, asking how firms and communities turn new economic opportunities into sustained development. The paper I propose to present, *Social Institutions and the Returns to Infrastructure: Divergent Development Paths in Rural South Korea*, examines how kinship structure shaped villages' responses to the opening of the Namhae Bridge in 1973. Villages dominated by a single lineage coordinated land contributions for feeder roads and mechanized rice production, while clan-fractionalized villages shifted toward cash crops.

I would particularly value the opportunity to discuss this work with researchers studying networks and development, and to exchange ideas about using historical microdata to investigate collective action and economic integration.

My application includes my CV, with a list of completed Ph.D. courses; a one-page statement of research interests and motivation; and the working paper. Professor Eric Verhoogen at Columbia University (eric.verhoogen@columbia.edu) could provide a recommendation should I be shortlisted.

Thank you for considering my application.

Sincerely,

BooKang Seol

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London, WC2A 2AE, UK

Academic positions

London School of Economics 2023–
Postdoctoral Fellow, Department of International Development

Education

Columbia University 2017–2023
Ph.D. in Economics
Dissertation: *Essays on Development Economics*
Committee: Miguel Urquiola, Suresh Naidu, Eric Verhoogen, Jack Willis, Rodrigo Soares
Ph.D. coursework (all completed): Microeconomics I–II, Macroeconomics I–II, Econometrics I–II, International Trade Theory, Topics in Trade and Growth, Industrial Organization I–III, Development Economics, Industrial Development, Economics of Education, Public Economics, Labor Economics

Harvard Kennedy School 2015–2017
MPA in International Development (MPA/ID)

Harvard University 2007–2013
A.B. in Economics

Research

Fields: Development Economics (primary); Applied Microeconomics; Economic Growth

Interests: Market access, infrastructure, industrial development, structural transformation, Korean economic development

Working papers

1. "A Godsend Bug: Demand-Driven Upgrading in India's IT Sector." [PDF]
2. "Social Institutions and the Returns to Infrastructure: Divergent Development Paths in Rural South Korea." [PDF]
3. "More Schools, Better Schools? Evidence from India's Secondary Education Expansion."
   Draft available upon request.

Selected work in progress

1. "Forests as Economic Infrastructure: Can Environmental Restoration Accelerate Industrialisation?" (with Hyunjoo Yang).
2. "Decomposing a Miracle: A Subnational Economic Database for South Korea, 1960–1989" (with Changkeun Lee and Hyunjoo Yang). *Data collection and digitisation in progress; pilot data release planned for late 2026.*

Data infrastructure

Project MIRACLE: Subnational Economic Data for South Korea, 1960–1989
with Changkeun Lee (KDI School) and Hyunjoo Yang (Sogang University)

Building a township-year economic panel designed to cover ∼3,500 townships, 30 annual panels, and 100+ variables, drawn from ∼2 million pages of municipal statistical yearbooks. Pilot data release planned for late 2026. Supported by LSE, with related project funding from STEG. [Project website]

Grants and honors

Research grants

LSE Seed Research Fund (£20,000), *Project MIRACLE* 2025–2026
STEG Small Research Grant (£25,000), *Forests as Economic Infrastructure* 2025–2026
LSE Research Infrastructure and Investment Fund, *The Y2K project* 2023–2025

Ph.D. research support, Columbia University (2017–2023)

CDEP Fellow; PER Field Fund; CDEP Field Research Fund; Dissertation Fellowship; Young-Iob Chung Fellowship; Jones Fellowship for Economics and History; PER Summer Research Fellow; Dean's Fellowship

Honors

LSE Class Teacher Award, Department of International Development 2024, 2025, 2026
Morris Kronfeld Prize, Harvard University 2013
Army Achievement Medal, U.S. Army 2010

Seminars and conferences

2026: POSTECH; SNU*

2025: World Congress of the Econometric Society (Seoul); LSE ID; KDI School; Korean Economic Review Int'l Conference

2024: GPRL–IPA Researcher Gathering (Northwestern); ICRIER (New Delhi); LSE ID; Chung-Ang University

2023: Columbia Development Seminar; Development Rookiefest (Northwestern); SNU; KDI; CAGE Summer School (Warwick); Asian Economic Development Conference (Tokyo); Korean Economic Review Int'l Conference

* *Planned*

Teaching

London School of Economics *Class Teacher Award: 2024, 2025 & 2026*
Econometrics for Development Policy (MSc) 2023–2026
Government Policy Analysis (MSc) 2023–2025
Dissertation Advising / Research Design for Dissertations (MSc) 2023–2026

Columbia University, Teaching Assistant

International Trade Fall 2021
Industrial Organization (Undergraduate/Master's) Spring 2020, Spring 2021
Principles of Economics *(Head TA)* Fall 2019, Fall 2020
Game Theory (Undergraduate/Master's) Fall 2018, Spring 2019

Selected evaluations: [Columbia], [LSE]

Professional service

Refereeing: *Industrial and Corporate Change*; *Journal of the European Economic Association*; *Politics and Governance*; *Quarterly Journal of Economics*

Invited manuscript reviewer: *Korean Economy Civic Lecture Series*: "Saemaul Undong", 2026

Earlier research and professional experience

World Bank 2014–2015
Analyst, *World Development Report 2016*

Harvard University and Harvard Kennedy School 2011–2016
Research Assistant for Pol Antràs, Ed Glaeser, Ricardo Hausmann, and Rohini Pande

Republic of Korea Army 2008–2010
Army translator, ROK-US Combined Forces Command

References

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Dean of Social Sciences
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Citizenship: Republic of Korea
Languages: English, Korean
Programming: Python, R, Stata, MATLAB, ArcGIS/QGIS

Last updated: September 2026

The Microeconomics of Growth Miracles: Social Ties and Economic Integration

Statement of research interests and motivation · BooKang Seol, London School of Economics · b.seol@lse.ac.uk

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Research interests. I study growth miracles one country or industry at a time, asking how firms and communities turn new economic opportunities into sustained development. I combine original data collection with empirical designs that exploit sharp changes in market access and demand. My current work on South Korea and India examines how inherited technologies and social institutions can become foundations for development, rather than simply obstacles to overcome.

The paper I propose to present, *Social Institutions and the Returns to Infrastructure*, examines how kinship structure shaped responses to the opening of South Korea's Namhae Bridge in 1973. Rice productivity rose substantially more in villages dominated by a single lineage than in clan-fractionalized villages, which instead responded by adopting cash crops. The larger rice-productivity gains were linked to complementary feeder roads, whose construction required land contributions from every affected landholder—a weakest-link public good in which one holdout blocks the whole. The evidence indicates that lineage ties facilitated the collective action needed to build these roads. The findings highlight how organizational constraints rooted in historical social networks can become binding when new opportunities require collective investment, shaping the development paths communities follow.

The same logic holds for firms, with an inherited technology in the role that lineage plays for villages. My research on India's software industry examines how temporary Y2K demand made legacy-system expertise, rather than frontier technology, a pathway to organizational upgrading. I digitized seven industry directories spanning 1992–2003 and compare incumbents whose pre-shock technologies did or did not match remediation requirements. Legacy-matched firms emerge roughly 53% larger in employment after the January 2000 deadline and advance further in process certification, while client counts and foreign-market reach show less robust persistence. Lasting gains ran through capabilities built inside the firm more than through the buyer relationships that first generated the demand.

I am extending this agenda through **Project MIRACLE** (miracle.bookangseol.com), digitizing roughly two million pages of municipal statistical yearbooks and harmonizing changing administrative boundaries to build a public township-year panel for South Korea, 1960–1989, with intended coverage of approximately 3,500 townships. I am developing new projects with an LSE-based team and exploring collaboration with researchers at Seoul National University, including a possible workshop on Korea's transformation.

Motivation for attending. I would use the workshop to sharpen the network questions emerging from this research. How do kinship ties and transport connections jointly determine where infrastructure gains accrue and how they spread? Which relationships sustain cooperation within villages and transmit opportunities across communities? My current measures capture lineage composition rather than a complete map of individual relationships. I would value discussion of how to study these partially observed networks, distinguish social connections from geographic proximity, and identify spillovers across communities. With MIRACLE's data collection underway, these discussions could directly inform which additional relational information I recover and how I link it to the panel.

I would also share the practical methods behind these projects: locating archival sources, developing AI-assisted digitization and validation pipelines, and linking historical records for causal analysis. I hope to exchange approaches with other early-career researchers building similar resources and find collaborators interested in using detailed microdata to answer large questions about how social relationships shape development.

Social Institutions and the Returns to Infrastructure:

Divergent Development Paths in Rural South Korea*

BooKang Seol†

April 1, 2026

Abstract

Infrastructure investments generate widely varying returns across similar communities. This paper argues the heterogeneity is structural: the same infrastructure shock leads communities to adopt fundamentally different development strategies depending on their social institutions. I study the 1973 Namhae Bridge in rural South Korea using village-level panel data spanning all villages in Namhae County. The bridge made rice modernization profitable, but capturing those gains required feeder roads. Road construction demanded permanent land donations from every landholder along the route, a classic anti-commons problem that had been latent when transport costs were prohibitive. Cohesive villages—those dominated by a single patrilineal clan—assembled the land, built roads, and mechanized rice production. Fractionalized villages pivoted to labor-absorbing cash crops that required no shared infrastructure. Both paths raised household income, but through different factor-intensity channels, demonstrating that infrastructure and social organization are institutional complements that determine not just how much communities gain from market access, but how they transform.

*I am grateful to Miguel Urquiola, Eric Verhoogen, and Suresh Naidu, for their guidance and support throughout my Ph.D. at Columbia. For helpful feedback, I thank Jie Bai, Michael Best, Sujoy Bhattacharyya, Sandra Black, Naman Garg, Florian Grosset, Do-Hyun Han, Vince Jeong, Sokbae Lee, Martin Rotemberg, Joana Naritomi, Cristian Pop-Eleches, Sandra Sequeira, Rodrigo Soares, Diana Weinhold, Jack Willis, Hyunjoo Yang, and Krzysztof Zaremba, as well as seminar and conference audiences at Columbia Development Seminar, Development Rookiefest 2023 (Northwestern), the Korean Association of Applied Economics/DEEP (SNU), the 2023 CAGE Summer School (Warwick), the 2nd Asian Economic Development Conference, and KDI. Special thanks to Mr. Eui-Yeon Jeong and Ms. Hee-Myung Ahn for generously sharing the Namhae County data catalogue, and to Hyunjoo Yang for providing digitized Korean historical data. Excellent research assistance was provided by Sanghwa Ahn, Chris Babcock, Yuqi Cheng, James Hu, Sujeong Kim, Seoyeon Kim, Hyungcheol Kim, Taein Kim, Byeongjin Min, Bukyung Min, ChaeYeon Oh, Jiyoung Park, Siyeon Song, and Abby Zhang. Finally, I thank Miguel Urquiola, the Program for Economic Research (PER), and the Center for Development Economics and Policy (CDEP) for financial support. A previous version of this paper was circulated under the title "The Endogenous Returns to Infrastructure: Social Institutions and the Choice of Development Paths."

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1 Introduction

Infrastructure investments are central to development policy, yet their returns vary dramatically across seemingly similar communities. This paper argues that this heterogeneity is structural: communities with different social organizations face different constraints in exploiting new infrastructure, and optimize along different margins accordingly. Using the 1973 construction of the Namhae Bridge in rural South Korea as a natural experiment, I show that a bridge connecting an isolated island to the mainland generated divergent development paths depending on village-level social structure. Socially cohesive villages—those dominated by a single patrilineal clan—used the bridge to modernize rice production through coordinated investments in feeder roads and mechanization, a labor-saving path that released surplus workers for migration to Korea's industrial cities. Fractionalized villages, unable to assemble the land donations required for road construction, pivoted instead to labor-absorbing cash crops whose cultivation required no shared infrastructure. Both paths generated comparable household income gains, but through fundamentally different factor-intensity channels.

The mechanism driving this divergence is a property-rights problem inherent in land assembly for road construction. Modernizing rice cultivation in 1970s Korea required heavy capital inputs—power tillers, bulk chemical fertilizer—that could only reach farms via paved feeder roads. However, building a feeder road demanded contiguous, permanent land donations from every landholder along the route: a classic "tragedy of the anti-commons" (Heller, 1998) in which a single holdout can block the entire project. In villages where a dominant clan's hierarchical authority could internalize holdout externalities, the road got built and modernization followed. In villages where land was dispersed across competing lineages with no focal authority, it did not. Before the bridge, this institutional variation was latent because prohibitive transport costs meant there was no surplus worth coordinating over. The bridge activated the constraint by making modernization profitable. Once activated, the anti-commons problem determined which villages could capture those gains through collective investment and which were left to find individualistic alternatives.

I formalize this logic in a simple model that maps social fractionalization to the number of veto players in an N-player land-assembly game. The model's central result is that

the probability of assembling a feeder road decays exponentially with the number of independent landholders, but only once a transport shock makes modernization profitable. This generates a set of empirical predictions. First, there should be no differential pre-trends before the bridge, but a fractionalization penalty in rice productivity after it. Following the same logic, the penalty should attenuate near the bridge, where the economic surplus grows large enough to compensate potential holdouts. Second, the model predicts that fractionalization impedes only *weakest-link* public goods—investments like roads that require every landholder's consent—while leaving *summation* public goods like total project budgets unaffected. This distinction separates the anti-commons mechanism from stories in which cohesive villages simply have more resources or better leadership. Finally, the model predicts that blocked villages do not necessarily stagnate. Instead, they optimize around their institutional constraint by pivoting to labor-absorbing cash crops, generating a divergence in factor intensity that shapes the broader pattern of structural transformation.

Testing these predictions requires a setting where an exogenous shock to market access activates latent institutional differences across communities that retain discretion over their own investment decisions. Rural South Korea in the 1970s provides this setting. The government's *New Village Movement* (NVM)—a nationwide campaign that raised agricultural output per household by 60%—was radically decentralized: villages chose and executed their own development projects, so whether a community built a feeder road or expanded into new crops was a local decision, not one dictated from Seoul. Moreover, social fractionalization is cleanly measured by clan composition. Korean villages were organized around patrilineal kinship networks (*bon-gwan*), with some dominated by a single lineage and others divided among competing clans. Because all villagers shared ethnicity, language, and religion, any coordination failures must stem from local power dynamics and trust networks within kin groups. This isolates the micro-mechanism more cleanly than settings where fractionalization confounds ethnicity with language, religion, or phenotype. The source of exogenous variation is the 1973 Namhae Bridge, built to connect Korea's fourth-largest island (population 124,674 across 196 villages) to the national highway network. The bridge was driven by national strategic priorities unrelated to conditions in any particular village, providing a sharp and plausibly exogenous shock to market access.

To study these dynamics, I assembled the first village-level panel dataset on Korea's rural development, linking four archival sources that have not previously been combined: annual township yearbooks, village-level NVM project records recovered from community centers across Namhae County, a 1972 national baseline survey, and the 1930 colonial census of clan composition. The dataset required digitizing 336 volumes of records and tracing village social structures across half a century, yielding annual data on agricultural outputs, inputs, public investments, and demographic outcomes for all 196 villages from 1969 to 1984.

Four complementary empirical designs progressively build the case for the anti-commons mechanism. The first exploits within-Namhae variation, interacting village proximity to the bridge with pre-existing clan composition. Villages closer to the bridge gain 228 kg of rice per agricultural household (27% of the pre-bridge mean), but fractionalized villages face a large productivity penalty. The exception occurs where proximity to the bridge generates sufficient surplus to compensate holdouts, consistent with the model's distance-substitution prediction. A cross-island triple-difference adds the 26 villages on the adjacent unconnected island as a counterfactual, confirming a fractionalization penalty of -353 kg (39% of the pre-bridge mean) that is absent in pre-bridge years. A stacked two-shock design then exploits the 1980 Changsun Bridge, which connected the control island seven years later, as an independent replication. This second shock asks whether the same institution-contingent pattern appears in a different time period, under different NVM policies, and on a different island. The estimate is similar (-365 kg), making explanations specific to either bridge implausible. Finally, a within-village crop panel compares rice to barley within the same village and year. Because rice production is coordination-intensive across multiple margins, including land assembly for feeder roads, joint water management, and synchronized planting, the anti-commons problem should bind more tightly for rice than for barley, which can be cultivated more individually. The penalty is indeed confined to rice, and barley shows no significant fractionalization effect. Horse-race regressions further confirm that fractionalization retains explanatory power after controlling for baseline agricultural orientation and village-level wealth proxies, ruling out the interpretation that clan composition merely captures "being more agricultural."

The mechanism operates through a causal chain whose temporal ordering is consistent

with the framework. Cohesive villages invested disproportionately in feeder roads following the bridge, while total NVM project spending—a summation public good that requires no unanimous consent—showed no difference across village types. Roads enabled adoption of chemical fertilizers and power tillers, which raised rice yields with a one-to-two-year lag. Fractionalized villages, slower to resolve the land assembly this path required, pivoted to crops whose profitability depended on transport access rather than local coordination: napa cabbage, whose perishability constraint the bridge resolved, and silk, whose state-procurement channel eliminated the need for collective marketing. Fractionalized connected villages expanded cash-crop cultivation by 39 log points, added nearly one new crop variety, and reversed rural Korea's depopulation trend. The resulting factor-intensity divergence—labor-saving mechanization in cohesive villages versus labor-absorbing diversification in fractionalized ones—meant that infrastructure shaped not just the level of agricultural income but its composition and labor demands.

The paper contributes to three literatures. First, it advances the study of infrastructure and development by showing that returns are endogenous to local institutions.[1] The existing literature documents heterogeneous returns but has largely attributed them to geographic or policy variation rather than to local institutional constraints. The anti-commons framework provides a specific mechanism. Infrastructure shifts the binding constraint from market access to local organization, and the organizational response depends on institutions that long predate the infrastructure itself. The policy implication is that standard cost-benefit analyses assuming homogeneous treatment effects will mispredict returns in both directions, overstating gains where coordination failures block complementary investments, and understating them where communities adapt along unanticipated margins.

Second, the paper contributes to the literature on fractionalization and public goods provision by showing that the coordination penalty operates through a specific channel: unanimity-requiring investments.[2] The standard finding in this literature is that diverse

[1] See Donaldson (2018) and Donaldson and Hornbeck (2016) for railways, Duflo and Pande (2007) for dams, Dinkelman (2011) and Lipscomb et al. (2013) for electricity, Asher and Novosad (2020) and Faber (2014) for roads with limited socioeconomic impacts, and Khandker and Koolwal (2011), Brooks and Donovan (2020), Shamdasani (2021), and Gebresilasse (2023) for positive effects of rural roads.

[2] On fractionalization and public goods, see Alesina et al. (1999), Miguel and Gugerty (2005), and Alesina and La Ferrara (2005). On kinship and economic outcomes, see Alesina and Giuliano (2014), Moscona et al. (2017), and Enke (2019). On cultural persistence, see Dell (2010), Lowes et al. (2017), and Dell et al. (2018).

communities under-provide public goods, but the mechanism is typically unspecified. It could reflect divergent preferences, lower trust, or any number of community-level deficits. The anti-commons framework makes a discriminating prediction: fractionalization should impede *weakest-link* public goods that require unanimous consent, while leaving *summation* public goods unaffected. The data confirm this prediction, which helps narrow the set of mechanisms through which social structure constrains collective investment. The Korean setting, where clans share ethnicity, language, and religion, isolates this coordination channel from the preference heterogeneity that confounds identification in more commonly studied contexts.

Third, the paper connects infrastructure to the factor intensity of agricultural modernization, and through it to the pattern of structural transformation.[3] Existing work on infrastructure and structural transformation treats the labor-displacing versus labor-absorbing margin as a function of technology type. This paper shows it also depends on local organizational capacity: a single infrastructure shock simultaneously produced labor-saving mechanization in villages that could coordinate, and labor-absorbing diversification in villages that could not. The result is that infrastructure shaped not just the level of agricultural income but its composition and labor demands, with consequences for the pace and character of rural-to-urban migration during Korea's industrialization.

The paper proceeds as follows. Section 2 describes the Korean setting, clan structure, and the Namhae Bridge. Section 3 develops the anti-commons framework and derives testable predictions. Section 4 describes the data. Section 5 presents baseline balance and pre-bridge collective action measures. Section 6 lays out the empirical specifications. Sections 7–9 present the results. Section 10 concludes.

2 Setting

The 1970s transformation of rural Korea provides a setting where an exogenous shock to market access activated latent institutional differences across communities that retained discretion over their own investment decisions. This section establishes three features of

[3] On structural transformation, see Bustos et al. (2016) on agricultural technology and labor reallocation, and Morten and Oliveira (2024) on general-equilibrium effects of roads. On the NVM and community-driven development, see Casey et al. (2012) and Casey (2018).

the setting. First, Korean villages were organized around patrilineal kinship networks that generated substantial variation in hierarchical authority—the institutional resource that, as formalized in Section 3, determines whether a village can assemble the contiguous land donations required for road construction. Second, the 1973 Namhae Bridge dramatically reduced the transport costs that had kept modernization unprofitable, activating the coordination constraint. Third, the government's *New Village Movement* decentralized investment decisions to villages, ensuring that whether a community built a feeder road or pursued alternative crops was a local choice shaped by local institutions.

2.1 Kinship Structure and Village Organization in Rural Korea

Korean villages organized around patrilineal kinship networks identified by the *bon-gwan* system, which pairs family names with ancestral geographic origins. The Parks from *Miryang* and the Parks from *Bannam* are distinct kinship groups despite sharing a surname, each maintaining separate genealogical records (*jokbo*) documenting lineage and hierarchy. These networks were not merely markers of shared identity. They sustained concrete institutions for collective action: labor-sharing arrangements (*poomasi*), cooperative credit associations (*gye*), and village councils (*doore*) that coordinated agricultural production, managed irrigation, and adjudicated land disputes (Brandt 1971, Wade 1982, Deuchler 2015).

Kinship patterns produced two broad categories of villages with qualitatively different organizational structures. About one-third of Korean villages were "clan villages," where a single *bon-gwan* comprised the majority of households. These villages emerged between the 15th and 17th centuries during Korea's "Confucian transformation," when the adoption of patrilineal succession laws concentrated property inheritance through the male line, driving daughters to leave their natal villages upon marriage and consolidating landholding within dominant lineages (Deuchler 1992, National Institute of Korean History 2023). Many clan villages were founded by *Yangban*—the scholarly elite of the *Joseon* dynasty—who selected sites suited to intensive rice cultivation and established hierarchical governance structures anchored by the clan elder's authority over land allocation, ritual obligations, and dispute resolution. The remaining villages arose from mixed settlements of diverse families, yielding fractionalized communities where no single lineage held comparable authority.

This distinction matters for the paper's mechanism because it generated variation not just in social cohesion but in the specific institutional capacity to resolve land assembly problems. In a clan village, the dominant lineage's elder could compel or persuade co-lineage landholders to donate strips of land for road construction, internalizing the holdout externalities that would otherwise block the project. In fractionalized villages, land was dispersed across competing lineages with no focal authority capable of coordinating permanent, irreversible property transfers. Routine cooperation—sharing labor at harvest, contributing to a common fund—could be sustained through repeated interactions even among diverse groups. But assembling a contiguous road required every landholder along the route to cede property permanently, a one-shot transaction where a single holdout could block the entire project.

A potential concern is that clan composition merely proxies for *Yangban* elite status—that cohesive villages outperformed because they were richer, better connected to the state, or populated by historically privileged families, not because they could coordinate land assembly. This concern is addressed empirically in Section 7.3 through horse-race regressions, but two features of the setting are worth noting here. First, by the 1970s, the economic privileges of *Yangban* status had been substantially eroded. The Kabo Reforms of 1894 abolished the hereditary status system, and commoner families subsequently adopted prestigious surnames en masse. By 1930, the most common *Yangban*-associated surnames (Kim, Lee, Park) accounted for nearly half the population (National Institute of Korean History 2023). What persisted was not elite economic privilege but the organizational infrastructure of clan governance: the hierarchical decision-making, the elder's authority, and the dense network of obligations that facilitated collective action. Second, as I show in Section 5, cohesive and fractionalized villages received similar NVM budgets and achieved similar NVM performance grades, suggesting that clan structure did not confer a generic resource advantage.

Unlike settings where fractionalization confounds ethnicity with language, religion, or phenotype, all Korean villagers shared the same ethnicity, spoke the same language, and practiced the same mix of Buddhist and Confucian traditions. Any coordination failures must therefore stem from local power dynamics and trust networks within and across kin groups, isolating the organizational channel more cleanly than cross-country or cross-ethnic

studies. Section 4 details the measurement of fractionalization using the 1930 colonial census and validates its persistence through the study period. Appendix A.1 provides a fuller account of clan village origins, the Confucian transformation, and a comparative case study of two villages illustrating how clan composition shaped approaches to road construction.[4]

2.2 The Namhae Bridge and the Geography of Isolation

Namhae County comprises two islands off Korea's southern coast: Namhae, the country's fourth-largest island (population 124,674), and the adjacent smaller island of Changsun. In 1970, the county comprised 196 villages across eight townships, with 170 on Namhae and 26 on Changsun. Before 1973, both islands were accessible only by ferry, with travel to the nearest mainland city of Busan taking 8–12 hours depending on weather and ferry schedules. This isolation kept transport costs prohibitively high, rendering bulk agricultural exports unprofitable and suppressing returns to capital-intensive modernization.

The 1973 Namhae Bridge connected Namhae Island to the mainland and to the newly completed Namhae Expressway (273 km), which linked coastal cities to Korea's national highway network. Travel time to Busan fell from 8–12 hours to approximately 3 hours, with remote villages gaining the most in proportional terms. The bridge's impact was immediate and visible: the number of bus routes serving the island more than doubled from 34 to 76 within four years of the bridge's completion (Namhae County Office 1980). Importantly, the bridge was driven by national strategic priorities—extending the expressway network along the southern coast—rather than by conditions in any particular Namhae village, providing plausibly exogenous variation in market access.

Changsun Island, separated from Namhae by a narrow strait, remained unconnected until the completion of the Changsun Bridge in 1980. This seven-year lag creates a natural experiment: Changsun villages experienced the same county-level administrative environment but did not gain bridge access until a second, independent shock. I exploit this timing in two ways. First, Changsun serves as a counterfactual in the cross-island triple-difference

[4]The case study, drawn from the Ministry of Internal Affairs' *Glorious Footsteps* publications, documents how a clan-dominated village completed land donations for road construction within two years, while a comparably sized but fractionalized village required seven years of door-to-door persuasion—a pattern consistent with the anti-commons framework.

design. Second, the 1980 bridge provides an independent replication, testing whether the same institution-contingent pattern appears in a different time period, under evolved NVM policies, and on a different island (Section 6).

Within Namhae Island, villages varied substantially in their proximity to the bridge. The median village lay 23.5 km from the bridge by walking distance, with the range spanning 1 to 52 km. Because residual transport costs increase with distance, villages closer to the bridge gained larger surpluses from improved market access. This continuous variation in treatment intensity provides the basis for the lead empirical specification, which interacts bridge proximity with pre-existing clan composition to identify how social structure mediated infrastructure returns.

2.3 The New Village Movement

The government launched the *New Village Movement* (NVM, *Saemaul Undong*) in 1970 as a nationwide campaign to modernize rural Korea. The program combined central resources with radically decentralized implementation: villages received government transfers but retained full authority over project selection, execution, and monitoring. Village leaders were responsible for building consensus on priorities, organizing labor contributions, and managing budgets. It was not uncommon for leaders' proposals to be rejected by villagers in open meetings (Han 2010). Between 1970 and 1979, participating villages constructed 43,506 km of rural roads and rebuilt virtually all community centers nationwide (The Ministry of Home Affairs 1980).

The NVM began with an unexpected test of village organizational capacity. In 1970–71, the government distributed 335 bags of cement to every village in Korea—a response to domestic cement oversupply rather than a planned development intervention (Jwa 2018). Villages were instructed to use the cement for public goods. Based on how effectively they utilized these resources, the government classified villages into grades A, B, and C by 1972, with higher-graded villages receiving larger subsequent allocations.[5] This grading created a performance-based funding system that rewarded demonstrated collective action capacity.

[5]The original labels were *Jarib* (independent), *Jajo* (self-help), and *Gicho* (basic). I follow Yang (2019) in translating these as A, B, and C.

For the paper's purposes, the NVM matters in three respects. First, it provided the institutional framework through which villages channeled the economic opportunities created by the bridge. The complementary investments that modernization required—feeder roads to connect to the highway, irrigation improvements for intensive rice cultivation, storage facilities for commercial crops—were undertaken as NVM projects, funded by a combination of government grants and local contributions. Second, the NVM's decentralized structure ensured that investment choices reflected local conditions and organizational capacity rather than central planning. Whether a village built a feeder road or expanded into cash crops was decided by the village, not by Seoul. This environment made social structure salient. Had the government dictated investment priorities or built roads centrally, the anti-commons problem would not bind. Third, the NVM raises a potential confound: if cohesive villages simply mobilized NVM resources more effectively regardless of the bridge, the estimated interaction effects could reflect differential NVM capacity rather than differential responses to market access. I address this concern directly by controlling for NVM intensity, and in Section 5 by documenting that baseline NVM performance grades and total project budgets show no significant differences by fractionalization status.

3 Conceptual Framework: Trade Costs and the Anti-Commons

This section develops a formal price-theoretic framework to explain how an exogenous reduction in transport costs interacts with local property rights to generate divergent paths of structural transformation. The goal is not to build a structural model for parameter estimation, but rather to use a simple mechanism-design logic as an analytical tool to discipline the empirical predictions. Specifically, the model formalizes the "anti-commons" holdout problem, demonstrating why coordination constraints were latent before the bridge, why standard repeated-game mechanisms could not resolve them, and how local institutions dictated the resulting paths of structural transformation.

3.1 Setup and Technologies

Consider a rural economy composed of villages, each populated by a continuum of agricultural households. Villages face an iceberg transport cost $\tau \in [\underline{\tau}, \bar{\tau}]$ to export goods to the urban market. Let the village infrastructure state be $G \in \{0, 1\}$, where $G = 1$ represents the successful construction of a paved feeder road. Households choose between three agricultural technologies, $j \in \{TR, MR, CC\}$:

1. **Traditional Agriculture (TR):** Subsistence technologies yielding output consumed locally, insulating the household from transport costs τ. These do not require a paved road ($G = 0$). The baseline payoff is V_{TR}. Traditional agriculture encompasses both subsistence rice and other locally consumed staples such as barley, whose modernization pathway—unlike that of rice—does not require heavy capital inputs or bulk export infrastructure.[6]

2. **Cash Crops (CC):** Market-oriented crops (e.g., cabbage, garlic). Because they are highly perishable, their effective transport costs are strictly higher than those of bulk goods, making their payoff, $V_{CC}(\tau)$, highly sensitive to τ. Furthermore, they are *labor-absorbing*: they require continuous manual tending, precluding out-migration. While adopting new commercial crops requires sharing market information and agronomic knowledge, these are divisible, repeated-game interactions easily sustained by routine village networks; they do not require the lumpy, irreversible alienation of property rights. Cash crops can be transported without a paved road—they are hand-harvested and moved in lighter batches along existing paths ($G = 0$ suffices).

3. **Modern Rice (MR):** A high-yield technology requiring heavy capital inputs (power tillers, bulk chemical fertilizers) to produce an exportable bulk surplus. Crucially, these heavy inputs cannot be imported, nor bulk yields exported, without a paved feeder

[6] Barley in 1970s rural Korea was grown primarily for household consumption and local markets using labor-intensive methods. Its production could be improved through better seeds and fertilizer application without the capital-intensive mechanization (power tillers, bulk chemical shipments) that rice modernization demanded. Barley did not rely as much on the paved feeder roads needed to import heavy machinery or export bulk surplus. This distinction makes barley a natural placebo crop in the empirical analysis: if fractionalization operates through the anti-commons mechanism specific to road construction, it should impede rice modernization but leave barley unaffected.

road; therefore, MR is strictly infeasible unless $G = 1$. Its payoff is $V_{MR}(\tau)$. Mechanization is *labor-saving*, replacing manual labor with capital and freeing surplus labor to migrate to the urban sector.

The key distinction is between technologies whose modernization requires the feeder road (MR) and those that do not (TR, CC). This distinction generates the model's empirical prediction: fractionalization should impede only the coordination-intensive, road-dependent pathway, not necessarily agricultural performance in general.

3.2 The Feeder Road as an N-Player Anti-Commons Game

Building the feeder road ($G = 1$) is a *weakest-link* land assembly problem. It requires contiguous, permanent land donations. This exposes the project to the "tragedy of the anti-commons" (Heller, 1998, Buchanan and Yoon, 2000). Unlike the reciprocal labor exchanges (*poomasi*) that govern daily village life, land donation is a one-shot, irreversible alienation of property, meaning standard repeated-game folk theorems fail to sustain cooperation.

Let N be the number of independent bargaining units (veto players) who must cede a strip of land. I map the village's historical social fractionalization $\theta \in [0, 1]$ to the number of veto players $N(\theta)$, with $N'(\theta) > 0$. In a highly fractionalized village ($\theta \to 1$), parcels are held by independent households across competing lineages. Bargaining is decentralized, driving N prohibitively high.

In a cohesive village ($\theta \to 0$), historical clan hierarchies—often rooted in elite (*Yangban*) lineages—fundamentally alter the bargaining game. The clan structure operates through two reinforcing channels: (1) land ownership is more concentrated among co-lineage members, reducing the raw number of distinct property owners, and (2) the clan elder wields dense social sanctions and hierarchical authority to compel donations from within the lineage.[7] This combination of concentrated ownership and hierarchical authority effectively internalizes the

[7]The model captures both channels through a single sufficient statistic, $N(\theta)$. Strictly, concentrated ownership reduces the number of veto players (the extensive margin), while hierarchical authority lowers the effective holdout cost c_i for co-lineage members (the intensive margin). Both forces push in the same direction—raising Π for cohesive villages—and are jointly sufficient for the comparative statics that follow. Modeling them as a reduction in N is a reduced-form representation of their combined effect.

holdout externalities, transforming an N-player weakest-link game into a manageable, near-single-agent optimization problem ($N \to 1$).

In this light, traditional elite authority is not an omitted confounder; it is the specific institutional technology that minimizes transaction costs and prevents holdouts. If elite authority simply conferred a generic advantage in wealth or state connections, cohesive villages would systematically outperform fractionalized villages across all investment margins. As I document empirically below, they do not: cohesive and fractionalized villages marshal identical total project budgets. Elite authority uniquely advantages cohesive villages only in resolving *weakest-link* land assembly.

To see this formally, let $\Delta V(\tau) \equiv V_{MR}(\tau) - \max\{V_{CC}(\tau), V_{TR}\}$ be the aggregate village surplus generated by the road. Giving up ancestral land entails a privately known idiosyncratic cost c_i for each veto player i.[8]

To build the road, the village mechanism offers a uniform compensation p to each of the N landowners. The total cost Np cannot exceed the village surplus $\Delta V(\tau)$. Each landowner agrees if $p \geq c_i$. Because the road requires all N parcels, the probability of success is $\left(\frac{p}{\bar{c}}\right)^N$. The village planner sets p to maximize the expected net surplus:

$$\max_p \left(\frac{p}{\bar{c}}\right)^N (\Delta V(\tau) - Np)$$

The first-order condition yields the optimal offer $p^* = \frac{\Delta V(\tau)}{N+1}$. Substituting back into the probability function gives the equilibrium probability of building the road:

$$\Pi(N, \tau) = \left(\frac{\Delta V(\tau)}{\bar{c}(N+1)}\right)^N \tag{1}$$

Two properties of Π drive the model's predictions. First, the probability of road construction is increasing in the surplus $\Delta V(\tau)$ and decreasing in the number of veto players N, with the decay in N being *exponential*: even modest increases in the number of independent landholders can dramatically reduce the probability of successful assembly. Second, higher

[8]For analytical tractability and to yield a clean closed-form solution for the optimal offer, I assume c_i is drawn from a uniform distribution $c_i \sim U[0, \bar{c}]$. The qualitative comparative static—that the probability of success decays rapidly with N—holds under any standard continuous distribution function with full support (Mailath and Postlewaite, 1990).

surplus can compensate for more veto players. However, because the exponent is N itself, the substitution is nonlinear. The first increments of surplus have disproportionately large effects on coordination success.

3.3 Equilibrium Dynamics and Testable Implications

I assume that with zero transport costs ($\tau = 0$) and a paved road ($G = 1$), Modern Rice strictly dominates Cash Crops, which strictly dominates subsistence: $V_{MR}(0) > V_{CC}(0) > V_{TR}$. Equation (1) yields five sharp empirical predictions that map sequentially to the empirical findings in the subsequent sections. Taken individually, some predictions are consistent with alternative mechanisms—for instance, any latent-constraint story generates Prediction 1, and pure risk-aversion differences could generate Prediction 5. It is the *joint* occurrence of all five—and especially the weakest-link versus summation distinction of Prediction 4—that uniquely isolates the anti-commons holdout mechanism.

Prediction 1: The Latent Constraint (No Pre-trends). Before 1973, geographical isolation meant transport costs were prohibitive ($\tau = \bar{\tau}$). The perishability penalty destroyed the value of cash crops, and the cost of importing capital made modernization unprofitable: $\Delta V(\bar{\tau}) \leq 0$. Because there is no surplus, $p^* = 0$, and the road is never built ($\Pi = 0$). *Empirical Translation: Social fractionalization θ acts as a latent constraint—it does not predict economic outcomes or differential pre-trends before the bridge because the anti-commons problem is dormant until activated by market access. (Tested in Section 7.1 via event studies.)*

Prediction 2: The Fractionalization Penalty in Modernization. The bridge exogenously collapses average transport costs to $\underline{\tau} \ll \bar{\tau}$, creating massive potential surplus for modernization: $\Delta V(\underline{\tau}) > 0$. However, because the probability of road construction (Π) decays exponentially with the number of veto players (N), highly fractionalized villages fail to assemble the land ($\Pi \to 0$). Without the road ($G = 0$), they cannot adopt Modern Rice. This prediction concerns the *reduced-form productivity consequence* of the anti-commons problem; the specific channel through which fractionalization impedes modernization—the weakest-link land assembly bottleneck—is formalized in Prediction 4. *Empirical Translation: Fol-*

lowing bridge construction, fractionalized villages will experience significantly smaller gains in rice productivity compared to their cohesive counterparts. (Tested in Section 7.1 via the within-Namhae and cross-island DDD estimates.)

Prediction 3: The Distance Substitution Effect. Within the connected island, residual transport cost $\underline{\tau}$ is strictly increasing in physical distance d to the bridge. Therefore, the surplus ΔV is decreasing in distance ($\frac{\partial \Delta V}{\partial d} < 0$). For villages sufficiently close to the bridge, ΔV grows large enough that the planner can afford to offer $p \geq \bar{c}$, driving $\Pi \to 1$ regardless of N. Moreover, the fractionalization penalty attenuates convexly with proximity. Because Π depends on ΔV raised to the power N, the first increments of surplus—experienced by the villages closest to the bridge—have the largest marginal effect on coordination success. This convex attenuation pattern is a distinctive prediction of the anti-commons framework. While a more generic "proximity matters" stories would predict monotonic distance gradients, the holdout mechanism predicts that the fractionalization penalty should vanish nonlinearly as surplus rises. *Empirical Translation: Proximity to the bridge generates sufficient economic surplus to compensate potential holdouts, allowing even highly fractionalized villages to overcome the anti-commons problem, thus attenuating the productivity penalty. The attenuation should be concentrated among villages nearest the bridge, not spread linearly across the distance distribution. (Tested in Section 7.1 via the proximity-interaction design.)*

Prediction 4: The Weakest-Link Mechanism. The fractionalization penalty arises strictly from the N-player land assembly problem required to achieve $G = 1$. It does not stem from a generalized inability to spend money, optimize, or adopt crops. *Empirical Translation: Fractionalization specifically impedes investments requiring unanimous land aggregation (weakest-link public goods like roads, and the coordination-heavy rice crop that relies on them). It has no effect on summation public goods (like total project budgets) or on crops whose modernization does not depend on the feeder road, such as barley, which is consumed locally and does not require bulk export infrastructure ($G = 0$ suffices). (Tested in Section 7.2 via the project taxonomy and the rice-vs-barley crop panel.)*

Prediction 5: Divergent Structural Transformation. Blocked from modernizing rice ($G = 0$), fractionalized villages optimize subject to their institutional constraint by pivoting to Cash Crops (CC), which the bridge has made highly profitable and which can be cultivated without the feeder road ($G = 0$). Because the bridge dramatically reduces τ, the cash-crop payoff $V_{CC}(\underline{\tau})$ rises substantially even though CC does not require the road. When $\Pi \to 0$, a fractionalized village's expected payoff converges to $V_{CC}(\underline{\tau})$, which can be large in absolute terms—the bridge resolves the perishability constraint that previously suppressed cash-crop returns. Because these crops are labor-absorbing, fractionalized villages will retain their population. Cohesive villages, having adopted labor-saving MR, will experience mechanical depopulation as surplus labor is freed. *Empirical Translation: Fractionalized villages will uniquely reallocate land to highly perishable crops and retain their population, while cohesive villages experience structural out-migration despite agricultural productivity gains. Whether the two paths yield comparable aggregate welfare gains is an empirical question. (Tested in Sections 9.1 and 9.2.)*

4 Data

I construct the first village-level panel dataset on rural Korean development, digitizing 336 volumes of archival records to track 196 villages from 1969-1979. The dataset combines four sources to measure agricultural productivity, infrastructure investments, technology adoption, demographic change, and pre-existing social structure through historical clan composition. This unique data effort was made possible by the convergence of rare circumstances in Namhae County: the 1978 standardization of village development records, the preservation of township archives, and access to colonial-era census data on kinship structures. Appendix A.2 provides further details on the data search and digitization process.

4.1 Data Sources and Coverage

Township Statistical Yearbooks (1969-1984) provide annual village-level data on agricultural output, input use, demographics, and socioeconomic indicators. These official records, compiled by township offices for county reporting, constitute my primary source

for productivity outcomes. Data availability varies over the period: coverage is comprehensive for the baseline year (1969) but narrows to 49 villages (25%) for the pre-bridge period (1970-1975). Availability then expands to all 196 villages from 1976 onward.

History of Our Village (1971-1979) documents development projects undertaken during the *New Village Movement*. In 1978, village leaders compiled standardized records of all local projects, including budgets, labor contributions, and physical specifications (e.g., road dimensions). I located and digitized records from 120 villages (61%), preserved in village community centers. To address the concern that villages with surviving records are systematically different, I test for balance on key pre-treatment characteristics (Appendix Table A.22). While the two groups are balanced on most measures, villages with surviving records were, on average, larger, had a higher share of paddy fields, and were located closer to the future bridge site. These differences are modest in magnitudes. To account for these observable baseline differences, I include these variables as controls in the regression analyses. Lastly, while these books were not formally audited, cross-validation with official township records suggests high data quality: project specifications match where both sources exist.[9]

New Village Comprehensive Survey (1972) provides baseline characteristics before bridge construction. This Ministry of Internal Affairs survey records initial infrastructure (road access, electricity), geographic features (topography, streams), and early collective action capacity measured through performance grades in cement utilization projects during the first year of the *New Village Movement*. The survey covers all 196 villages.[10]

1930 Census Appendix on Family Names enables measurement of social fractionalization through village-level clan composition.[11] The census recorded all kinship groups (*bon-gwan*) comprising at least 10% of village households, revealing substantial variation: in Namhae County, 40 villages had a single dominant clan (>50% of households) while others

[9]See Appendix Figure A.7 for an example, which shows an official record card for a 1975 farm road project alongside the corresponding *History* entry with identical project specifications.

[10]I thank Hyunjoo Yang of Sogang University for providing this dataset. See Appendix Figure A.6 for an example page from this survey.

[11]I thank Hyunjoo Yang of Sogang University for providing this dataset.

showed no dominant lineage. Historical sources and fieldwork confirm that these kinship structures remained salient through the 1970s, a point I validate empirically below.

4.2 Sample Construction and Key Variables

I link villages across sources using official administrative codes and village names, with manual verification for ambiguous cases. The final analysis sample comprises an unbalanced panel of 196 villages over 16 years (1969–1984), with 1,364 village-year observations for the core productivity analysis (1969–1979). Missing data primarily affects early years, as documented above; event-study figures explicitly flag the low-coverage years as "gray zones" to distinguish them from the full-coverage post-1976 period.

Bridge Access. The key treatment variable is bridge access. Villages on the connected island (Namhae) experienced immediate market access improvements, while those on the unconnected island (Changsun) serve as controls. The median connected village lies 23.5 km from the bridge, with distances ranging from 1 to 52 km. To capture this heterogeneous treatment intensity, I use several complementary measures:

- **Overall Access** (I_i^{Bridge}): An indicator variable distinguishing villages on the newly connected Namhae Island from those on the adjacent, unconnected Changsun Island within the same county. This captures the average impact of gaining bridge/expressway access.

- **Proximity-Based Intensity** ($I_i^{Proximate}$, $-log(Dist_i^{Bridge})$): Within the connected Namhae Island, treatment intensity is proxied by proximity to the bridge. $I_i^{Proximate}$ is an indicator for villages located closer than the median walking distance (23.5 km) to the bridge. $-log(Dist_i^{Bridge})$ uses the continuous walking distance, where higher values indicate closer proximity to the bridge. Distances are calculated based on detailed 1970 road network matrices to reflect travel paths at the time (see Appendix A.2.2 for details).

- **Local Infrastructure-Based Intensity** (I_i^{Roads}, $-log(Dist_i^{Township})$): Treatment intensity is also proxied by factors influencing a village's ability to leverage the new

bridge access. I_i^{Roads} is an indicator for whether a pre-existing local road network passed through the village in 1972. $-log(Dist_i^{Township})$ measures the walking distance to the nearest township office, which served as local administrative and market centers.

Social Fractionalization. The conceptual framework maps village social fractionalization θ to the number of independent veto players $N(\theta)$ in the land assembly game. In the data, I operationalize this mapping using the 1930 census of clan composition. Because all Korean villagers shared ethnicity, language, and religion, clan composition isolates the specific organizational channel—the presence or absence of a dominant lineage whose hierarchical authority can internalize holdout externalities—from the preference heterogeneity that typically confounds fractionalization measures in cross-country or cross-ethnic settings.

I construct three complementary measures that capture different aspects of this organizational structure:

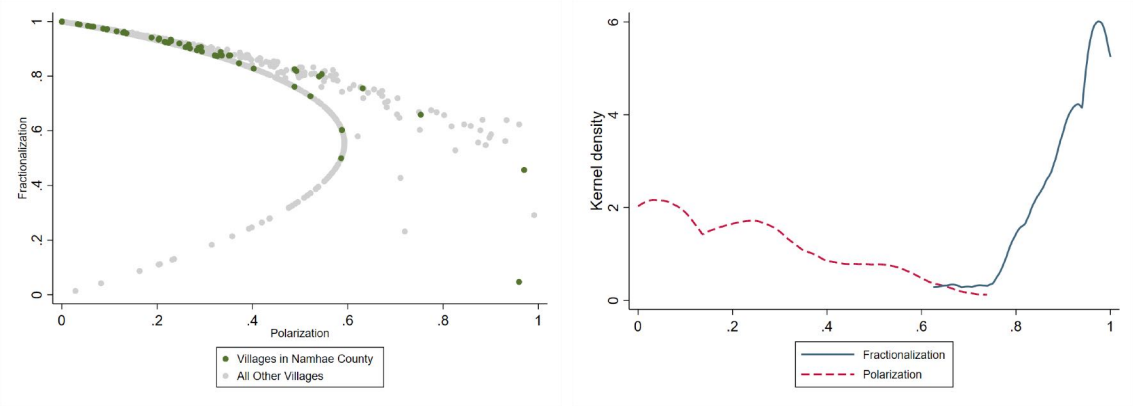
- **Top Clan Share** ($TopShare_i$): The proportion of households belonging to the largest single clan (mean = 0.29, SD = 0.25). This most directly captures the model's mechanism: a village with a high $TopShare$ has a dominant lineage whose elder can plausibly internalize holdout externalities, driving $N(\theta)$ toward one.

- **Significant Clan Share** ($ClanShare_i$): The combined share of households in clans comprising >10% of village population (mean = 0.25, SD = 0.16). This captures the extent to which the village population is organized under identifiable kinship hierarchies capable of coordinating land assembly.

- **Fractionalization Index** (F_i): The standard Herfindahl-based index, $F_i = 1 - \sum_{c=1}^{N} s_{ic}^2$, where s_{ic} is the share of households belonging to clan c (mean = 0.92, SD = 0.07). I also report the Esteban-Ray Polarization index, $P_i = 4 \sum_{c=1}^{N} s_{ic}^2 (1 - s_{ic})$, which measures the extent to which the population is divided into antagonistic groups (Esteban et al. 2012).

For the main analysis, I use a binary indicator (I_i^{Frac}) equal to one for villages with above-median F values.

Figure 1: Fractionalization (F) and Polarization (P)



(a) Villages in Gyeongsangnam-do province (b) F and P Distributions in Namhae County

Notes: Figures are constructed using data from the 1930 Census, Family Names of the Korean Peninsula. Figure 1a plots F against P for all villages in Gyeongsangnam-do province. Each point represents a village, with villages in Namhae County, a part of this province, highlighted in green. Figure 1b shows the kernel density estimates of F and P for villages in Namhae County. The blue solid line represents the distribution of F, while the red dashed line represents the distribution of P. The kernel density estimation uses an Epanechnikov kernel with a rule-of-thumb bandwidth.

Interpreting Fractionalization in Namhae County. Figure 1a plots F against P for villages in Gyeongsangnam-do (South Gyeongsang Province), highlighting those in Namhae County, a subregion of the province, in green. Figure 1b shows the distributions of F and P for Namhae County villages. The F values in Namhae County are notably high compared to benchmarks in the broader literature, with a mean of 0.92 and a distribution skewed toward high values (Montalvo and Reynal-Querol 2005, Bazzi et al. 2019). This partly reflects a methodological factor: clans are more finely categorized than broader groupings like ethnicity or religion commonly used in other studies, which naturally inflates F by increasing the likelihood that two randomly selected individuals belong to different groups.

Despite high absolute F values, the relative differences across villages are empirically meaningful, and the measures that most directly capture the model's mechanism—$TopShare$ and $ClanShare$—show stark contrasts. Table 1 compares clan composition across the binary fractionalization indicator. Less fractionalized villages have a top clan share of 0.32 compared to just 0.06 in highly fractionalized villages, and 48% of their households belong to significant clans compared to only 8% in high-F villages. In terms of the model's mapping from θ to $N(\theta)$: a village where nearly half the population falls under identifiable clan

Table 1: Clan Composition by Fractionalization Status in Namhae County

	$I_i^{Frac} = 0$ (Less Fractionalized)	$I_i^{Frac} = 1$ (Highly Fractionalized)	p-value
Fractionalization Index (F_i)	0.85	0.98	<0.01
Top Clan Share ($TopShare_i$)	0.32	0.06	<0.01
Significant Clan Share ($ClanShare_i$)	0.48	0.08	<0.01
Number of Villages	100	96	

Notes: This table compares clan composition metrics for villages below ($I_i^{Frac} = 0$) and above ($I_i^{Frac} = 1$) median fractionalization in Namhae County, using 1930 census data mapped to the 1970s. F_i is the Herfindahl-based fractionalization index. $TopShare_i$ is the share of households in the largest clan. Significant Clan Share ($ClanShare_i$) is the combined share of households in clans with $> 10\%$ representation (overall mean = 0.25, SD = 0.16). The 1930 census only reports clans with $> 10\%$ of households, so smaller clans (e.g., those in highly fractionalized villages with shares of 5-6%) are not counted as significant. p-values from t-tests of mean differences.

hierarchies—headed by an elder with authority over land allocation and dispute resolution—faces a fundamentally different bargaining problem from one where 92% of households belong to clans too small to exercise collective authority. The former approximates a near-single-agent optimization ($N \to 1$); the latter a decentralized negotiation among many independent holdouts.

Relevance and Persistence of Clan Networks. The primary data source for clan composition is the "Family Names of the Korean Peninsula," an appendix to the 1930 Japanese colonial census. It documented clans comprising more than 10% of a village's households. The key methodological challenge is establishing relevance across the 40-year interval to the 1970s study period. I address this using two pieces of evidence: the continued presence of ancestral shrines (*jaesil*) for clans recorded in the 1930s, and the strong correlation between 1930s and 2000s clan composition.

First, ancestral shrines (*jaesil*) constructed between the 1970s and 1990s illustrate the enduring salience of clan affiliation in village life. These shrines, dedicated to clan ancestors, serve as focal points for ritual practices, community gatherings, and the reinforcement of clan identity and cohesion. Namhae County township history books (*myeonji*) written between 2004 and 2020 recorded the locations and origins of existing ancestral shrines in the county.[12]

[12]These township history books were often compiled with substantial input from Mr. Eui-Yeon Jeong and Ms. Hee-Myung Ahn, who generously shared with me the full archive of Namhae data they had collected over several decades. Their contributions were instrumental in assembling the quantitative dataset and in contextualizing it through local historical narratives. The eight townships that made up Namhae County in the 1970s were subdivided into 10 townships in the 2000s: *Kohyun* (township history book published in

Between 1980 and 2000, there were 74 shrines constructed or substantially renovated. The investment in these physical markers of clan heritage underscores the continued centrality of kinship networks in organizing collective behavior and reinforcing shared norms.

To establish this connection directly, I mapped shrine-associated clans to those recorded as significant in 1930. Of 74 shrines, 65 (87%) were affiliated with clans that had significant presence in 1930. For example, the Jinyang Jeong clan, present across 10 villages in 1930, constructed five shrines across five townships after 1970. This correspondence demonstrates that clans maintaining ritual presence through shrine construction were predominantly the same clans that held demographic weight four decades earlier. While not all shrines map to county-wide dominant clans, their association with clans documented as village-level significant in 1930 shows these kinship structures retained practical relevance rather than becoming historical relics.

Second, clan distributions from 2000s township history books provide direct evidence of persistence across the 20th century. All villages except twenty-eight semi-urban ones reported clan compositions at publication. Appendix Figure A.8a plots 1930 F-indices against 2000s counterparts, showing strong correlation ($\beta = 0.996$, SE $= 0.16$). Appendix Figure A.8b shows similar persistence for TopShare ($\beta = 0.703$, SE $= 0.14$). Despite seven decades spanning Japanese occupation, the Korean War, and rapid industrialization, clan structures show remarkable stability.

Mapping Historical Clan Data (1930) to the Study Period (1970s). Mapping the 1930 clan data to the study period requires several steps and assumptions, detailed further in Appendix A.3. First, since the 1930 census only provided township-level household counts, I estimated village-level counts by assuming that each village's share of its township's households remained constant between 1930 and 1972. Second, population growth led to village subdivisions: while there were 79 villages in 1930, this number increased to 196 by 1970. New villages typically emerged from subdivisions of existing ones, often retaining the parent name with a numerical suffix (e.g., Namhae-dong becoming Namhae-1-dong and Namhae-2-dong). For these cases, I assumed that both newly created villages inherited the

2004), *Nam* (2009), *Namhae* (2008), *Mijo* (2020), *Samdong* (2007), *Sangju* (2008), *Seo* (2007), *Seolchun* (2017), *Leedong* (2008), *Changsun* (2007).

clan composition of their 1930 parent village. Third, for the few clans that were spread across multiple villages in 1930, I allocated their households proportionally based on estimated 1930 village sizes.

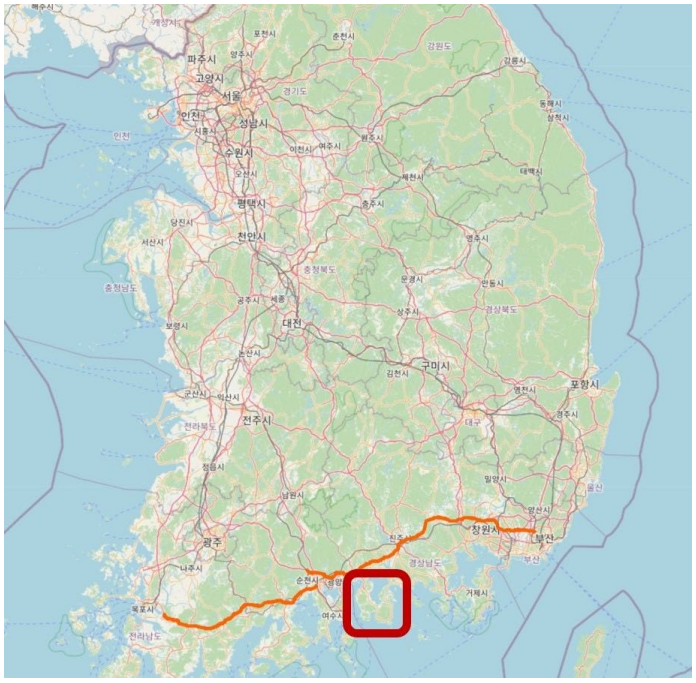
The most critical assumption—that subdivided villages retained their parent village's composition—warrants careful scrutiny. If subdivisions reflected an influx of diverse newcomers into a specific area, the resulting villages could be more heterogeneous than their parent. Conversely, if divisions occurred along existing clan lines, homogeneity may have been preserved or even heightened. While available data cannot directly test these scenarios, empirical studies using Korean social security numbers mitigate concerns. Park (2018) and Rhee (2015) show that clan concentration generally increased in rural Korea during this period, as selective out-migration led marginal groups to leave first in search of new economic opportunities. This suggests that assuming compositional stability may, if anything, understate clan homogeneity in the 1970s.

4.3 Descriptive Patterns

Appendix Table A.14 presents summary statistics for key variables. Three patterns warrant emphasis. First, despite population decline—from 689 to 566 residents per village between 1969 and 1979—rice output increased by 50%, representing the productivity puzzle this paper seeks to explain. Second, technology adoption proceeded slowly, with only 7% of agricultural households owning power tillers by 1979, suggesting mechanization alone cannot explain productivity gains. Third, development priorities shifted toward infrastructure, which rose from 52% to 72% of village project budgets during the decade. Section 5 examines how these and other baseline characteristics—including barley production, which serves as a placebo crop in the empirical analysis—varied systematically with social fractionalization.

Figure 2a presents a map of South Korea, highlighting the Namhae Expressway in orange and Namhae County within a red rectangle. Figure 2b shows Namhae County, which comprises two islands and eight townships further subdivided into 196 villages.

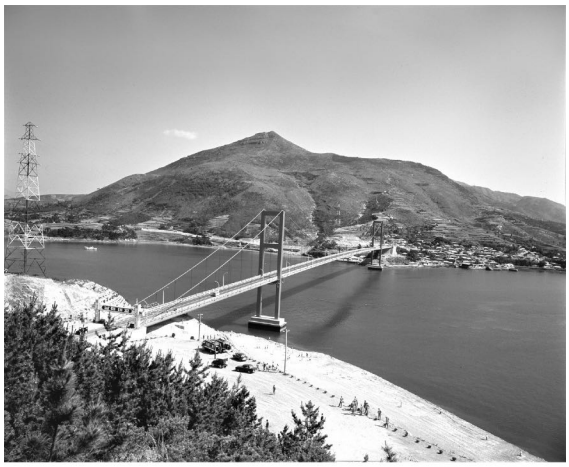
Figure 2: The Namhae Expressway, Namhae Bridge, and Namhae County



(a) The Namhae Expressway is highlighted in orange, and Namhae County is highlighted with the red rectangle.



(b) Namhae County and its eight townships



(c) The Namhae Bridge in 1973

5 Baseline Characteristics and Identifying Variation

Villages with different levels of clan-based fractionalization were not randomly distributed across Namhae County. They had sorted along economic, geographic, and organizational dimensions that predate the bridge by decades. This section documents these baseline differences, distinguishes those that are threats to identification from those that are equilibrium consequences of the mechanism under study, and presents direct evidence on pre-bridge collective action capacity.

Equilibrium Sorting versus Confounding. Table 2 reports baseline village characteristics by fractionalization status and by eventual bridge access. The most striking differences between cohesive and fractionalized villages appear in their economic orientations: less fractionalized villages ($I_i^{Frac} = 0$) were fundamentally agricultural communities, with only 9% of households engaged in non-farm activities compared to 22% in highly fractionalized villages. They devoted 62% of arable land to rice paddies—six percentage points more than high-F villages—and achieved 17% higher rice productivity (921 kg vs. 783 kg per agricultural household). This productivity advantage was accompanied by complementary investments: less fractionalized villages maintained 0.45 cows per household compared to 0.32 in highly fractionalized villages, with draft animals serving as important inputs for paddy cultivation.

A natural concern is that these differences confound the analysis: perhaps fractionalization merely proxies for baseline agricultural orientation, and the bridge simply had higher returns in villages where rice was already dominant (Wade 1982). Two features of the data argue against this interpretation. First, the rice-specific differences are themselves predicted by the conceptual framework. Section 3 models clan structure as the institutional technology that enables coordination-intensive investments; rice cultivation in rural Korea required precisely such investments—irrigation management, synchronized planting, collective land preparation. That cohesive villages specialized in rice before the bridge is an equilibrium outcome of the same coordination capacity the paper studies, not an independent confound. If baseline orientation were driving the results mechanically, fractionalization should predict baseline differences across *all* crops, not selectively in the coordination-intensive one. Yet baseline barley output is nearly identical across fractionalization levels (1,251 vs. 1,234 kg

per agricultural household, $p = 0.86$), consistent with the model's prediction that fractionalization constrains only the coordination-intensive margin.[13] Second, horse-race regressions in Section 7.3 show that fractionalization retains explanatory power for post-bridge rice productivity after controlling for baseline rice share and agricultural orientation, ruling out the interpretation that clan composition merely captures "being more agricultural."

Geography, Market Access, and Information. Geographic patterns reinforce the economic divergence. High fractionalization villages occupied peripheral positions in land-based networks: 45% farther from the county office (13.9 km vs. 9.6 km) with significantly worse county road access (35% vs. 55%), limiting their connections to traditional administrative and agricultural market centers. Appendix Tables A.16 and A.18 confirm that these patterns persist after controlling for village characteristics and township fixed effects.

However, high fractionalization villages compensated through alternative networks. Appendix Table A.16 shows that high-F villages were closer to existing ports, and Appendix Table A.17 shows that they were 21 percentage points more likely to have port facilities within the village. They also had significantly greater telephone access (56% vs. 38%, $p = 0.01$). This pattern is informative for distinguishing among alternative mechanisms: fractionalized villages were not informationally isolated or disconnected from external networks. Their constraint was specifically organizational—the inability to coordinate irreversible land assembly—not a deficit in information, communication, or market access per se.[14]

This geographic sorting—peripheral to land-based networks but proximate to maritime routes and telecommunications—reflects longstanding adaptation. Less fractionalized villages concentrated where collective agricultural investments yielded returns, while highly fractionalized villages settled where individualistic economic activities remained viable.

[13] Appendix Tables A.15 and A.19 confirm that the rice orientation pattern is robust to controlling for geography and township fixed effects, while basic geographic characteristics (land area, presence of streams, mountainous terrain) are unrelated to fractionalization.

[14] One might suggest that external network ties or "weak ties" could drive cash-crop adoption in fractionalized villages. If anything, fractionalized villages' greater telecommunications connectivity and port access suggest they faced fewer information barriers, not more. The diversification results persist after controlling for port proximity (Appendix Table A.17), consistent with the interpretation that the binding constraint was coordination over land, not access to information or markets.

Table 2: Baseline Village Characteristics

	Kinship Fractionalization			Eventual Access to Bridge		
	$I_i^{Frac}=0$	$I_i^{Frac}=1$	p-value	$B_i=0$	$B_i=1$	p-value
Panel A: Demographics & Basic Infra. (1972)						
Population	646.1	732.6	0.05	804.7	670.7	0.04
Number of Households	106.5	123.9	0.04	124.4	113.6	0.39
Share of Non-Agricultural Households	0.09	0.22	0.00	0.24	0.14	0.00
Avg. Num. of Schools	0.17	0.27	0.12	0.19	0.22	0.74
Modern Roof Share	0.31	0.35	0.10	0.34	0.33	0.70
Panel B: Agricultural Prod. & Structure (1969)						
Rice Output per Agri. HH (kg)	921	783	0.01	880	849	0.71
Barley Output per Agri. HH (kg)	1251	1234	0.86	1741	1166	0.00
Rice Yield (kg/ha)	3177	3081	0.36	2763	3186	0.00
Special-use Crop Area (ha)	3.49	2.74	0.00	3.24	3.11	0.72
Number of Special-use Crops Grown	4.79	4.44	0.08	4.96	4.56	0.18
Share of Arable Land as Rice Paddies	0.62	0.56	0.00	0.48	0.60	0.00
Total Cultivated Area (ha)	46.9	43.9	0.29	54.8	44.0	0.01
Panel C: Livestock Assets (1969)						
Cows per HH	0.45	0.32	0.00	0.43	0.38	0.21
Pigs per HH	0.27	0.28	0.66	0.16	0.29	0.00
Chickens per HH	9.02	6.95	0.06	4.35	8.57	0.01
Rabbits per HH	0.33	0.24	0.02	0.18	0.30	0.04
Panel D: Amenities & Info. Access (1969)						
Radios per HH	0.31	0.30	0.70	0.40	0.29	0.06
Newspapers per HH	0.12	0.09	0.02	0.06	0.12	0.00
Share of Villages with Telephone Access	0.38	0.56	0.01	0.23	0.51	0.01
Panel E: Market Access (1972)						
Distance to the Bridge (km)	22.6	25.8	0.06	N/A	24.1	N/A
Share of Car Accessible Villages	0.79	0.72	0.26	0.65	0.77	0.21
Share of Highway Accessible Villages	0.22	0.19	0.57	N/A	0.24	N/A
Share of County Road Accessible Villages	0.55	0.35	0.01	0.54	0.44	0.36
Distance to Closest Admin Office (km)	4.44	6.12	0.06	4.15	5.43	0.33
Distance to County Office (km)	9.6	13.9	0.00	N/A	11.6	N/A
Panel F: Baseline NVM Indicators (1972)						
Share of Grade A Villages (initial assessment)	0.15	0.10	0.34	0.12	0.13	0.84
Initial Project Budget (USD)	1761	2205	0.40	1370	2024	0.43
Initial Voluntary Contributions (% of cost)	0.27	0.19	0.08	0.15	0.25	0.19
Initial Project Labor Input (worker-days per capita)	2.47	1.89	0.18	1.71	2.28	0.41

Notes: This table presents mean baseline characteristics of villages in Namhae County, grouped by kinship fractionalization and eventual bridge access. $I_i^{Frac}=1$ indicates above-median fractionalization (lower clan concentration, based on the Herfindahl index). $B_i=1$ indicates villages on the island connected by the 1973 Namhae Bridge. Columns 3 and 5 report p-values from t-tests comparing means across I_i^{Frac} and B_i groups, respectively. Panels A, C–F use 1972 data; Panel B uses 1969 data. Panels cover demographics and infrastructure (A), agricultural production (B), livestock assets (C), amenities and information access (D), market access (E), and New Village Movement (NVM) indicators (F). Korean Won values are converted to USD using an approximate exchange rate of 1,000 Won = 1 USD. Distances to the bridge and county office are unavailable for unconnected villages ($B_i=0$). See Table A.21 for means by joint I_i^{Frac} and B_i categories.

Pre-Bridge Collective Action Capacity. Villages' initial responses to the *New Village Movement* provide a revealed-preference measure of collective action capacity before the bridge. In 1970-71, prior to the NVM's formal launch, the government distributed 335 bags of cement to every village in Korea with the requirement that they be used for public goods provision.[15] Based on how effectively villages used these resources, the government classified them into grades A, B, and C by 1972.[16]

Two patterns in Panel F of Table 2 merit emphasis. First, less fractionalized villages contributed a significantly higher share of project costs through voluntary labor and materials (27% vs. 19%, $p = 0.08$). This eight-point gap in voluntary contributions is a direct measure of the willingness and ability to contribute to public goods, the organizational capacity that the anti-commons framework identifies as the binding constraint for road construction. Ethnographic accounts confirm that dominant lineages served as focal points for labor mobilization in rural Korea (Deuchler 2015, National Institute of Korean History 2023), and Yang (2019) finds that across 5,539 villages in North Kyungsang Province, higher social heterogeneity is associated with lower NVM performance grades.

Second, and equally important for identification, NVM performance grades and total project budgets show no significant differences by fractionalization (Grade A share: 15% vs. 10%, $p = 0.34$; project budgets: \$1,761 vs. \$2,205, $p = 0.40$). This null result shows that the government did not systematically favor cohesive villages in resource allocation, and that fractionalized villages were not generically less capable or less motivated. The gap appeared specifically in voluntary contributions requiring coordination across households, not in externally provided resources or aggregate effort.

Implications for Identification. The baseline sorting documented above is a feature the conceptual framework predicts and the empirical strategy exploits. The model implies that villages with different coordination capacities will have selected into different pre-bridge equilibria. What the model additionally predicts, and what standard confounding stories do not, is that the bridge should activate a new divergence along margins that were previously

[15] This distribution originated from domestic cement oversupply rather than development planning, adding to its unexpected nature as a test of village capacity (Jwa 2018).

[16] The original labels were *Jarib* (independent), *Jajo* (self-help), and *Gicho* (basic). I follow Yang (2019) in translating these as A, B, and C, respectively.

dormant: rice modernization conditional on feeder road construction. The key identification test is therefore not whether cohesive and fractionalized villages looked identical before the bridge, but whether the bridge generated differential changes in outcomes, absent differential pre-trends. The event-study evidence in Section 7 confirms no differential pre-trends in rice productivity, supporting the interpretation that post-bridge divergence reflects the activation of a latent coordination constraint rather than a continuation of pre-existing trajectories.

6 Empirical Strategy

The primary identification challenge is isolating how pre-existing social structures mediate infrastructure impacts from confounding factors that correlate with both clan composition and economic trajectories. By 1973, villages with different fractionalization levels had sorted into distinct economic equilibria—less fractionalized villages specialized in coordination-intensive rice cultivation while more fractionalized ones diversified near coastal areas. This endogenous sorting precludes simple cross-sectional comparisons.

To address this, I exploit quasi-random variation in market access generated by the 1973 opening of the Namhae Bridge, interacted with historically determined variation in village-level clan composition. The core empirical question is whether villages with different pre-existing clan structures translated the same market-access shock into different economic adjustments. The lead specification uses *within-Namhae* variation in treatment intensity: among villages on the connected island, the reduction in travel cost was larger for villages closer to the bridge landing point. A cross-island triple-difference incorporates the adjacent unconnected island as a counterfactual, and a stacked two-shock design exploits the 1980 Changsun Bridge as an independent replication. A crop-panel specification then exploits within-village variation across rice and barley to isolate the coordination-specific channel.

The conceptual framework (Section 3) generates five testable predictions. The first four—the latent constraint (Prediction 1), the fractionalization penalty (Prediction 2), the distance-substitution effect (Prediction 3), and the weakest-link mechanism (Prediction 4)—are tested directly by the specifications below. The fifth, divergent structural transformation, is examined in Section 9.2.

6.1 Within-Island Proximity Design

The lead empirical strategy restricts the sample to the 170 villages on the connected Namhae island. By working entirely within the treated landmass, this design eliminates concerns about unobservable differences between islands and substantially mitigates general-equilibrium confounders—such as selective labor migration from unconnected to connected regions—that could bias cross-island comparisons.

Let Z_i denote a time-invariant measure of proximity to the bridge (either $I_i^{Proximate}$, a binary indicator for below-median walking distance, or $-\log(Dist_i^{Bridge})$, a continuous measure; see Section 4.2). The main tables use the binary indicator $I_i^{Proximate}$ for transparency. Continuous distance results are reported separately and confirm that effects are not an artifact of the median split. Walking distances are reconstructed from the predetermined (1970) road network matrices rather than Euclidean distance, better reflecting actual travel burdens across Namhae's mountainous terrain (Appendix A.2.2).

The proximity difference-in-differences specification is:

$$Y_{it} = \alpha_i + \lambda_t + \beta\left(Z_i \times Post_t\right) + \gamma X_{it} + \varepsilon_{it}, \tag{2}$$

where Y_{it} is the outcome of interest (e.g., rice output per agricultural household) for village i in year t; α_i and λ_t are village and year fixed effects; $Post_t$ equals one for years after 1973; and X_{it} includes time-varying demographic controls (log population, average household size, and the share of women). This specification identifies whether villages closer to the bridge experienced larger post-1973 gains in outcomes.

To test whether social structure mediates this proximity gradient, I add the fractionalization interaction:

$$\begin{aligned} Y_{it} = \alpha_i + \lambda_t + \beta_1\left(Z_i \times Post_t\right) + \beta_2\left(I_i^{Frac} \times Post_t\right) \\ + \beta_3\left(Z_i \times I_i^{Frac} \times Post_t\right) + \gamma X_{it} + \varepsilon_{it}. \end{aligned} \tag{3}$$

The coefficient of interest is β_3. With I_i^{Frac} coded as above-median fractionalization, $\beta_3 > 0$ implies that proximity to the bridge attenuates the fractionalization penalty—consistent with sufficiently large market-access gains substituting for local coordination ca-

pacity (Prediction 3). β_1 captures the proximity gradient common to both village types, and β_2 absorbs differential post-bridge trends by fractionalization status that are unrelated to proximity. The conceptual framework predicts no differential pre-trends in the proximity gradient by fractionalization: because the anti-commons problem is triggered only when market access creates surplus worth coordinating over, the triple-interaction coefficients should be near zero prior to 1973 (Prediction 1). Event study analogs of Equation (3), which replace $Post_t$ with year indicators, provide direct tests of this prediction; the resulting figures are presented alongside the main results in Section 7.1.

To ensure that fractionalization is not simply proxying for baseline agricultural orientation, I progressively saturate the specification with additional fixed effects: township × year effects (absorbing township-level shocks such as local NVM resource allocation), and baseline rice cultivation share × year trends (absorbing differential trajectories associated with initial crop specialization). Standard errors are clustered at the village level, with Conley (1999) spatial HAC corrections reported alongside (see Section 6.5).

6.2 Cross-Island Triple-Difference

As a complementary approach, I incorporate the 26 villages on the adjacent, unconnected Changsun island to construct a cross-island triple-difference. Changsun Island is not an arbitrary comparison group: together with Namhae Island it formed Namhae County, sharing the same administrative institutions, policies, and broader economic environment. The key difference is that the 1973 Namhae Bridge connected only Namhae Island to the mainland. While Namhae villages gained immediate road access to mainland markets in 1973, Changsun villages remained accessible only by boat. This contrast provides a natural counterfactual for how villages with different social structures would have evolved absent the infrastructure shock. In this specification, the proximity measure is replaced with an island-level treatment indicator:

$$\begin{aligned} Y_{it} = \alpha_i + \lambda_t + \delta_1 \left(I_i^{Bridge} \times I_i^{Frac} \times Post_t\right) \\ + \delta_2 \left(I_i^{Bridge} \times Post_t\right) + \delta_3 \left(I_i^{Frac} \times Post_t\right) + \gamma X_{it} + \varepsilon_{it}, \end{aligned} \tag{4}$$

where I_i^{Bridge} equals one for villages on the connected island. This specification complements the within-Namhae design by offering a sharper temporal comparison (pre versus post across a discrete treatment boundary), while the proximity design offers stronger protection against cross-island confounders.

6.3 Validation: Stacked Two-Shock Design

To provide internal validation, I exploit a second, independent infrastructure shock: the 1980 Changsun Bridge, which finally connected the control island. Because all Changsun villages received the bridge simultaneously, a standard difference-in-differences cannot separate the average bridge effect from the year effect. However, the *differential* response by social structure is identified: village fixed effects absorb time-invariant differences, and the interaction $Post_t^{1980} \times I_i^{Frac}$ is identified from cross-sectional fractionalization variation within Changsun, asking whether villages on the same island, receiving the same shock, diverged by pre-existing clan composition.

I stack the two bridge episodes—Namhae (centered on 1973) and Changsun (centered on 1980)—into a pooled event-time framework with episode × year fixed effects absorbing episode-specific aggregate shocks. The Changsun episode has a cleaner pre-period (full data coverage from 1976 onward) but a smaller sample (26 villages), so this specification provides suggestive corroboration rather than a definitive replication test. The key question is whether the same institution-contingent mechanism operates across an independent shock occurring seven years later, under different NVM policies, and on a different island.

6.4 Mechanism Identification: Crop-Panel Design

The specifications above identify heterogeneous infrastructure returns by social structure, but cannot rule out all village-level confounders that may differ between high- and low-fractionalization villages. To isolate the coordination-specific channel, I exploit within-village variation by stacking rice and barley into a village × crop × year panel:

$$Y_{ict} = \alpha_{ic} + \lambda_{ct} + \mu_{it} + \psi \left(I_i^{Frac} \times I_c^{Rice} \times Post_t \right) + \varepsilon_{ict}, \tag{5}$$

where α_{ic} are village $\times$ crop fixed effects (absorbing baseline crop specialization), λ_{ct} are crop $\times$ year fixed effects (absorbing national crop-specific shocks), and crucially, μ_{it} are village $\times$ year fixed effects, which absorb *all* village-level time-varying confounders—including differential trends in income, labor supply, or NVM intensity—that affect both crops symmetrically. The coefficient ψ identifies whether fractionalization differentially constrains rice relative to barley. Barley cultivation in Namhae is organized at the individual household level, with plots dispersed across hillside terraces that require neither the shared irrigation systems nor the feeder road access that paddy rice demands. Any village-level confounder that affects rice and barley symmetrically is therefore absorbed by μ_{it}. Only a mechanism that differentially penalizes coordination-intensive production can generate $\psi \neq 0$—exactly the prediction of the anti-commons framework (Prediction 2).

6.5 Identifying Assumptions and Spatial Inference

Parallel Trends in Differences. The within-Namhae proximity design requires that, absent the bridge, the gap in outcomes between proximate and distant villages would have evolved identically for high- and low-fractionalization villages. The cross-island DDD requires the analogous assumption across islands. Both are weaker than requiring parallel trends for all groups separately—the triple-difference structure absorbs differential trends between proximity groups (via β_1) and between fractionalization types (via β_2), requiring only that the interaction of these differences remains stable.

SUTVA. Within-island spillovers could in principle attenuate or amplify estimates. Feeder roads in this setting are village-specific investments—short connectors linking individual villages to the nearest trunk road—rather than shared regional infrastructure, so the direct treatment spillovers from one village's road to its neighbors' productivity are limited. To the extent that indirect spillovers operate (for example, if successful mechanization in a cohesive village raises demand for hired labor from neighboring fractionalized villages), they would attenuate the estimated differential, biasing against finding the predicted pattern. Conversely, if NVM resource allocation responded to early successes by channeling additional investment toward already-performing villages, the differential could be amplified. The within-island

design mitigates the most consequential general-equilibrium concern: that bridge-induced labor reallocation *between* islands could confound cross-island comparisons. By restricting the lead specification to Namhae, this class of confounders is eliminated.

Selection on Observables. Because social structure is not randomly assigned, historically cohesive villages may differ in baseline wealth or sectoral composition. The progressive fixed effects in the lead specification directly address this: township × year effects exploit within-township variation, and rice share × year trends absorb differential trajectories by initial agricultural orientation. To further distinguish coordination capacity from correlated baseline endowments, I estimate horse-race specifications that augment Equation (3) with competing heterogeneity dimensions—agricultural household share (the most direct measure of agricultural orientation), modern roof share (a proxy for baseline wealth and early NVM engagement), and baseline rice share—both as standalone predictors and alongside fractionalization. If fractionalization merely captures "being more agricultural" or "being wealthier," these competing dimensions should absorb its coefficient. Section 7.3 reports this exercise.

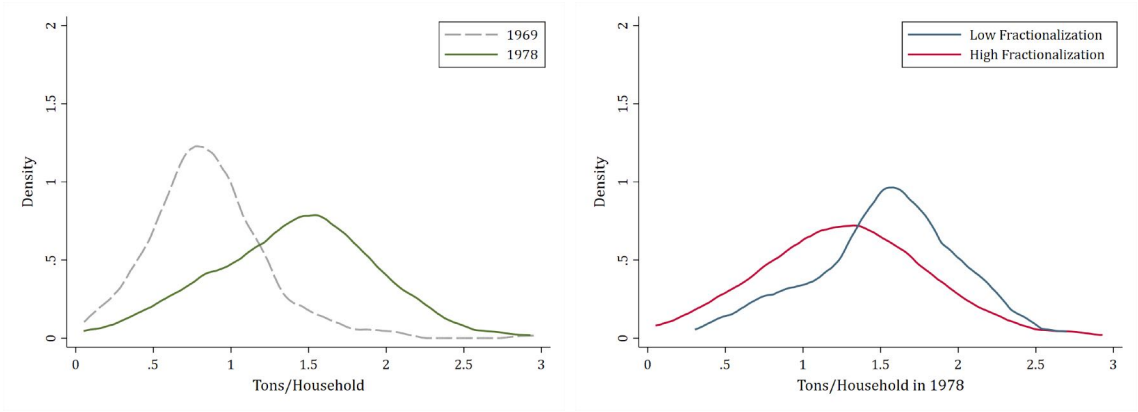
Spatial Inference. Standard errors are clustered at the village level in all specifications. Because unobserved geographic shocks may generate spatial correlation across nearby villages, I also report Conley (1999) spatial HAC standard errors with a 10 km distance cutoff, motivated by Namhae's geographic scale. Where the two inference procedures diverge, I discuss the implications for specific coefficients.

7 Rice Productivity and the Fractionalization Penalty

7.1 Main Results

Descriptive Patterns. Figure 3 motivates the analysis. The left panel shows the village-level rice productivity distribution shifting rightward from 1969 to 1978, with mean output per agricultural household rising 71% (from 0.83 to 1.42 tons). This aggregate growth coincided with increased dispersion. The right panel decomposes the 1978 distribution by social structure, revealing higher mean productivity in less fractionalized villages, suggestive of a

Figure 3: Rice Productivity Distributions in Namhae County Villages



Notes: The left panel shows the distribution of rice output per agricultural household at the village level in 1969 and 1978. The right panel focuses on 1978 village-level productivity, comparing villages with different levels of pre-existing social fractionalization.

coordination constraint. The regression designs below address this identification challenge.

Within-Namhae Proximity Estimates. Table 3 presents the main result, restricting the sample to the 170 villages on the connected island and exploiting variation in walking distance to the bridge. Column (1) establishes that treatment intensity matters: villages below the median walking distance gain 228 kg per agricultural household post-1973 (27% of the pre-bridge mean of 857 kg). Column (2) shows that, within Namhae, high-fractionalization villages experienced slower post-bridge productivity growth (−105 kg, about 12% of the pre-bridge mean). Column (3) tests the key implication of the framework: whether proximity attenuates the fractionalization penalty. Among villages *distant* from the bridge, the coefficient on $I_i^{Frac} \times Post_t$ is −181 kg, implying a large penalty where market-access gains are modest. The interaction term $I_i^{Proximate} \times I_i^{Frac} \times Post_t$ is positive, so the implied penalty among proximate villages is close to zero.[17] This attenuation is consistent with the distance-substitution prediction (Prediction 3): sufficiently high returns to market access can offset coordination frictions. The magnitudes are economically large but plausible, given that national agricultural productivity in Korea grew by roughly 60% during this decade.

Columns (4)–(5) address the leading alternative interpretation: that fractionalization

[17] $-181 + 226 = 45$ kg

Table 3: Within-Namhae Bridge Proximity and Rice Productivity

	Rice Output per Agri. HH (kg)				
	(1) Prox. DD	(2) Frac. DD	(3) Baseline	(4) +Twp×Yr	(5) +Rice×Yr
$I_i^{Proximate} \times Post_t$	228.15***		130.21**	199.49***	120.48**
	(41.90)		(50.22)	(55.65)	(53.08)
			[66.19]	[12.06]	[74.05]
$I_i^{Frac} \times Post_t$		−104.86**	−181.05***	−177.02***	−134.37**
		(48.79)	(53.80)	(54.01)	(52.02)
			[76.65]	[110.47]	[43.88]
$I_i^{Proximate} \times I_i^{Frac} \times Post_t$			226.13**	231.14**	175.74**
			(91.83)	(97.24)	(87.24)
			[89.44]	[132.71]	[55.99]
Demographic Controls	✓	✓	✓	✓	✓
Village & Year FE	✓	✓	✓	✓	✓
Township × Year FE				✓	
Rice Share$_{1969}$ × Year FE					✓
Mean of Y (pre-1973)	857.3	857.3	857.3	857.3	857.3
Observations	1,079	1,079	1,079	1,079	1,067
N Villages	170	170	170	170	170

Notes: Sample restricted to Namhae island (connected) villages. The dependent variable is rice output per agricultural household in kilograms. $I_i^{Proximate} = \mathbb{1}$[walking distance to bridge < median] and $I_i^{Frac} = \mathbb{1}$[kinship fractionalization > median]. Walking distances are recovered from archival distance matrices (see Appendix A.2.2). Column (1) reports the simple proximity difference-in-differences; column (2) the fractionalization difference-in-differences; column (3) the full triple-interaction specification. Columns (4)–(5) progressively add demanding fixed effects: township × year (absorbing township-level shocks) and baseline rice cultivation share × year (absorbing differential trends by initial agricultural orientation). Demographic controls include log population, average household size, and share of women. Standard errors clustered at the village level in parentheses; Conley (1999) spatial HAC standard errors with a 10 km distance cutoff in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

merely proxies for baseline agricultural orientation rather than coordination capacity. Column (4) adds township × year fixed effects, absorbing time-varying shocks at the township level, including differential New Village Movement resource allocation. Column (5) allows trends to vary flexibly with initial crop specialization by including baseline rice-cultivation share × year effects. The qualitative pattern is stable across both specifications: a large fractionalization penalty among distant villages that attenuates among proximate ones. Standard errors are clustered at the village level, and inferences remain robust to spatial autocorrelation adjustments (Conley 1999). Section 7.3 directly pits fractionalization against these competing heterogeneity dimensions.

Cross-Island Triple Difference. The within-Namhae design compares more-treated to less-treated villages, but every village on the connected island received some improvement in market access. To provide a counterfactual for how villages with different social structures would have evolved absent the bridge entirely, I incorporate the 26 villages on the adjacent Changsun island, which shares Namhae County's administrative jurisdiction and economic hinterland but remained accessible only by boat until 1980.

Column (3) of Table 4 reports the triple-difference estimate: the coefficient on $I_i^{Bridge} \times Post_t \times I_i^{Frac}$ is -353 kg, indicating that bridge access widened the productivity gap between cohesive and fractionalized villages by 39% of the pre-bridge mean.[18] The point estimate is larger than the within-Namhae penalty, but the two designs identify different estimands. The proximity design captures the fractionalization gradient along treatment intensity, while the cross-island DDD captures the full treatment-control contrast. The key finding is qualitative consistency: both designs point to a large, significant fractionalization penalty activated by bridge access.

Panel B shows that the estimate is robust to propensity score reweighting (which adjusts for observable baseline differences between islands), alternative inference procedures (wild cluster bootstrap and randomization inference), and a pre-treatment placebo test that yields a precisely estimated null effect.

[18]To benchmark: the average agricultural household in Namhae produced roughly 900 kg of rice annually, so 353 kg represents approximately three months of household rice consumption at prevailing per-capita consumption rates.

Table 4: The Effect of Social Fractionalization on Rice Productivity

Panel A: DDD Results

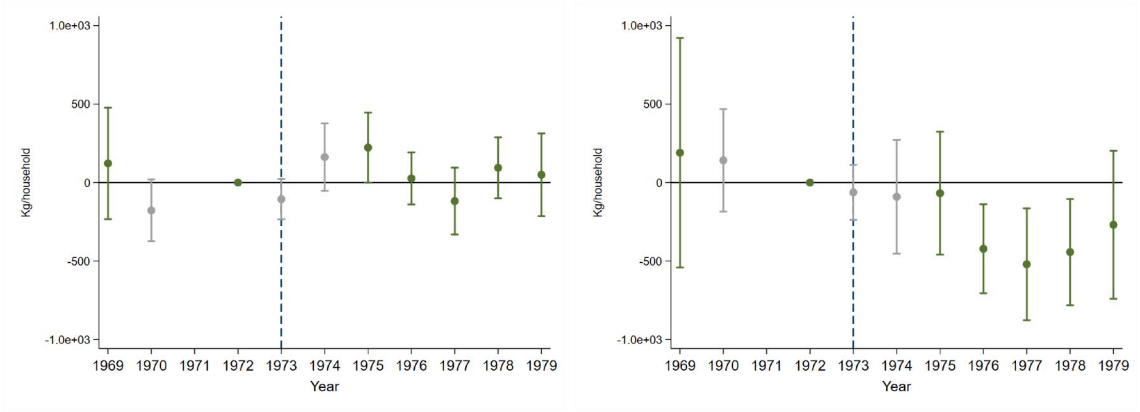
	Rice Output per Agri. HH (kg)		
	(1)	(2)	(3)
$I_i^{Bridge} \times Post_t$	9.79		188.23**
	(97.59)		(93.72)
$I_i^{Frac} \times Post_t$		-15.62	234.11**
		(51.06)	(113.29)
$I_i^{Bridge} \times Post_t \times I_i^{Frac}$			-352.97***
			(127.68)
Demographic Controls	✓	✓	✓
Mean of Y (Pre-1973)	886.0	886.0	886.0
Observations	1,364	1,364	1,364
Number of Villages	196	196	196
R-squared	0.76	0.76	0.76

Panel B: Robustness of the Triple-Difference Estimates

	Baseline	PSW	Placebo
$I_i^{Bridge} \times Post_t \times I_i^{Frac}$	-352.97***	-328.54**	-3.27
	(127.68)	(138.68)	(149.74)
Wild Cluster p-val	[0.009]		
Randomization p-val	{0.004}		

Notes: Panel A presents double-difference estimates (columns 1-2) and the main triple-difference specification (column 3). Panel B examines the robustness of the triple-difference coefficient using alternative approaches. All specifications include village and year fixed effects, and controls for demographic characteristics: log of total village population, average household size, and share of women in the village population. Wild cluster bootstrap p-values in brackets and randomization inference p-values in braces are based on 1,000 replications. PSW = Propensity Score Weighting. The mean standardized bias was reduced from 0.190 before weighting to 0.051 after weighting. Placebo = Pre-treatment placebo using 1971–1972 vs. 1969–1970. Standard errors clustered at the village level in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Figure 4: Event Study of Bridge Impact on Rice Productivity



(a) The Bridge on Rice Productivity (b) Heterogeneity by Clan Composition

Notes: These figures present event study estimates of the bridge's impact on rice productivity (kg per agricultural household). The vertical dashed line marks bridge construction (1973), with 1972 omitted as the baseline year. Figure 4a shows double-difference (DD) estimates comparing connected and unconnected islands. Figure 4b shows triple-difference (DDD) estimates, interacting bridge access with above-median social fractionalization. Grey markers indicate years with incomplete data coverage (only 49 of 196 villages reporting in 1970, 1973, and 1974). All specifications include village and year fixed effects. Points represent coefficients with 95% confidence intervals based on standard errors clustered at the village level.

Figure 4 presents the event-study analog in the cross-island framework. Panel (b) provides a direct test of Prediction 1: the triple-interaction coefficients are close to zero in all pre-bridge years, confirming no differential pre-trends in the fractionalization penalty. The divergence begins after 1975, with a two-to-three year lag consistent with the time required for complementary investments to translate into output gains. The gap peaks in 1977–1978 before attenuating, consistent with the gradual adaptation documented in Section 9. Panel (a) shows that the average bridge effect is close to zero, masking the heterogeneity by social structure that the triple-difference reveals.

A Second Bridge Episode: Changsun 1980. A remaining concern is that some feature specific to the 1973 episode—timing with early NVM implementation, coincident shocks, or other unobservables—could generate the estimated heterogeneity. The 1980 Changsun Bridge provides an independent test. This bridge connected Changsun island to the Namhae landmass, giving Changsun villages road access to the mainland through the existing Namhae Bridge for the first time. The setting differs from the 1973 episode in several respects: by

1980, the NVM had entered a different phase, national agricultural policy had shifted, and the Changsun villages had observed seven years of post-bridge development on neighboring Namhae.

Because all 26 Changsun villages received the bridge simultaneously, a standard difference-in-differences cannot separate the bridge effect from the year effect. But the differential response by social structure is identified: villages on the same island, receiving the same shock at the same time, differed in their pre-existing clan composition. I therefore estimate whether fractionalization predicts differential productivity responses within Changsun, paralleling the within-Namhae analysis. Namhae villages are excluded from this episode because their trajectories were already altered by the first bridge.

Table 5 reports the results. Panel A presents each episode separately. Columns (1)–(2) reproduce the Namhae cross-island DDD for reference: the fractionalization interaction is −353 kg. Column (3) shows the Changsun episode alone: fractionalized villages experience a productivity penalty of −365 kg following bridge access, similar in magnitude despite the smaller sample, different time period, and different NVM policy environment. That the same pattern emerges under different policy conditions and on a different island strengthens the case that the result reflects a general feature of how social structure mediates infrastructure returns rather than an artifact of the 1973 setting. Panel B pools both episodes in a stacked framework with episode × year fixed effects. The pooled fractionalization interaction in Column (4) is −411 kg, larger than either episode-specific estimate. This reflects the changed counterfactual in the stacked design, where episode × year effects absorb episode-specific means rather than the island-specific year effects used in the cross-island DDD.[19] Column (5) adds an episode-specific interaction ($I_e^{Ep.2} \times Post_e \times I_i^{Frac}$) to test whether the fractionalization penalty differs across the two bridge shocks. The coefficient is −210 kg but statistically insignificant, indicating that the data cannot reject equal fractionalization penalties across episodes.

[19] The stacked and cross-island designs impose different fixed-effect structures, so the pooled estimate need not equal a simple average of the episode-specific coefficients.

Table 5: Stacked Two-Shock Design: Namhae (1973) and Changsun (1980) Bridges

	Rice Output per Agricultural HH (kg)				
	Namhae (1973)		Changsun (1980)	Pooled	
	(1)	(2)	(3)	(4)	(5)
Panel A: Episode-Specific Estimates					
$I_i^{Bridge} \times Post_t^{1973}$	9.79	188.23**			
	(97.59)	(93.72)			
$I_i^{Bridge} \times Post_t^{1973} \times I_i^{Frac}$		-352.97***			
		(127.68)			
$Post_t^{1980} \times I_i^{Frac}$			-365.45**		
			(171.16)		
Panel B: Pooled Stacked Estimates					
$Treated_e \times Post_e$				213.71**	198.38**
				(101.47)	(99.94)
$Treated_e \times Post_e \times I_i^{Frac}$				-410.99***	-359.10***
				(155.35)	(128.43)
$I_e^{Ep.2} \times Post_e \times I_i^{Frac}$					-210.43
					(161.82)
Village FE	✓	✓	✓	✓	✓
Year FE	✓	✓	✓		
Episode × Year FE				✓	✓
Demographic Controls	✓	✓	✓	✓	✓
N Villages	196	196	26	222	222
Observations	1,364	1,364	207	1,571	1,571

Notes: This table exploits two independent bridge shocks to test whether the same fractionalization-contingent productivity pattern replicates across events. **Namhae columns** (1–2): The 1973 Namhae Bridge connects Namhae Island to the mainland. $I_i^{Bridge} = 1$ for Namhae villages; Changsun villages serve as controls. Sample: all 196 villages, 1969–1979. **Changsun column** (3): The 1980 Changsun Bridge connects Changsun to Namhae. Since all Changsun villages receive the bridge simultaneously, only the fractionalization interaction ($Post^{1980} \times I^{Frac}$) is identified. Sample: 26 Changsun villages, 1976–1984. Namhae villages are excluded because their post-1973 trajectories are contaminated by prior treatment. **Pooled columns** (4–5): Stack Namhae episode (all villages, event time centered on 1973) and Changsun episode (Changsun only, centered on 1980). Village × episode FE and episode × event-time FE are included. Column 5 tests whether the fractionalization heterogeneity differs across episodes. Standard errors clustered at the village level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

7.2 A Crop-Panel Test of Coordination Specificity

The three designs above establish a consistent reduced-form pattern: market access raises rice productivity most in socially cohesive villages, with the penalty attenuating near the bridge. A natural concern is that villages with different clan structures may differ along other dimensions—baseline wealth, political connections, or NVM exposure—that also shape infrastructure responses. To isolate the coordination-specific channel, I exploit the within-village contrast between rice and barley developed in Section 6.4. Because barley is cultivated individually on dispersed upland plots without shared infrastructure, any village-level confounder affecting both crops symmetrically is absorbed by village × year fixed effects. If the mechanism operates through a coordination bottleneck, the fractionalization penalty should appear for rice but not barley.

Table 6 implements this test. Columns (1)–(2) present separate proximity-based triple-difference regressions for rice and barley within Namhae. The triple-interaction coefficient is 226 kg for rice and 162 kg for barley. While the point estimates might appear similar, the economic magnitudes differ substantially once scaled to baseline output: the rice effect is 26% of the pre-bridge rice mean, whereas the barley effect is 14% of the pre-bridge barley mean. Moreover, the rice estimate is precisely estimated while the barley estimate has a standard error nearly twice its magnitude, so the data cannot distinguish it from zero.

Column (3) stacks rice and barley into a village × crop × year panel and estimates a formal quadruple-difference specification with village × year fixed effects.[20] The key coefficient ($I_i^{Prox} \times Post_t \times Rice_c \times I_i^{Frac}$) is 309 kg, indicating that proximity to the bridge attenuates the fractionalization effect 309 kg more for rice than for barley—36% of pre-bridge rice output. This is consistent with the anti-commons framework. The coordination bottleneck binds specifically for rice, so the surplus gains from proximity, which compensate potential holdouts, matter more for the coordination-intensive crop. The same conclusion holds when replacing the binary proximity indicator with continuous distance (Panel B), where the DDDD coefficient is 231 kg.

[20] This is a demanding mechanism test: village × year fixed effects absorb *all* village-level time-varying confounders—including differential NVM intensity, labor supply shifts, income shocks, or administrative responses—so identification comes purely from within-village differences between rice and barley in the same year.

Table 6: Crop-Panel Test: Rice vs. Barley Productivity

	Separate Regressions		Crop Panel
	(1) Rice	(2) Barley	(3) Rice vs. Barley
Panel A: Binary Proximity			
$I_i^{Prox} \times Post_t \times I_i^{Frac}$	226.13**	161.77	
	(91.83)	(150.84)	
$I_i^{Prox} \times Post_t \times Rice_c$			-165.05**
			(81.06)
$I_i^{Prox} \times Post_t \times Rice_c \times I_i^{Frac}$			308.88**
			(155.89)
Panel B: Continuous Distance			
$-\log(Dist_i) \times Post_t \times I_i^{Frac}$	146.46*	10.10	
	(80.02)	(102.56)	
$-\log(Dist_i) \times Post_t \times Rice_c$			-195.28***
			(74.71)
$-\log(Dist_i) \times Post_t \times Rice_c \times I_i^{Frac}$			230.96**
			(97.04)
Demographic Controls	✓	✓	✓
Village FE	✓	✓	
Year FE	✓	✓	
Village × Crop FE			✓
Village × Year FE			✓
Sample	Namhae	Namhae	Namhae
Observations	1,079	1,053	2,094
Mean of Y, Rice (Pre-1973)	857.3		857.3
Mean of Y, Barley (Pre-1973)		1,153.8	1,153.8

Notes: This table tests whether the fractionalization penalty operates specifically through the high-coordination crop (rice) rather than affecting all agricultural output equally. Columns (1)–(2) estimate separate triple-difference regressions for rice and barley output per agricultural household (kg). Column (3) stacks rice and barley observations within each village-year to form a crop panel. The stacked sample requires both rice and barley observations within a village-year, reducing the observation count relative to the sum of Columns (1)–(2). The quadruple-difference coefficient (Column 3, $I^{Prox} \times Post \times Rice \times I^{Frac}$) provides a formal test of whether the proximity–fractionalization interaction is significantly larger for rice than for barley. The DDDD coefficient in Column (3) does not mechanically equal the difference between the Column (1) and Column (2) coefficients because the stacked specification uses village × year fixed effects (which absorb all village-level time-varying unobservables), whereas Columns (1)–(2) use separate village and year fixed effects. The surviving variation is purely within-village and across-crop: any confound that affects both rice and barley equally within a village-year is absorbed. Panel A uses the binary proximity indicator ($I_i^{Prox} = \mathbb{1}$[walking dist. < median]). Panel B uses continuous $-\log$(walking distance to bridge). Demographic controls (log population, avg. household size, share of women) enter directly in Columns (1)–(2) and interacted with the crop indicator in Column (3). All lower-order interactions are included but not reported. Clustered SEs in parentheses.

This crop-panel evidence is difficult to reconcile with explanations that operate at the village level but do not differentially penalize coordination-intensive production. Any village-level confound—elite status, baseline wealth, risk preferences, credit access, political connections—would need to affect rice and barley differently in fractionalized versus cohesive villages to survive the village × year fixed effects. The anti-commons mechanism predicts precisely this crop-specific pattern because rice modernization requires lumpy shared investments that barley does not.

7.3 Coordination Capacity versus Agricultural Orientation

The crop-panel test rules out village-level confounders that do not differentially affect coordination-intensive production. But specific observable correlates of fractionalization could plausibly generate crop-specific effects through channels unrelated to coordination. Less fractionalized villages were more agricultural, devoted more land to rice, and maintained higher livestock ownership (Table 2). If these correlated endowments—rather than the ability to solve collective-action problems—drive the differential bridge response, then the anti-commons interpretation overstates the role of social structure. I focus on agricultural household share and modern roof share as the leading competitors. Baseline rice share is excluded for the reasons discussed in Section 5.

Table 7 addresses this concern by running the paper's main specification—the within-Namhae proximity design—with alternative heterogeneity dimensions substituted for, and then included alongside, fractionalization. The exercise has two parts: testing whether the leading competitors can alone generate the proximity pattern, and then whether they absorb the fractionalization coefficient when included jointly.

Column (1) reproduces the baseline result: the triple interaction $I_i^{Proximate} \times Post_t \times I_i^{Frac}$ is 226 kg. Columns (2)–(3) replace fractionalization with its two leading competitors. Baseline agricultural household share—the most direct measure of agricultural orientation—generates a negative but statistically insignificant triple interaction (Column 2), indicating that villages with a higher share of agricultural households did not differentially benefit from proximity to the bridge in a way that survives the proximity design's demanding structure. Modern

Table 7: Horse-Race: Fractionalization vs. Alternative Heterogeneity Dimensions

	Rice Output per Agri. HH (kg)					
	(1) Frac	(2) Agri Share	(3) Wealth (Roof)	(4) Frac+ Agri	(5) Frac+ Wealth	(6) All
Panel A: Within-Namhae Proximity						
Sample: Namhae island only						
$I_i^{Proximate} \times Post_t \times \ldots$						
I_i^{Frac}	226.13**			237.13***	211.57**	218.22**
	(91.83)			(85.51)	(91.51)	(89.02)
Share of Agri. HH		-368.12		-90.55		137.30
		(357.86)		(373.49)		(365.20)
Modern Roof Share			90.58		25.66	-48.34
			(239.24)		(240.18)	(246.68)
Baseline Rice Share						-108.57
						(303.70)
Panel B: Cross-Island DDD						
Sample: All 196 villages						
$I_i^{Bridge} \times Post_t \times \ldots$						
I_i^{Frac}	-352.97***			-269.68**	-320.10***	-45.01
	(127.68)			(113.20)	(115.51)	(99.73)
Share of Agri. HH		716.08		576.12		502.02
		(473.08)		(394.07)		(393.04)
Modern Roof Share			-741.24		-534.00	-527.75
			(543.15)		(510.55)	(426.75)
Baseline Rice Share						-738.38
						(498.60)
Village & Year FE	✓	✓	✓	✓	✓	✓
Demo. Controls	✓	✓	✓	✓	✓	✓
Panel A						
Observations	1,079	1,079	1,073	1,079	1,073	1,067
R^2	0.81	0.81	0.81	0.82	0.81	0.82
Panel B						
Observations	1,364	1,364	1,358	1,364	1,358	1,352
R^2	0.76	0.77	0.76	0.77	0.76	0.78

Notes: Each column reports triple-interaction coefficients. Panel A: $I_i^{Proximate} \times Post_t \times$ Heterogeneity Measure (Namhae only). Panel B: $I_i^{Bridge} \times Post_t \times$ Heterogeneity Measure (full sample). Columns 1–3 enter each measure individually; columns 4–5 test fractionalization against each competitor; column 6 includes all measures simultaneously, including baseline rice cultivation share. Rice share enters only in column 6 because rice specialization partly reflects coordination capacity itself, making it a demanding over-control rather than a distinct competing channel. All lower-order interactions included but suppressed. Share of agricultural HH and baseline rice share are measured in 1969; modern roof share measured in 1971. Demographic controls: log population, average HH size, share of women. Village-clustered SEs in parentheses.

roof share—a proxy for baseline village-level wealth and early NVM engagement—also fails to generate a significant triple interaction (Column 3). Neither competitor, on its own, can reproduce the proximity-mediated heterogeneity that fractionalization captures.

Columns (4)–(6) include fractionalization alongside its competitors. In Column (4), adding agricultural household share leaves the fractionalization coefficient largely unchanged in magnitude and significance, contributing no additional explanatory power. Column (5) adds wealth instead; the fractionalization coefficient is stable. Column (6) includes all three dimensions simultaneously. The fractionalization interaction remains the only statistically significant predictor of differential proximity effects, while neither competing dimension is significant.

Panel B replicates the exercise using the cross-island DDD specification. The fractionalization coefficient remains stable through the pairwise comparisons in Columns (1)–(5), consistent with the within-Namhae results. In the kitchen-sink specification of Column (6), however, the fractionalization interaction loses significance when all competitors are included simultaneously. This attenuation likely reflects the additional heterogeneity that the cross-island design introduces: pooling Namhae and Changsun villages into a single comparison adds variation in geography, administrative capacity, and pre-bridge economic structure that the within-Namhae design holds constant. The cross-island DDD remains valuable as a validation design for the main reduced-form patterns (Sections 7.1–7.2), but discriminating among competing heterogeneity dimensions is most credible in the tighter within-island setting.

This pattern is difficult to reconcile with the view that fractionalization merely captures "being more agricultural" or "being wealthier." The result is consistent with fractionalization capturing something about village organization—specifically, the capacity to solve the land-assembly problems—that is not reducible to baseline endowments.

Taken together, the evidence in this section establishes three facts about the fractionalization penalty in rice productivity: it is specific to the coordination-intensive crop rather than household-level barley, it is not absorbed by baseline agricultural orientation or wealth, and it attenuates with proximity to the bridge consistent with the distance-substitution prediction. Section 8 traces the causal chain underlying this penalty, from bridge access through

feeder-road construction and technology adoption to rice output.

8 The Channel: Roads, Technology, and Productivity

The anti-commons framework identifies a specific bottleneck: feeder-road construction, the step at which the N-player land-assembly problem binds (Prediction 4). The framework further predicts that fractionalization should impede *weakest-link* public goods requiring unanimous consent while leaving *summation* public goods unaffected. This section traces the downstream causal chain from bridge access through road construction and technology adoption to rice productivity, drawing on NVM project records from *History of Our Village* volumes (120 villages) and technology measures from the statistical yearbooks (83–103 villages).

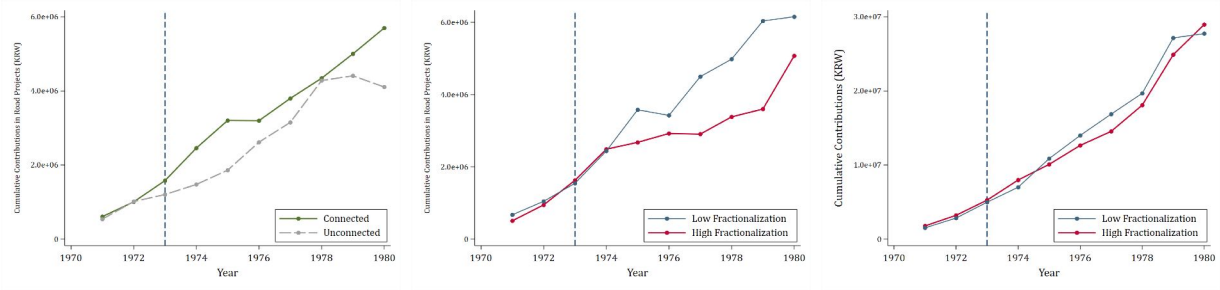
8.1 Road Construction as the Bottleneck

Figure 5 provides direct evidence on the weakest-link prediction. Panel 5a shows that road investment rose after 1973 on the connected island relative to the unconnected island, consistent with higher returns to local connectivity after bridge access. Panel 5b restricts to the connected island and shows that the post-1973 increase was driven by cohesive villages: cumulative road investment trends are similar through 1973 and then diverge sharply beginning in 1974. This divergence is consistent with the pre-bridge collective action gap documented in Section 5: the same villages that contributed a higher share of NVM project costs through voluntary labor before the bridge (27% vs. 19%) were those that subsequently built more feeder roads when the bridge raised the returns to doing so.

Panel 5c tests the summation-good placebo. Cumulative spending on *all* village projects—a summation public good requiring aggregate effort rather than unanimous consent—does not diverge by fractionalization. This pattern rules out the interpretation that cohesive villages simply had more resources, greater motivation, or better NVM engagement. The differential response is specific to the investment category that requires land assembly across multiple landholders, where the anti-commons bottleneck binds.[21]

[21] A natural extension would estimate the triple-difference coefficient separately by NVM project category.

Figure 5: The Role of Social Cohesion in Public Goods Investment



(a) Road Investment (By Bridge Access)

(b) Road Investment (By Fractionalization)

(c) All Project Investment (By Fractionalization)

Notes: This figure plots the cumulative average contributions per village to public goods projects from 1971 to 1980. The vertical dashed line in each panel indicates the opening of the Namhae Bridge in late 1973. Panel (a) compares villages on the connected island to those on unconnected islands, showing a divergence in road investment after the bridge opened. Panels (b) and (c) restrict the sample to connected villages only. Panel (b) shows the divergence in road investment was driven by low-fractionalization (more socially cohesive) villages. Panel (c) serves as a placebo test, showing no systematic difference between high- and low-fractionalization villages in contributions to all village projects combined, suggesting the coordination problem was specific to road-building. Data are from digitized *History of Our Village* records.

8.2 From Roads to Technology Adoption

If feeder roads are the bottleneck, they should predict adoption of the modern inputs and machinery that roads make physically accessible. Table 8 provides evidence on two technologies central to Korea's 1970s agricultural modernization: chemical fertilizers (proxied by declines in organic manure use, available for 83 villages in a panel) and power tillers (available in cross-section for 103 villages).

Fertilizer Transition. Column (1) shows that bridge access reduced organic manure use by 7.14 kg per agricultural household, a 43.8% decline from the pre-bridge mean of 16.3 kg, consistent with rapid substitution toward chemical fertilizers once transport costs fell. Column (2) adds the fractionalization interaction: the decline was 7.41 kg in cohesive villages but only 3.31 kg ($= -7.41 + 4.10$) in fractionalized ones—a 56% smaller modernization effect. Column (3) links this differential to road investment, measured as cumulative kilometers of feeder roads constructed under the NVM through the end of the sample period.[22] While

In practice, disaggregating the 120 villages with project records by category leaves too few observations per cell—particularly on the control island—for the triple interaction to be identified.

[22]Road stock is computed from village-level NVM project records in the *History of Our Village* volumes, which report the type, timing, and physical scope of each project. In Table 8, specifications that include road

bridge access alone reduced manure use by 4.36 kg, villages that additionally built feeder roads experienced a total reduction of 8.01 kg ($= -4.36 - 3.65$), nearly doubling the effect. This suggests that a substantial share of the bridge's modernization impact operated through the feeder-road channel, though the endogeneity of road investment to village coordination capacity precludes a strict mediation interpretation.

Mechanization. Columns (4)–(5) show that bridge access enabled mechanization in cohesive villages but not fractionalized ones. The bridge increased power tiller ownership by 2.6 per 100 agricultural households (46% of the post-period mean of 5.7), but this effect was concentrated entirely in cohesive villages: fractionalized villages gained only 0.7 tillers per 100 households ($= 0.026 - 0.019$), a statistically insignificant effect. Column (5) confirms that road stock drives this differential: each additional kilometer of feeder roads above the sample mean amplified the bridge's impact on tiller ownership by 1.3 per 100 households.[23]

The consistency across both technology margins is notable: whether the outcome is fertilizer adoption or mechanization, the bridge effect is large in cohesive villages, attenuated in fractionalized ones, and amplified by feeder-road provision.

8.3 Mechanism Timing

If productivity gains caused road investment rather than the reverse, the rice productivity divergence documented in Section 7 should precede or coincide with the road investment divergence. The data show the opposite ordering. Figure 5 shows the road investment gap between cohesive and fractionalized villages opening in 1974–1975, immediately following the bridge. Rice productivity divergence emerges only in 1976–1978 (Figure 4), two to three years later, consistent with the time required for road access to enable input adoption and for modern inputs to translate into measured output. The intervening links confirmed in Table 8—fertilizer substitution and mechanization, both amplified by road stock—complete the sequence. The overall chain unfolds over three to five years: bridge (1973) $\rightarrow$ roads

stock re-center the variable at the sample mean of 2.27 km, so the main effect captures the bridge impact at mean road provision and the interaction captures the marginal effect per additional kilometer.

[23]The coefficient 0.020 represents the bridge effect evaluated at mean road stock (after re-centering at 2.27 km). The interaction coefficient 0.013 captures the additional effect per kilometer above the mean.

Table 8: Road Infrastructure and Agricultural Modernization

	Organic Manure Use (kg per agri. HH)			Power Tillers (per agri. HH, avg. 1977-79)	
	(1) Baseline	(2) Frac.	(3) Road Building	(4) Baseline	(5) Road Stock
$I_i^{Bridge} \times Post_t$	-7.14***	-7.41***	-4.36***		
	(0.83)	(0.83)	(1.33)		
$I_i^{Bridge} \times Post_t \times I_i^{Frac}$		4.10***			
		(0.73)			
$I_i^{Bridge} \times Post_t \times I_{i,t}^{BuiltRoads}$			-3.65**		
			(1.70)		
I_i^{Bridge}				0.026**	0.020**
				(0.011)	(0.009)
$I_i^{Bridge} \times I_i^{Frac}$				-0.019**	
				(0.008)	
$I_i^{Bridge} \times RoadStock_{i,1977}$					0.013**
					(0.005)
Interpretation:					
Bridge effect (low frac.)	-7.14***	-7.41***		0.026**	
Bridge effect (high frac.)		-3.31***		0.007	
Bridge + Road effect			-8.01***		See note
Village and Year FEs	✓	✓	✓		
Controls				✓	✓
Observations	398	398	398	103	103
Number of Villages	83	83	83	103	103
R^2	0.73	0.73	0.73	0.13	0.13
Mean of Y (Pre-1973)	16.3	16.3	16.3		
Mean of Y (1977-79)				0.057	0.057

Notes: This table examines how road infrastructure facilitated agricultural modernization through technology adoption. *Panel A* (Columns 1-3): DiD estimates using organic manure use (kg per agricultural household) as dependent variable, 1970-1979. Declining manure use indicates substitution to chemical fertilizers. $I_{i,t}^{BuiltRoads} = 1$ if village i constructed feeder roads by year t. *Panel B* (Columns 4-5): Cross-sectional analysis of power tiller ownership per agricultural household (average 1977-79). $RoadStock_{i,1977}$ measures cumulative kilometers of feeder roads built through 1977 minus the sample mean of 2.27 km. $I_i^{Bridge} = 1$ if village received bridge access in 1973. $I_i^{Frac} = 1$ if clan fractionalization exceeds median. Controls in columns 4-5: car accessibility dummy (1972), share of modern roofs (1972), and log population (1972). Standard errors clustered at village level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Interpretation notes: Column 3: Combined effect calculated as -4.36 + (-3.65) = -8.01 for villages that built roads. Column 5: With re-centered road stock variable, the bridge effect at mean road stock is 0.020 (35% of mean power tiller ownership). Each additional kilometer of roads above the mean increases the bridge effect by 0.013, representing a 23% increase relative to mean ownership.

(1974–75) → technology adoption → rice productivity (1976–78). This temporal structure is consistent with the causal ordering the anti-commons framework predicts and difficult to reconcile with reverse causality from productivity to roads.

The next section asks how fractionalized villages—blocked from this coordination-intensive modernization path—adapted along alternative margins.

9 Alternative Paths and Structural Transformation

The anti-commons framework does not predict that fractionalized villages simply lose from infrastructure investment. Prediction 5 identifies a specific alternative: blocked from the coordination-intensive path, fractionalized villages pivot to cash crops whose cultivation requires no shared infrastructure, generating a *labor-absorbing* diversification path that contrasts with the *labor-saving* modernization path pursued by cohesive villages. I present the evidence in two steps: first, crop-level evidence showing that diversification was strategic; second, the aggregate consequences for population and welfare.

9.1 Crop Diversification and Strategic Specialization

Table 9 documents the aggregate reallocation. On the intensive margin, bridge access increased special-use crop cultivation by 24 log points on average (Column 1), but this effect was concentrated in fractionalized villages, which expanded their crop area by an additional 23 log points (Column 2), bringing their total effect to 39 log points—nearly 2.5 times the effect in cohesive villages. The extensive margin reveals a sharper contrast: cohesive villages showed a slight reduction in crop diversity, while fractionalized villages increased their cultivated varieties by a net 0.95 (Column 5), a 21% increase from the pre-period mean of 4.42. Road infrastructure amplified the extensive margin—each additional kilometer of feeder roads increased cultivated varieties by 0.74 (Column 6)—but had no significant effect on area expansion (Column 3), suggesting that roads lowered the fixed costs of experimenting with new crops without necessarily making large-scale cultivation immediately profitable.

Table 10 decomposes these aggregates across Namhae's five key crops, which differ in their coordination requirements, perishability, and market structure. Three patterns emerge. First,

Table 9: Bridge Access and Agricultural Diversification

	Intensive Margin: Log(Special-use Crop Area + 1)			**Extensive Margin**: Num. of Special-use Crop Varieties		
	(1) Baseline	(2) Frac.	(3) Road Stock	(4) Baseline	(5) Frac.	(6) Road Stock
$I_i^{Bridge} \times Post_t$	0.24***	0.16***	0.36	-0.00	-0.39**	-0.49**
	(0.05)	(0.04)	(0.26)	(0.14)	(0.16)	(0.23)
$I_i^{Bridge} \times Post_t \times I_i^{Frac}$		0.23**			1.34***	
		(0.10)			(0.29)	
$I_i^{Bridge} \times Post_t \times RoadStock_{i,t}$			-0.06			0.74***
			(0.11)			(0.24)
Interpretation:						
Net effect for high-frac. villages		0.39***			0.95***	
Net effect at mean road stock			0.26			0.72
Village and Year FEs	✓	✓	✓	✓	✓	✓
Log(Farmland$_{i,1972}$) × Year FE	✓	✓	✓	✓	✓	✓
Observations	989	989	479	937	937	453
Number of Villages	195	195	106	195	195	106
R-squared	0.51	0.52	0.55	0.67	0.69	0.76
Mean of Y (Pre-1973)	2.90 ha	2.90 ha	2.46 ha	4.42	4.42	3.73
Mean RoadStock$_{i,t}$ (km)			1.64			1.64

Notes: Triple-difference estimates examining how bridge access affects agricultural diversification into special-use crops, moderated by social fractionalization and complementary road infrastructure. The sample includes villages from 1970-1979. Columns 1-3 examine the intensive margin using log(hectares + 1) devoted to special-use crops. Columns 4-6 examine the extensive margin using the count of distinct special-use crop varieties cultivated. $I_i^{Bridge} = 1$ if village received bridge access in 1973. $Post_t = 1$ for years after 1973. $I_i^{Frac} = 1$ if clan fractionalization exceeds the median. $RoadStock_{i,t}$ measures cumulative kilometers of feeder roads constructed through year t. Sample size reduction in columns 3 and 6 reflects data availability: road construction records from *History of Our Village* survive for only 122 villages, with projects beginning in 1971. Not all villages with road data reported special-use crop cultivation, resulting in 106 villages. All specifications include village and year fixed effects, plus interactions between log(1972 farmland area) and year fixed effects to control for size-specific trends. Standard errors clustered at village level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Interpretation: Column 2: High fractionalization effect calculated as 0.16 + 0.23 = 0.39. Column 3: Bridge effect at mean road stock (1.64 km) is 0.36 + (-0.06 × 1.64) = 0.26. Column 5: High fractionalization effect is -0.39 + 1.34 = 0.95. Column 6: Bridge effect at mean road stock is -0.49 + (0.74 × 1.64) = 0.72.

the rice column confirms the main result: cohesive villages gained 0.19 tons per household, while fractionalized villages show a statistically insignificant net effect of −0.10 tons (= 0.19− 0.30), consistent with these villages failing to capture the rice productivity gains that cohesive villages enjoyed rather than experiencing absolute declines. Second, fractionalized villages drove the expansion in cabbage and silk. The net cabbage effect for fractionalized villages was 0.38 tons per household—a 264% increase from the pre-bridge mean of 0.14 tons—as the bridge solved the perishability constraint that had previously limited this crop to local markets.[24] Silk, a government-purchased commodity offering stable returns without local market risk, was also disproportionately taken up by fractionalized villages (+0.52 log points net effect), while cohesive villages were the first to abandon it (−0.67).[25] Third, the universal abandonment of subsistence potatoes (−1.97 and −2.00 tons for cohesive and fractionalized villages, respectively) confirms that when the opportunity cost of subsistence farming rose for everyone, all villages exited equally—the fractionalization differential is specific to coordination-intensive margins.

The "Crop Characteristics" rows at the bottom of Panel B make the theoretical logic transparent. Coordination requirements are high only for rice; perishability matters for cabbage but not potatoes or silk; market orientation separates crops that benefit from the bridge from those that do not. The criss-cross pattern of coefficients across these dimensions is difficult to generate from a single alternative explanation. If the differential response reflected baseline agricultural orientation rather than coordination capacity, fractionalized villages should underperform across all market-oriented crops, not selectively in rice while outperforming in cabbage and silk. The pattern follows naturally, however, from the interaction of crop characteristics with village-level coordination capacity: fractionalized villages are penalized only on the margin that requires collective infrastructure, and they exploit pre-

[24]The 0.38-ton increase translates to approximately 127 additional napa cabbages per household. At 1973 wholesale prices of 30 KRW per kilogram, this generated roughly 11,400 KRW in extra income, equivalent to 1.5 to 2 months' worth of rural labor income from a single crop season. To benchmark against the rice results in Section 7: the cross-island fractionalization penalty of 353 kg represents approximately three months of household rice consumption. The cabbage gains for fractionalized villages were thus of comparable economic magnitude to the rice gains they forfeited.

[25]Small-scale silk production became largely obsolete by 1980 as synthetic fabrics undercut demand. The negative coefficient for cohesive villages is consistent with earlier reallocation away from a declining sector, facilitated by rising returns to rice modernization.

Table 10: Strategic Crop Specialization Following Bridge Construction

	Output per Agricultural Household (tons)				$log(Output+1)$
	(1)	(2)	(3)	(4)	(5)
	Rice	Potatoes	Garlic	Cabbage	Silk
Panel A: Average Treatment Effect (DiD)					
$I_i^{Bridge} \times Post_t$	0.04	-1.97***	-0.00	0.25***	-0.07
	(0.09)	(0.18)	(0.01)	(0.04)	(0.30)
Panel B: Heterogeneity by Social Fractionalization (DDD)					
$I_i^{Bridge} \times Post_t$ *(Low-Frac. effect)*	0.19**	-1.97***	-0.00	0.20***	-0.67**
	(0.09)	(0.20)	(0.01)	(0.04)	(0.29)
$I_i^{Bridge} \times Post_t \times I_i^{Frac}$	-0.30**	-0.03	0.00	0.17**	1.19**
	(0.13)	(0.28)	(0.02)	(0.08)	(0.49)
Interpretation:					
Net effect for high-frac. villages	-0.10	-2.00***	-0.00	0.38***	0.52
Crop Characteristics:					
Coordination Requirements	High	Low	Low	Low	Medium
Perishability	Medium	Low	Low	High	Medium
Market Orientation	Local/State	Subsistence	Urban	Urban	State
Demographic Controls	✓	✓	✓	✓	✓
Village and Year FEs	✓	✓	✓	✓	✓
Log(Farmland$_{i,1972}$) × Year FE	✓	✓	✓	✓	✓
Mean of Y (Pre-1973)	0.89	1.35	0.06	0.14	115.9 kg
Observations	1,358	1,135	924	924	982

Notes: This table reports the effect of bridge access on output per agricultural household across different crops. The dependent variable is output per agricultural household for all crops except silk, which could be produced by both agricultural and non-agricultural households. For silk, the outcome is the log of the total village output. The number of observations varies across columns due to missing crop data in certain years; missing values are not assumed to be zero. All specifications include village and year fixed effects, interactions between year fixed effects and log(1972 farmland area), and demographic controls (log population, household size, and the share of female residents). Panel A shows the average treatment effect using a difference-in-differences (DiD). Panel B reports heterogeneous effects from a triple-difference (DDD) model, separating the effect for low-fractionalization villages (the baseline DiD term) from the additional effect in high-fractionalization villages (the triple-interaction term). Standard errors, clustered at the village level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

cisely those alternative margins—perishable crops and state-procured commodities—where the bridge's transport-cost reduction is sufficient without feeder roads. Appendix Table A.34 extends this logic by testing which type of infrastructure drives each crop's response. Feeder roads predict potato abandonment but not cabbage adoption, while township market proximity drives the cabbage boom but is irrelevant for state-procured silk, confirming that the definition of "effective infrastructure" is endogenous to the economic strategy pursued.

The crop-level evidence is thus consistent with the first component of Prediction 5: fractionalized villages did not stagnate but instead pursued a genuine optimizing response, reallocating to crops whose returns the bridge raised without requiring the coordination-intensive investments they could not provide.

9.2 Structural Transformation and Welfare

The second component of Prediction 5 concerns factor intensity: because rice modernization is labor-saving while cash-crop diversification is labor-absorbing, the two paths should generate opposing demographic signatures. Cohesive villages, having mechanized, should release surplus labor for migration. Fractionalized villages, having expanded labor-intensive cultivation, should retain population. Table 11 tests this divergence directly.

Panel A reports triple-difference estimates for village population. The bridge is associated with a population decline of approximately 7% in cohesive villages ($p < 0.05$), while the triple-interaction term implies a 10 percentage-point relative increase for fractionalized villages ($p < 0.01$), yielding a net effect close to +3%. The population decline in cohesive villages should not be interpreted as a negative outcome: labor-saving productivity growth mechanically accelerates out-migration by freeing workers from agriculture. The divergent demographic response confirms that the two village types were on fundamentally different factor-intensity paths—one releasing labor, the other retaining it—as the framework predicts.

Did the diversification path generate comparable welfare gains? The crop-level evidence suggests it should: the cabbage expansion alone was worth 1.5 to 2 months of rural labor income, and silk provided a stable secondary source through state procurement. Panel B provides a direct test using household income, though the available data impose design limitations. Income records from *History of Our Village* cover 96 villages; the specification

is therefore a cross-sectional difference-in-differences for the post-1973 period with township fixed effects rather than the full DDD used elsewhere.[26] The coefficient on I_i^{Frac} is -0.43, indicating that fractionalized villages had lower baseline income conditional on location and observables. But the interaction $I_i^{Frac} \times I_i^{Bridge}$ is $+0.48$, implying that bridge access more than offset this penalty. Fractionalized connected villages had incomes approximately 62% higher than predicted by fractionalization and location alone ($e^{0.48} - 1 \approx 0.62$). The cross-sectional design warrants caution—unobserved village characteristics correlated with both fractionalization and income could bias the estimate—but the direction and magnitude are consistent with what the crop-level evidence independently predicts: diversification into high-value cash crops generated substantial income gains for villages that could not coordinate the rice modernization path.

A natural concern is selective migration: if high-ability households disproportionately left cohesive villages (which lost population), compositional changes could mechanically inflate measured productivity gains and deflate welfare in those villages relative to fractionalized ones. Two pieces of evidence mitigate this concern. First, rice results are similar when using yield (output per hectare) rather than output per agricultural household, which is less sensitive to changes in the size of the agricultural labor force. Second, if selective out-migration from cohesive villages were driving the results, we would expect observable welfare indicators in those villages to deteriorate relative to fractionalized villages. Appendix Tables A.35 and A.36 report triple-difference estimates for two such proxies—livestock ownership and media access (radios, televisions)—and neither shows systematic differences between cohesive and fractionalized connected villages.

Taken together, the evidence in this section confirms both components of Prediction 5. Fractionalized villages, blocked from the coordination-intensive rice modernization path, pursued a labor-absorbing diversification strategy that was strategic rather than residual: they reallocated to crops whose characteristics matched the bridge's direct transport-cost reduction, retained population, and generated income gains of comparable magnitude. The bridge did not produce a single "average" development effect but instead shifted the binding

[26] Income data from *History of Our Village* cover 96 villages with available records; the cross-sectional specification includes township fixed effects to absorb location-specific determinants of income.

Table 11: Aggregate Economic and Demographic Outcomes

	(1) Log(Village Population)	(2) Log(Household Income)
Panel A: Village Population (Full DDD)		
$I_i^{Bridge} \times Post_t$ *(Low-Frac. Effect)*	-0.07**	
	(0.03)	
$I_i^{Bridge} \times Post_t \times I_i^{Frac}$	0.10***	
	(0.04)	
Panel B: Household Income (avg. 1975-79)		
I_i^{Frac}		-0.43**
		(0.18)
$I_i^{Frac} \times I_i^{Bridge}$		0.48**
		(0.19)
Demographic Controls	✓	✓
Fixed Effects	Village, Year	Township
Observations	1,310	96
Number of Villages	196	96
R-squared	0.97	0.33

Notes: This table presents the effect of bridge access on aggregate outcomes. Panel A estimates a triple-difference (DDD) model for village population. Panel B estimates a cross-sectional difference-in-differences (DiD) model for household income, restricted to the post-1973 period due to data limitations. All specifications control for the log of total village farmland, average household size, and share of women. The income regression additionally controls for the log of population. Population data (Column 1) are from the *Statistical Yearbooks of Namhae County* covering all 196 villages. Income data (Columns 2) are from *History of Our Village*, covering 97 villages with available income records. The income regression includes township fixed effects. Standard errors, clustered at the village level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

constraint from market access to local organization, inducing divergent modernization paths whose factor intensity depended on whether villages could coordinate complementary public goods.

10 Conclusion

This paper shows that infrastructure does not only reduce transport costs; it changes the type of problem communities face. Before the bridge, Namhae's villages were constrained by geography, isolated from markets by the strait separating them from the mainland. After the bridge, the binding constraint shifted from market access to local organization: whether villages could assemble the complementary investments needed to convert lower transport costs into productivity gains. This regime shift is what made pre-existing institutions salient. Clan-based social structure, an inheritance of settlement patterns stretching back centuries, had been economically latent when prohibitive transport costs foreclosed the returns to coordination. The bridge made those returns available, and organizational capacity determined which villages could capture them.

The most direct evidence for this mechanism comes from within-village crop comparisons. Rice modernization required collective feeder-road construction—a weakest-link problem in which a single holdout could block the entire project—while barley was individually cultivated and required no shared infrastructure. The fractionalization penalty appeared for rice but not barley. Because this crop-panel test operates within village, absorbing all time-invariant village characteristics, it isolates the coordination channel from competing village-level confounders.

Three additional designs corroborate this finding, each addressing a different identification concern. Within the connected island, proximity to the bridge amplified rice productivity gains in cohesive villages, but this proximity advantage was attenuated in fractionalized villages—except where the bridge was close enough that the economic surplus overwhelmed holdout incentives, consistent with the model's distance-substitution prediction. A cross-island triple difference, comparing Namhae to the unconnected Changsun Island, confirms that the fractionalization penalty emerged only after 1973 and was absent in pre-bridge years.

And a stacked design exploiting the 1980 Changsun Bridge as an independent shock produces similar point estimates under different policy conditions and on different geography, ruling out explanations specific to either episode. Together, these four specifications map onto the five predictions of the anti-commons framework and are difficult to reconcile with alternative explanations rooted in baseline agricultural orientation or village-level wealth.

Following the bridge, cohesive villages, where clan hierarchies could internalize the hold-out externality, invested disproportionately in feeder roads, even though total Saemaul project budgets were similar across village types. Roads enabled adoption of chemical fertilizers and power tillers, which in turn raised rice productivity with a one-to-two-year lag. The temporal sequence—roads first, then technology, then productivity—unfolds in the predicted order. Fractionalized villages, blocked from this coordination-intensive path, pivoted to labor-absorbing cash crops whose cultivation required no shared infrastructure: napa cabbage, whose perishability constraint the bridge resolved, and silk, whose state-procurement channel eliminated the need for collective marketing. This was not passive failure but strategic adaptation to an institutional constraint.

The divergent paths carry implications for how we understand Korea's structural transformation. Cohesive villages pursued a labor-saving modernization strategy: mechanization raised output per worker and released surplus labor for migration to Korea's industrial cities. Fractionalized villages pursued a labor-absorbing diversification strategy: cash crops retained population in agriculture. The demographic signatures confirm this divergence. Cohesive connected villages lost population despite rising productivity, while fractionalized connected villages retained theirs. Cross-sectional evidence suggests that both paths generated comparable household income levels, consistent with welfare convergence through different factor-intensity channels, though this result should be interpreted cautiously given limited income coverage relative to the full agricultural panel. The 60% growth in Korean agricultural productivity during the 1970s, often cited as uniform progress accompanying industrialization, was not uniformly distributed; it was concentrated where local institutions could convert improved market access into labor-saving technology adoption.

When should we expect similar dynamics? The mechanism requires three ingredients: an infrastructure shock that creates new demands for local collective action, pre-existing

variation in the capacity to solve that collective action problem, and an alternative economic margin available to those who cannot coordinate. Importantly, the anti-commons logic generates predictions about *which types* of infrastructure will show heterogeneous returns—those requiring complementary local public goods that involve contiguous land assembly or analogous weakest-link coordination—and which will not—those provided centrally by the state or requiring no collective action to realize their returns. India's Pradhan Mantri Gram Sadak Yojana program connects villages that vary in caste-based social organization; the framework predicts that *jati* composition should mediate returns specifically for road investments that require complementary feeder infrastructure, while showing no differential effect where state agencies directly construct last-mile connections. In sub-Saharan Africa, where ethnically fragmented communities face analogous holdout problems in land assembly for shared transformer infrastructure or feeder roads, the model predicts that fragmentation penalties should scale with the number of independent landholders along the required right-of-way, a testable implication at the village level. These are specific predictions about the interaction between infrastructure type, property-rights structure, and the technology of local public-goods provision.

For infrastructure policy, the anti-commons framework identifies a specific lever: the number of veto players in the land-assembly game. Standard cost-benefit analyses that assume homogeneous treatment effects will mispredict returns in both directions, overstating gains where coordination failures block complementary investments, and understating gains where communities adapt along margins the analyst did not anticipate. In Namhae, a naive evaluation would have concluded that fractionalized villages benefited little from the bridge, missing the substantial income gains generated through crop diversification. But the framework does more than diagnose the problem. It points toward interventions that directly reduce the anti-commons friction. Land consolidation programs, right-of-way legislation for village roads, or state provision of the complementary infrastructure that local coordination cannot assemble—each of these reduces N, the effective number of holdout-capable agents, rather than relying on the slower and less certain strategy of building generalized social capital. The policy question is not whether to invest in infrastructure but how to match the mode of delivery to the local organizational environment.

Several limitations should inform interpretation. The fractionalization measure derives from the 1930 Census of Family Names mapped to 1970s administrative villages under assumptions about settlement continuity that, while validated against available cross-references, cannot be verified for every village. The income results rely on a cross-sectional specification with limited coverage rather than the full panel design used for agricultural outcomes. Additionally, while horse-race regressions show that fractionalization retains explanatory power after controlling for baseline agricultural orientation and proxies for village-level wealth, the observational design cannot fully exclude the possibility that clan structure captures unmeasured historical endowments that independently shape infrastructure responses. Finally, the analysis documents adjustment over roughly a decade. Whether the divergent paths persisted, converged through learning and diffusion, or generated lasting differences in human capital accumulation remains an open question. The labor-saving path released workers for industrial employment and the education investments that accompanied it; the labor-absorbing path retained families in agriculture. If these initial divergences compounded through intergenerational human capital channels, then the institutional mediation of infrastructure returns may matter not only for the first decade of adjustment but for the long-run trajectory of structural transformation itself.

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A.1 Background

A.1.1 The Development of Localized Lineage Organizations

Definition of Kinship. "The indigenous kinship ideology, with its celebration of status hierarchy and status exclusivity, ran like a red thread through Korea's history from early Silla to the late nineteenth century," claimed Martina Deuchler, a renowned historian on Korean history (Deuchler 2015). Kinships had been the defining social characteristic of Korean communities for centuries and shaped the way these communities organized themselves.

A kinship group in Korea is identified by a combination of a family name and specific regional origins. For instance, the Parks from *Miryang* city and the Parks from *Bannam* county are considered distinct kinship groups, despite sharing the same surname. These groups are often referred to as *bon-gwan*. Each *bon-gwan* has its own genealogical records (known as *jokbo*) documenting the family history and lineage. An example of the genealogical records from the Seol family from *Gyeongju* city is shown in Figure A.1.

The concept of *Bon-gwan* provides a strong sense of identity and establishes a structured hierarchy within villages. Dominant local elite groups not only influence local political dynamics and governance, but also shape social interactions, orchestrating marriage arrangements to maintain or enhance their social status, hosting and sponsoring communal festivals and rituals to reinforce their leadership, and spearheading local business ventures (Brandt 1971, Wade 1982).

Persistence and Significance of Clan Villages. A unique characteristic of Korean kinship groups is their tendency to cluster geographically, forming clan villages where a single clan comprises the majority of the village population. This distinctive social organization was noted by Japanese colonial authorities during their occupation, and they included a survey on family clans and their geographic distributions as an appendix to Korea's first modern census in 1930.

According to the 1930 census, there were approximately 15,000 clan villages nationwide at the time, accounting for about one-third of all villages. Among the 1,685 notable clan villages for which their period of formation could be traced, 207 had existed for over 500

years, 646 for 300-500 years, 351 for 100-300 years, 23 for less than 100 years, and 458 were of unknown origin. This data suggests that clan villages were predominantly formed around 300-500 years ago, between the 15th and 17th centuries (National Institute of Korean History 2023).

This predominance of specific clans in villages continued well into the 20th century. Although the next survey on family clans was not conducted until 1985, three pieces of evidence demonstrate continuing trend, especially in rural areas where rapid industrialization had not yet occurred.

First, a village leader of *Pungdeok* village in *Gyeonggi* province, Sae-Young Lee, documented the changes in clan composition of the village from 1945 to 2000 in his book *The Village History of Pungdeok Village* (Lee n.d.). Throughout this period, the Lees from *Jeonju* city made up the majority of households, ranging from 70 to 90 percent. While the total number of households in the village started to decline in the 1980s, the share of Lee families remained consistently above 80 percent, demonstrating the resilience of the kinship-based social structure despite demographic changes.

Second, a similar pattern was observed in *Eonyang* province, now part of *Ulsan* city. Based on social security data, Park (2013) and Park (2018) find that the share of the population belonging to kinship groups grew consistently from 1910 to the late 1960s in 14 villages where this research was conducted. For instance, the number of kinship groups with at least 15 households of the same surname increased from 17 in 1912 to 45 in 1962. Additionally, their share of the total households rose from 20.9% in 1912 to 44.5% in 1962 (Rhee 2015).

The significance of clan compositions in 20th-century Korea is also well documented in *Glorious Footsteps*, an annual publication issued by the Ministry of Internal Affairs from 1978 to 1985 (The Ministry of Home Affairs 1978). This series featured case studies of approximately 50 successful villages each year, providing detailed accounts of each community's development history. These publications frequently highlighted clan composition as a defining characteristic that influenced how villages overcame development challenges, underscoring its importance in local governance and decision-making. In subsection A.1.3, I illustrate this concept in greater detail by comparing case studies of two villages with varying clan compositions.

Together, these examples illustrate that villages' clan compositions were not only a historical phenomenon but continued to play a vital role in rural Korean communities throughout the 20th century.

Origins of Clan Villages. The origins of clan villages in Korea are multifaceted, involving a combination of religious beliefs, cultural practices, and economic strategies.

Clan villages emerged from the widespread adoption of Confucian beliefs during the 14th to the 18th century, a period known as the "Confucian transformation" (Deuchler 1992). With the establishment of the *Joseon* dynasty in 1392, Confucian principles became national doctrines. Korean Confucianism particularly emphasized the patrilineal family order, as codified in the clan law, known as *jong-bup*. However, the permeation of these doctrines into rural societies was a gradual process that unfolded over centuries.

The key element of the clan law was its alignment of ancestral rites with patrilineal succession, a practice that excluded daughters from the line of succession. Ancestral rites are central to Confucian values, emphasizing honoring one's ancestors through rituals performed by descendants. The exclusion of daughters ensured that the responsibility for these rites remained within the male lineage, reinforcing the patriarchal structure of the society.[27]

Consequently, property and family leadership were passed down exclusively through male descendants, and daughters gradually lost their inheritance rights. Before the implementation of the clan law, daughters were equally likely to remain in the same village after marriage. This would contribute to clan heterogeneity of villages, since they would then belong to their husband's family name. However, with the wider adoption of the clan law, it became customary for daughters to leave their natal villages upon marriage, because immovable assets, such as houses, could only be inherited through the male line. As patrilinear succession became entrenched, villages began to form around dominant patrilinear kinship groups. In short, the increasing alignment of genealogical practices with patrilineal principles drove the formation of clan-based villages.

Along with the religious changes, agrarian practices around rice farming likely accelerated

[27]This cultural shift is evident in the changes in recording of genealogies. In the 14th century, genealogies were composite, including both paternal and maternal lines. However, by the 17th century, as the belief that ancestral rites should be performed by the eldest son became more predominant, genealogies evolved to focus solely on patrilinear descendants (National Institute of Korean History 2023).

the adoption of the patrilineal family order and made the formation of clan-based villages sensible (Lee 1993). Rice farming is labor-intensive, requiring collective coordination and cooperation among villagers. Examples include community-managed irrigation systems, and synchronizing planting and harvesting schedules. Therefore, rice farming creates incentives for villagers to form strong social ties and mutual obligations based on kinship and clan affiliation. These practices became ingrained in the culture and remain in the forms of informal institutions, such as *doore* (village councils), *gye* (village cooperation associations), and *poomasi* (labor-sharing arrangements). This clan-based culture, rooted in agrarian practices and the Asian-specific economic and religious context, endured over time, even after modernization efforts in the 20th century.

A.1.2 The *New Village Movement*: Decentralization of Public Goods Provision

A lesser-known aspect of Korea's economic development is that it was accompanied by a 60% growth in agricultural productivity. Figure A.2 plots rice output per agricultural household and rice yield between 1965 and 1979, with values from 1970 normalized to 100. In less than a decade, both measures of agricultural productivity increased by 40% to 60%. This productivity growth resulted in a subsequent rise in rural income. Between 1974 and 1978, the average income of agricultural households exceeded that of urban households and continued to grow at a similar rate to urban income until 1984.

The rapid agricultural productivity growth and income during the 1970s were driven by two concurrent economic policies: the expansion of transport infrastructure networks and the decentralization of public goods provision, known as the *New Village Movement*.

Expansion of Transport Infrastructure. The Korean government pursued ambitious national transport infrastructure projects during this period. For instance, the first large-scale highway, the Gyeongbu Expressway, spanning 428 km between Seoul and Busan, was completed in 1970. By the end of 1973, two additional major highway networks were added: the Honam Expressway (260.7 km) and the Namhae Expressway (273.17 km), totaling 533 km. The Namhae bridge, connecting Namhae island (the fourth largest island in Korea) to the Namhae Expressway, was also completed in 1973.

This paper focuses on the construction of this new bridge, which marked a pivotal moment in the region's development. One of the most immediate and tangible impacts was the expansion of bus services. Bus availability on the island grew relatively slowly prior to the bridge's completion, increasing from 12 to 34 buses over a decade (1963-1973). However, in just five years following the bridge's opening (1973-1977), the number of buses more than doubled to 76. This indicates a fast expansion of public transportation network and increased mobility for the residents (Namhae County Office 1980).

The bridge's construction, coupled with the expansion of bus services, created a growing demand for improved connectivity *within* the island. This presented both opportunities and challenges for individual villages. On the one hand, the bridge and bus services increased the potential for villages to connect with the larger transportation network, incentivizing villagers to engage in public goods provision, particularly road construction projects. On the other hand, not all villages were equally positioned to capitalize on these new opportunities. The ability to construct connecting village roads often required significant coordination within villages, including potentially relocating houses and resolving differences of opinions among residents. These contrasting effects underscore the potential for heterogeneous responses based on villages' internal characteristics.

The *New Village Movement*. The expansion of transport infrastructure coincided with the launch of a rural development campaign known as the *New Village Movement*. This nationwide, community-driven program provided government transfers to local communities conditional on their use for investments in public goods. A key element of this initiative was the decentralization of public goods provision, which delegated authority for fund allocation to village leaders. Villagers were responsible for all phases of the projects, from planning and implementation to monitoring. Often, they matched government transfers with voluntary labor and material contributions.

In 1970, the *New Village Movement* began by distributing the same amount of cement to all villages for small-scale infrastructure projects. By the end of the decade, nearly all of the 36,000 villages in Korea had participated, and public interest and support for the movement were often described as "spreading like wildfire" (The Ministry of Home Affairs

1978). Between 1970 and 1979, 43,506 km of new village rural roads were constructed and paved, and virtually all villages rebuilt their community centers (The Ministry of Home Affairs 1980). Traditional thatched roofs were replaced with modern metal roofs throughout the countryside. To this day, the success of the *New Village Movement* is celebrated across the country. Flags symbolizing the movement are commonly seen, especially in rural areas. The President of South Korea appoints the president of the *New Village Movement* organization, and an annual convention is held, consistently attended by the President of South Korea.

The *New Village Movement*'s emphasis on decentralization highlighted the importance of local informal governance and provided villagers with the flexibility to choose their own priorities. Despite ongoing controversies over the extent of discretion villages actually had, the *New Village Movement* was fundamentally a grassroots initiative. Village leaders were responsible for reaching a consensus on project priorities, encouraging participation, and budgeting. It was not uncommon for their suggestions to be rejected by villagers (Han 2010). Figure A.3 shows the evolution of project budgets in *Namhae* county during the 1970s. Villagers' contributions comprised most of the budget, a feat that would have been difficult to achieve without their significant influence over project choices. The *New Village Movement* allowed local communities to actively shape their development, fostering a sense of ownership and civic engagement. The *New Village Movement* bears a strong resemblance to contemporary community-driven development projects, but it was much larger in scope and had a strong top-down commitment to achieving its objectives.

A.1.3 A Case Study of Two Villages with Different Clan Compositions

In this subsection, I contextualize how village clan composition shaped approaches to rural development in 1970s Korea, with a focus on road construction projects. Through a comparative study of two villages, I argue that both the kinship-based social structures and economic incentives played crucial roles in overcoming the "tragedy of the anti-commons" problems, where excessive fragmentation of property rights impedes efficient resource use (Heller 1998, Buchanan and Yoon 2000). While clan homogeneity facilitated faster project initiation, I find that the anticipation of increased land values ultimately drove consensus in both homogeneous and heterogeneous villages.

A long-standing aspiration of Korean rural villagers was to gain access to road networks and make villages accessible to buses. However, road infrastructure improvements necessitated significant village-level organization. Villagers had to relocate houses and sell land make way for road construction. In rural Korea, where land ownership was often fragmented, even a small fraction of owners could potentially block the entire development process, making consensus and progress difficult to achieve.

To illustrate these dynamics, I compare two villages, referred to as Village A and Village B,[28] which had different origins and, consequently, distinct clan compositions and economic activities.

Initial Conditions of Two Villages. Village A was a typical slum settlement, formed by a diverse mix of families that sporadically came together. The residents built earthen houses by arbitrarily clearing mountainsides. The population had grown rapidly from 30 households in 1969 to 189 households in 1978. The majority (88%) of households were non-agricultural. The village was highly fractionalized, with no dominant clans and an average of 7.4 households per family name (The Ministry of Home Affairs 1978).

In contrast, Village B, with its deep historical roots, was traditionally associated with the elite class. Of its 110 households, 89 belonged to the *Euisung* Kim clan, representing a strong clan majority in the village. The village occupied a traditionally ideal geographical setting for settlement, described as "with a mountain at the back and a river in front," which was particularly suitable for rice farming. As a result, 102 of the 110 households were engaged in agriculture.

Despite their different origins, both Village A and Village B faced significant infrastructural challenges. Village A, situated in mountainous terrain, was particularly vulnerable to landslide during rainy season. Village B, located alongside a stream, suffered from annual floods that frequently submerged farmland and houses. Neither village had paved roads,

[28]The actual names of the villages are *Takbakgol* (Village A) and *Cheonjeonli* (Village B). Both are featured in the 1978 publication of *Glorious Footsteps*, an annual publication by the Ministry of Internal Affairs between 1978 and 1985. This publication provided case studies of selected villages that successfully escaped poverty, presenting around 50 village case studies each year. The typical structure of these case studies includes key village metrics (population, electricity access, geographic conditions, clan composition), descriptions of initial poor conditions, how challenges were overcome through village projects, detailed project information, and meeting logs.

which led to severe mobility issues during the rainy season. Housing infrastructure was equally poor in both villages. Even in Village B, which had historically been associated with the elite class, over 70% of the houses still had thatched roofs, and almost none had fences.

Road Construction Projects. The initiation of road development projects differed significantly between Village A and Village B, primarily due to their distinct clan compositions and consequent abilities to self-organize. These differences highlight how the clan-based social structure of Village B facilitated a more efficient process for initiating the road development project, despite facing similar challenges of fragmented land ownership and initial opposition.

In Village A, the village project of building 2000 meters of additional roads faced considerable initial resistance. Meeting logs reveal widespread skepticism among villagers, with many questioning the project's feasibility. One resident complained: "I can barely take care of my own house, so how can I take care of the village's work?" The project leader, along with a few supportive villagers, had to go door-to-door to explain the benefits and gradually gain consent. Despite these efforts, strong opposition persisted, and a major point of contention was the need to demolish seven buildings on 1,000 square meters of land, belonging to villagers who opposed the project and refused to consent. The village reached a consensus in 1977, seven years into the *New Village Movement*. A breakthrough came when five families donated their land for small compensation, and the project eventually started to gain momentum.

In contrast, Village B's experience, while not entirely smooth, demonstrated a different dynamic. A village project of similar magnitude also received initial backlash, but land donations came earlier and in larger numbers. By 1972, twelve Lee clan members had already contributed their land for the project, and all necessary land donations were completed by 1973. Although land ownership in Village B was also similarly fragmented, it was predominantly owned by the Lees. With senior clan leaders supporting the project, people were more quickly mobilized. Even though each family within the Lee clan was a separate unit requiring individual persuasion, the shared clan identity appeared to facilitate cooperation.

Interestingly, the leaders of both Village A and Village B used a similar argument to persuade opposing residents to contribute their land for road development. In both cases,

potential increase in the value of residents' remaining assets following road construction played a crucial role in motivating residents to participate in the project. While the more homogeneous, clan-based Village B received "compensated land donations" sooner than Village A, the ultimate driver in both cases was economic incentives: the anticipated increase in asset values resulting from improved infrastructure.

These government-conducted case studies should be interpreted with caution, but two clear patterns emerge: 1) the intricate local politics within villages and the significant role of dominant clans in rural development during the 1970s, and 2) the importance of expected returns to better road connectivity. In the rest of the paper, I empirically examine how clan composition and local economic factors mediate the impact of large-scale infrastructure projects, such as bridge construction, on village-level development outcomes. Specifically, I analyze how the benefits of improved market access vary based on a village's clan structure and its proximity to the new infrastructure.

A.2 Further Data Documentation

A.2.1 Data Search and Digitization

This paper focuses on Namhae County, which provides a unique opportunity for data collection due to a set of exceptional circumstances. The groundwork was first laid by local historian Mr. Eui-Yeon Jeong, who dedicated his life to studying Namhae County's history. In particular, between 2016 and 2017, Mr. Jung and his research team visited all 196 village centers in the county, meticulously photographing every old document stored in their archives. Mr. Jung passed away in 2018, and his widow, Ms. Hee-Myung Ahn, who also participated in his research projects, generously shared his entire catalogue with me in 2021. Additionally, Namhae County offered another rare advantage: its county office remained in its original location without major renovations since its establishment, unlike most other counties. This allowed for the preservation of documents predating 1984, when Korea updated its law governing document archiving that prioritized cost-cutting and inadvertently led to the loss of such records elsewhere. However, in Namhae county, these historical documents fortuitously survived, providing an unprecedented wealth of data for this research project.

Data Sources and Digitization Process. I digitized and combined data from two primary sources in Namhae County: village project data from the *History of Our Village* and village-level administrative data from *Township Statistical Yearbook*. To expedite the digitization of 336 volumes (approximately 33,000 pages) of archival documents and to work within financial constraints, I used an off-the-shelf OCR engine to automate the initial stage of the digitization process. An example page of the OCR-processed page is shown in Figure A.4. Recent advances in deep learning have significantly improved the accuracy of automated digitization, and automation has garnered increased attention in social sciences (Shen et al. 2020). The first draft of digitization was then manually reviewed by a data-entry company in India to identify errors. Then, I hired research assistants to further check for errors by comparing the original sub-totals of each column with those from the digitized data.

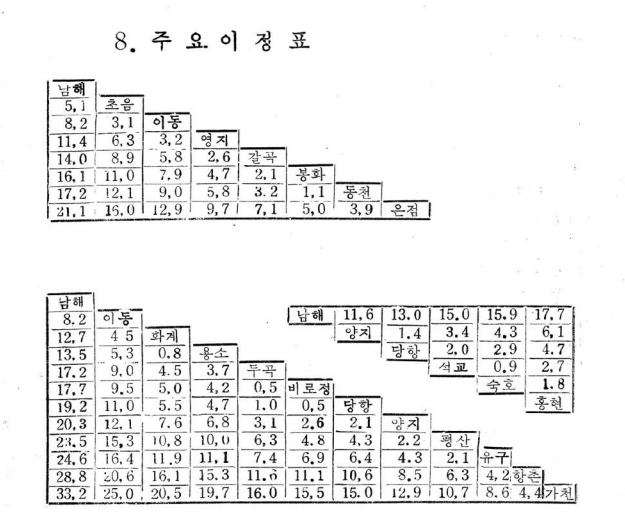
Overall, the search and digitization efforts resulted in Korea's first village-level panel

data spanning from 1969 to 1984. To my knowledge, this paper is the first to employ such granular data in examining Korea's successful rural development during the 1970s.

A.2.2 Estimating the Distances to the Bridge

This subsection details how distances between villages and the bridge are estimated using distance matrices from the *Statistical Yearbooks of Namhae County*. Figure 6 shows distance matrices for three of the ten local road networks from the 1970 Statistical Yearbook. These matrices provide pairwise distances between destinations along each route. While most stopovers in the matrices represent village centers, some entries indicate regional names for sections where roads pass through unpopulated areas.

Figure 6: Distance Matrices


8. 주 요 이 정 표

남해							
5,1	초음						
8,2	3,1	이동					
11,4	6,3	3,2	영지				
14,0	8,9	5,8	2,6	갈곡			
16,1	11,0	7.9	4,7	2,1	봉화		
17,2	12,1	9,0	5,8	3.2	1,1	동천	
21,1	16,0	12,9	9,7	7,1	5,0	3,9	은점

남해											
8.2	이동					남해	11.6	13.0	15.0	15.9	17.7
12.7	4 5	화계					양지	1.4	3.4	4.3	6,1
13.5	5,3	0.8	용소					당항	2.0	2.9	4.7
17.2	9.0	4.5	3.7	두곡					석교	0,9	2,7
17,7	9,5	5,0	4,2	0,5	비로정					숙호	1.8
19,2	11,0	5.5	4,7	1.0	0,5	당항					홍현
20,3	12,1	7.6	6,8	3,1	2,6	2,1	양지				
23,5	15,3	10,8	10,0	6,3	4.8	4.3	2.2	평산			
24,6	16,4	11,9	11,1	7,4	6,9	6,4	4.3	2.1	유구		
28,8	20,6	16,1	15.3	11.6	11,1	10,6	8,5	6,3	4, 2	황촌	
33,2	25,0	20,5	19,7	16.0	15,5	15.0	12,9	10,7	8.6	4, 4	가천

I calculated the shortest route between each village and the bridge by identifying and comparing all possible travel routes. The calculation process follows two main steps:

(1) For villages with direct road connections to the bridge (requiring no road changes), I use these direct routes as the shortest travel distances. This applies to 18 villages.

(2) For villages requiring multiple roads to reach the bridge, I identify routes that pass through the 18 directly-connected villages mentioned above. The total distance is then calculated by summing two components: the distance from the origin village to

the directly-connected village, and the distance from that village to the bridge. This method provides distances for 62 additional villages.

This initial process yields accurate distances for 80 villages, representing 47% of the 170 villages in the connected island. For the remaining villages, I employ two additional methods:

First, I use historical "legal" village boundaries to estimate distances for 60 more villages. These boundaries, established during the colonial period and still used in legal documents, were later subdivided into "administrative" villages as populations grew. These administrative divisions follow natural community patterns within legal villages, typically resulting in two or three administrative villages per legal village unit. Since villages within the same legal boundary are usually within 1 kilometer of each other, I assume they share similar routes to the bridge.

Finally, for the remaining 30 villages, I use Google Maps to determine contemporary walking distances to the nearest village with known 1970s bridge distances. For example, if village A's distance is unknown but neighboring village B's 1970s distance is available, I calculate village A's distance by using village B as a reference point and adding the walking distance between them.

A.2.3 Types of Projects Recorded in the *History of Our Village*

The *New Village Movement* framework allowed villages to select projects based on their specific needs. While the government encouraged certain types of projects, the only universal requirement for receiving government support was that projects must create public goods. This section analyzes the distribution of project types and explains the approach used to categorize them.

The *History of Our Village* documents 5,271 village development projects implemented across 120 villages in Namhae county between 1971 and 1982. Given that Namhae county comprised 195 villages in 1971, this historical record covers 62% of all villages. The documented projects encompass 266 unique project types.

Table 12 presents the 15 most common projects, comparing two islands that comprise Namhae county: Namhae island (the larger island connected by the new bridge) and Changsun island. These projects align with the major initiatives listed in *The Ten Years of New*

Table 12: Top 15 Most Common Village Projects

	Total	*Namhae* Island	*Changsun* Island
Total (Entire data set)	5,271	4,420	851
15 Most Frequent Projects			
Housing Improvement (roof amelioration)	322	261	61
Housing Improvement (fence)	308	229	79
Construction of Farm Roads	290	262	28
Expansion of Village Roads	210	164	46
Small Bridges	208	182	26
Modernizing Kitchens	178	138	40
Storage Houses	141	126	15
Installing Water Ways	137	118	19
Small River Arrangements	137	104	33
Public Restrooms	137	96	41
Village Halls	130	121	9
Farm Roads Repairs	126	109	17
Housing Improvement (roof painting)	124	96	28
Sewage Systems	108	102	6
Pavement of Village Roads	88	82	6

Village Movement, published by the Ministry of Home Affairs in 1980 to commemorate the program's achievements. The majority were small-scale infrastructure projects that village residents could implement and manage with local government support.

A.2.4 Categorization of Projects

The 238 unique projects are organized into 15 broad categories, as shown in Table 13. These categories are not mutually exclusive, as some projects serve multiple purposes. For example, *construction of waterways* appears in both *village water management* and *agricultural irrigation* categories, reflecting the overlapping nature of these infrastructure improvements.

Table 13: Categorization of Village Projects

Broad Categories	Detail (*# of the unique projects under each broad category*)
Village Roads	Construction/Expansion/Repair/Pavement/Widening of village/farm/entry/other roads (23)
Village Bridges	Construction/Expansion/Repair of village bridges (3)
Ports	Construction/Expansion/Repair of village ports (3)
Village Water Management	Construction/Expansion/Repair of portable water supply facilities; Construction/Repair of water ways, public wells, and reservoir banks; Establishment/Repair/Covering of sewage system (20)
Village Stream Management	Construction/Repair of breakwaters, weirs (low head dams), reservoir banks, dams; Cleaning/Deepening of river bottom (22)
Roof Improvements	Modernizing/Painting roofs (3)
House Improvements	Renovating houses; Remodeling fences/walls/kitchens (5)
Electricity	Electrification (2)
Miscellaneous Facilities	Public baths, Laundry places, Children's parks, Senior centers, Street lights, Restrooms, Salons, Libraries, etc. (55)
Village Centers	Construction/Expansion/Repair of village centers (3)
Village Warehouse	Construction/Repair of village warehouses or silos (3)
Agriculture	Land reclamation, Vinyl houses, Orchards, Farming machines, Introducing high-yield varieties, Farmland irrigation/arrangement, Construction/Repair of water ways and reservoir banks, Construction/Repair of village warehouses or silos, etc. (57)
Agricultural Irrigation	Irrigation/Arrangement of farmland, Stream channel straightening, Construction/Repair of water ways and reservoir banks, etc. (29)
Foray into New Businesses	Raising diary cattle, Stockbreeding, Oyster farming, Other shellfish farming, Nursery gardens, etc. (31)
All Others	Activities of Women's Association, Training Sessions, Cleaning village roads, Afforestation (32)

A.3 Construction of the Variables

A.3.1 Fractionalization Index Construction.

The 1930 Census recorded family clans that comprised more than 10% of village households (hereafter referred to as *significant clans*). For each village, the census documented the number of households belonging to specific clans, identified by family names and ancestral origins. Within Namhae county, 58 villages contained at least one significant clan, with 27 villages containing multiple such clans.

To calculate clan concentration at the village level, household counts for each village are required. Since the 1930 Census only provides township-level population data, I estimate village-level households by assuming each village's share of township households remained stable between 1930 and 1970. Using village-level population data from the 1972 *New Village Comprehensive Survey*, I apply the 1972 village household shares to the 1930 township household totals.

Population growth in Namhae county led to an increase from 79 villages in 1930 to 196 by 1970. Given the geographical constraints of the two islands comprising Namhae, this growth occurred through village subdivision rather than territorial expansion. New villages typically emerged as subdivisions of existing ones, often retaining the original village name with added numerical suffixes (1, 2, 3, etc.). For these cases, I assume the clan composition of new villages matches their parent villages.

Four clans had households spread across multiple villages. For these cases, I allocate clan households proportionally based on village size. For example, the Park family from Milyang county had 72 households distributed between two adjacent villages: SeokPyung (107 total households) and YangAh (288 total households). I estimate each village's share of the clan's households by multiplying the clan's total households by the village's proportion of combined households. Thus, SeokPyung's estimated Park family households $= 72 \times \frac{107}{107+288} = 19.5$.

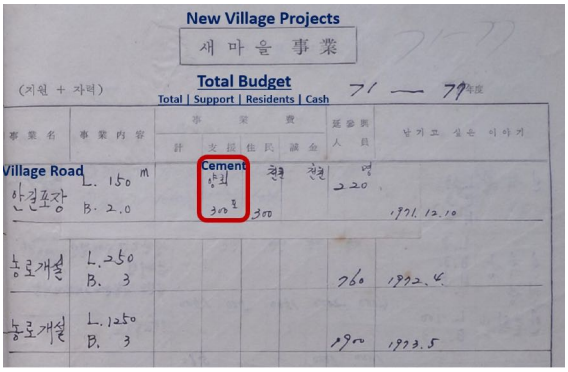
For villages with at least one significant clan (clan share $\geq$ 10%), F_i is computed as $F_i = 1 - \sum s_{ic}^2$, where s_{ic} are the shares of significant clans reported in the 1930 census. The remaining share of households $(1 - \sum s_{ic})$ is assumed to be split among many smaller clans (¡10%), each with negligible shares, contributing minimally to $\sum s_{ic}^2$. For villages with

no significant clans, the census provides no clan data, and F_i is assigned a value of 1 to reflect maximal fractionalization, as the absence of a dominant clan suggests many small clans below the 10% threshold. For such villages, $TopShare_i$ and $ClanShare_i$ are imputed as 0, reflecting the lack of reported significant clans.

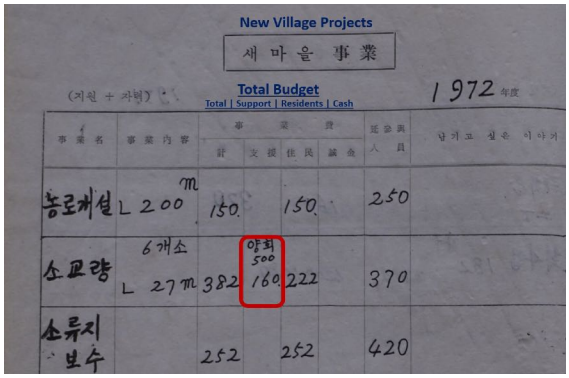
A.3.2 Converting In-kind Transfers / Contributions to Cash Amounts:

I convert all in-kind transfers and contributions to cash equivalents. This conversion uses market-value data from villages that maintain parallel records of both in-kind transfers and their corresponding monetary valuations.

Figure 7: Conversions of In-kind Transfers to Cash Amounts



(a) A Page with Missing Total in Cash

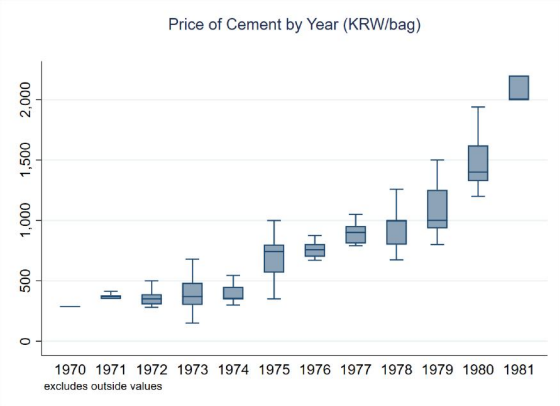


(b) A Page with the Conversion

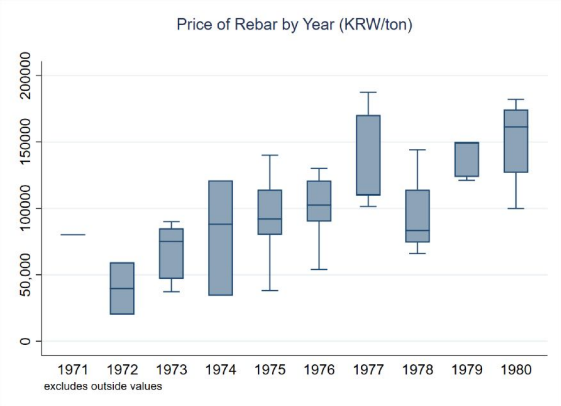
Figure 7 presents a section of *History of Our Village* that documents village projects chronologically. The documentation format includes six columns: project type (e.g., road construction, public restroom construction), project specifications (e.g., L=150m, 1 new public restroom), and four budget-related columns detailing the total amount, government support, villager contributions, and external cash donations.

Figure 7a illustrates a 1971 road pavement project extending 150 meters. While the record shows that the government provided 300 bags of cement and villagers contributed 300,000 Korean Won (KRW, approximately $300 USD), the total project cost remains undetermined as the cement contribution lacks monetary conversion. In contrast, Figure 7b demonstrates complete documentation from another village in 1972, where 500 bags of cement provided by the government for constructing six small bridges (total length: 27 meters) were valued

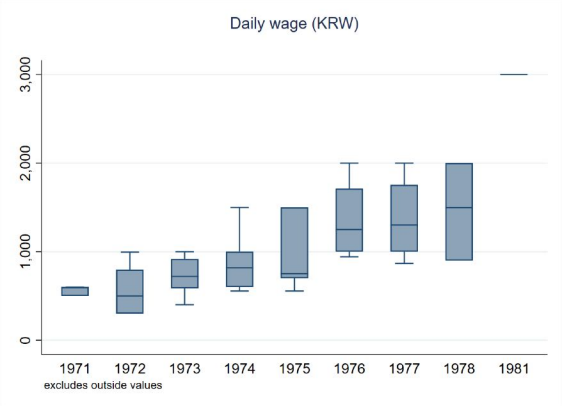
Figure 8: Distributions of the Prices of Cement, Rebar, and Labor



(a) Distribution of Price of Cement



(b) Distribution of Price of Rebar



(c) Distribution of Daily Wage

at 160,000 KRW, indicating a market price of 320 KRW per bag.

The dataset contains 481 such price conversions from 120 villages, primarily for cement but also including rebars and daily wages. Figure 8 displays the yearly price distributions for these three inputs. Among the 5,271 projects recorded across 120 villages in Namhae county between 1971 and 1981, I utilized median prices for cement, rebar, and daily wages to monetize 53 in-kind villager contributions and 233 in-kind government support cases. This conversion process expanded the analyzable sample by 244 projects, representing 4.6% of the total project count.

A.4 Additional Figures and Tables

Figure A.1: The Seol clan's *JokBo*, a genealogy book

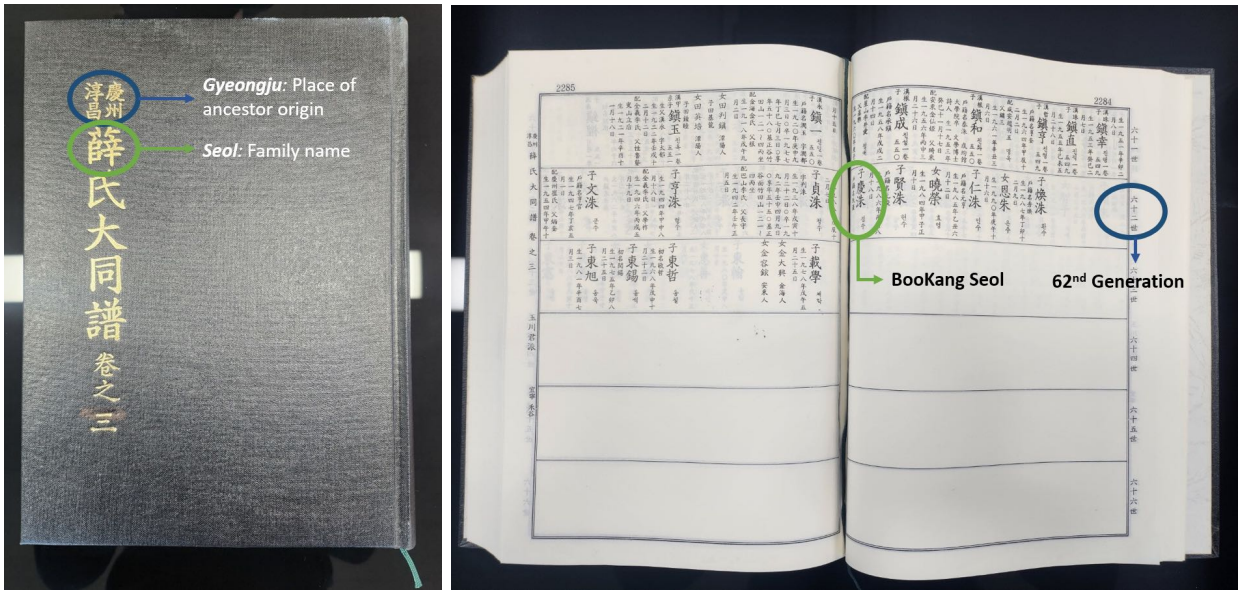


Figure A.2: Agricultural Productivity Growth in Korea in the 1970s

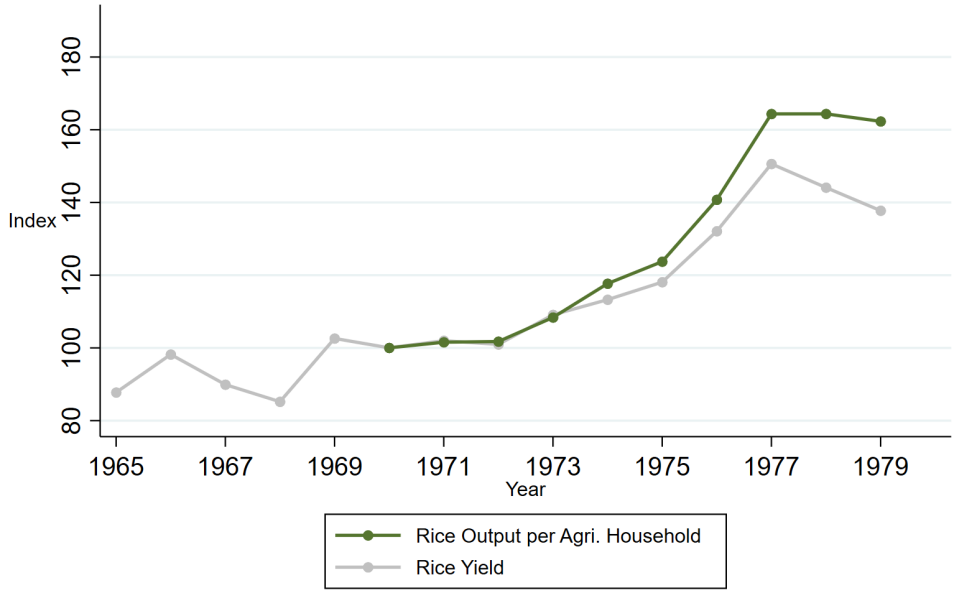


Figure A.3: Total Budget for the *New Village Movement* in *Namhae* County (KRW)

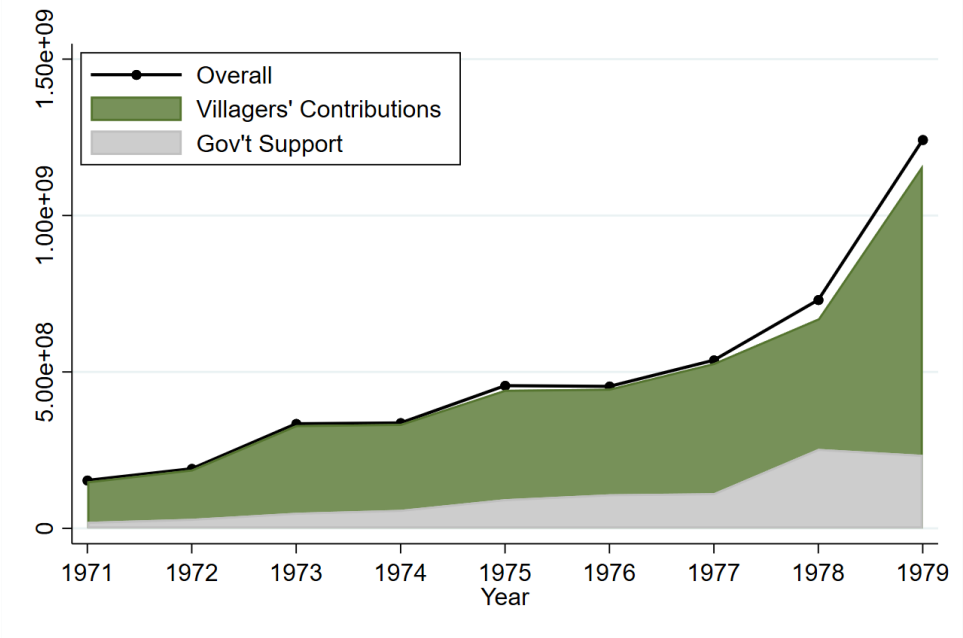


Figure A.4: An Example Page of OCR Result



Figure A.5: *History of Our Village*



Figure A.6: An Example Page of the *New Village Comprehensive Survey*

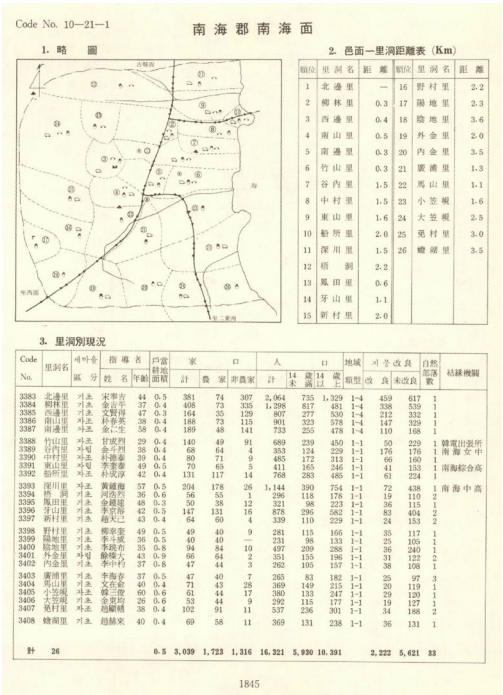
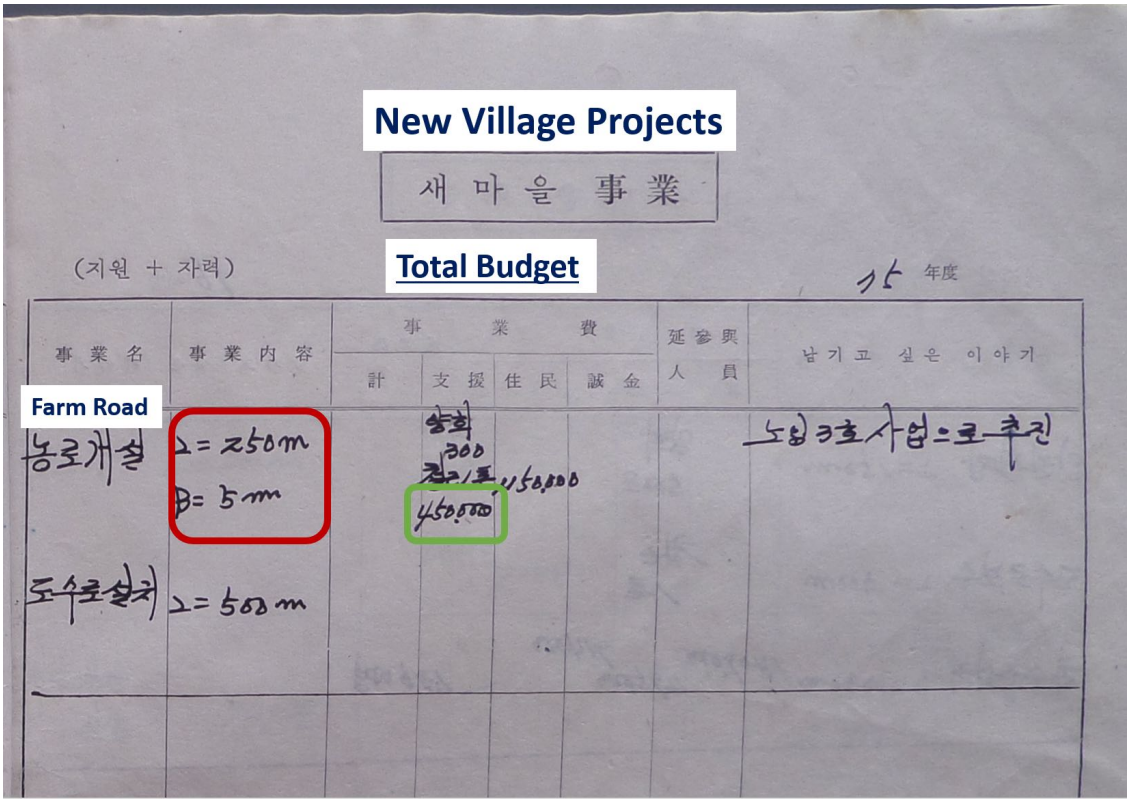


Figure A.7: Evidence of Validity of *History of Our Village*



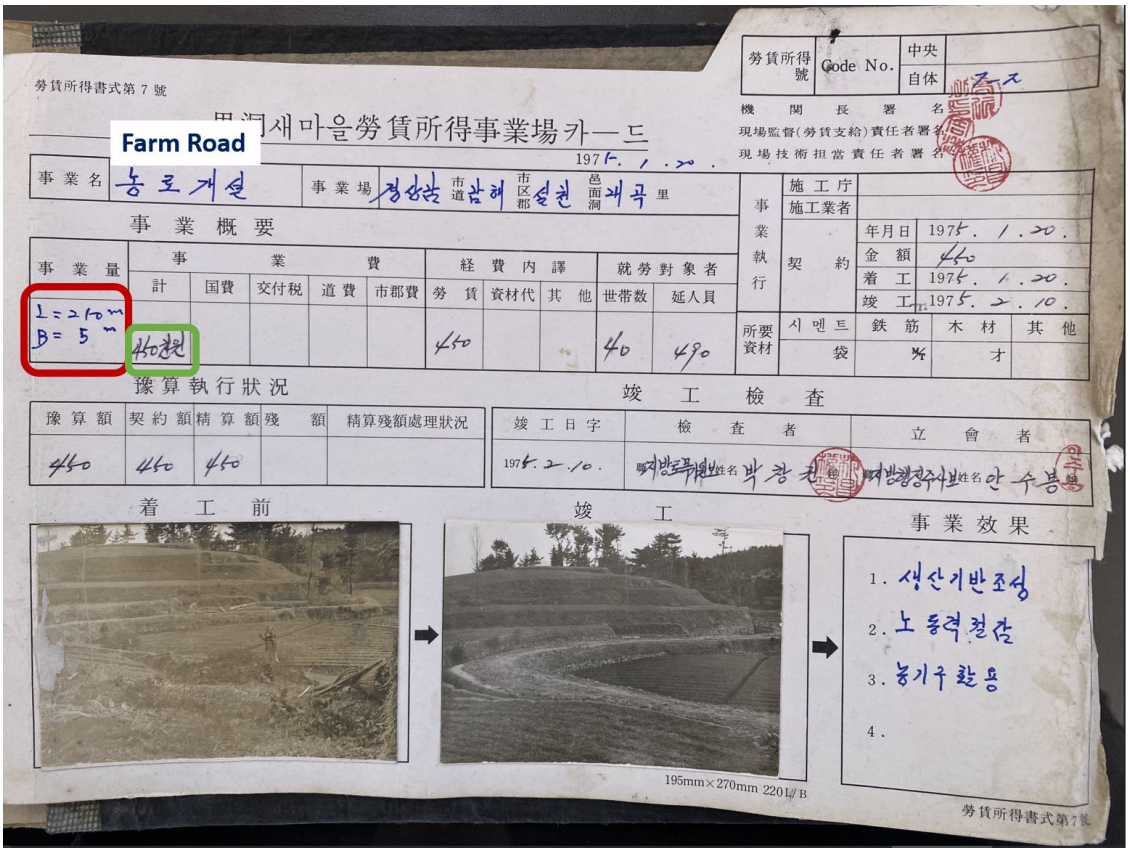
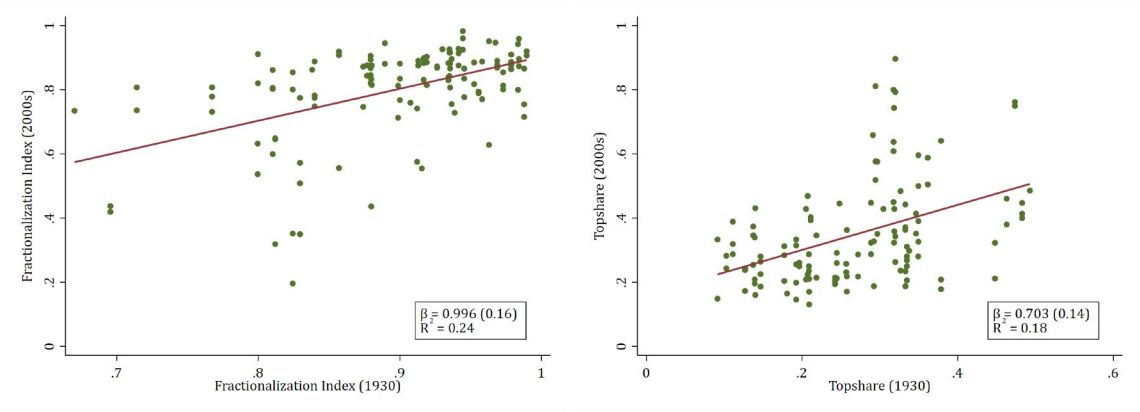


Figure A.8: Persistence of Clan Fractionalization Across Decades



(a) F-index in 1930 vs. F-index in 2000s (b) TopShares in 1930 vs. TopShares in 2000s

Notes: The left panel shows the correlation between F-index values calculated from 1930 clan composition data and F-index values from 2000s clan distributions. The right panel displays the correlation for TopShare, the share of households belonging to the largest clan. To ensure consistent comparison with 1930 data, the 2000s fractionalization measures include only clans comprising at least 10% of village households. Results remain similar when all clans are included without this threshold. Sample includes all villages for which clan composition data is available in both time periods. $N = 122$ villages.

Figure A.9: Spatial Distribution of the Herfindahl Index in Namhae County

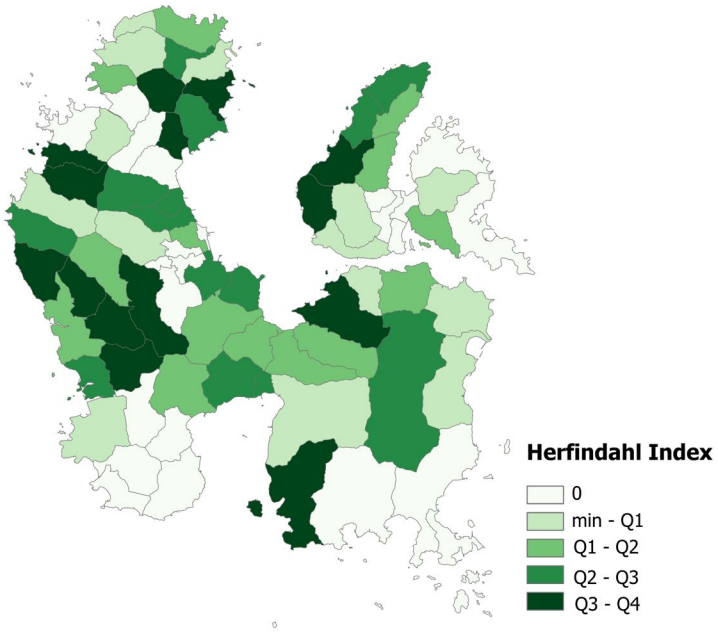


Figure A.10: Event Study of Bridge Impact on Rice Productivity, Long-run

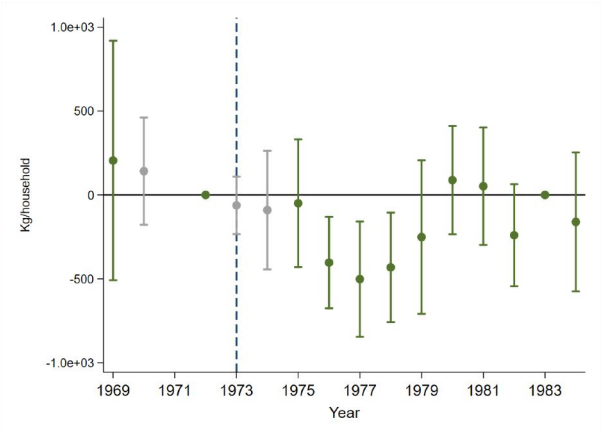
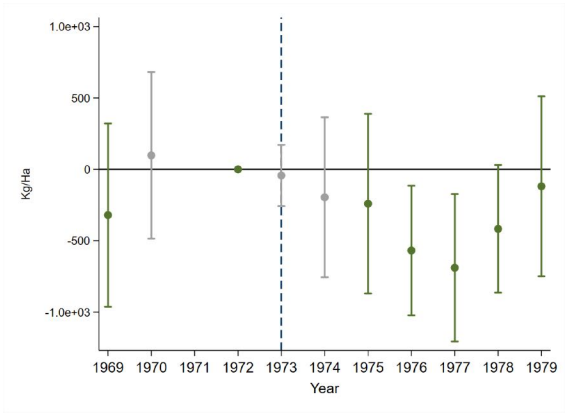
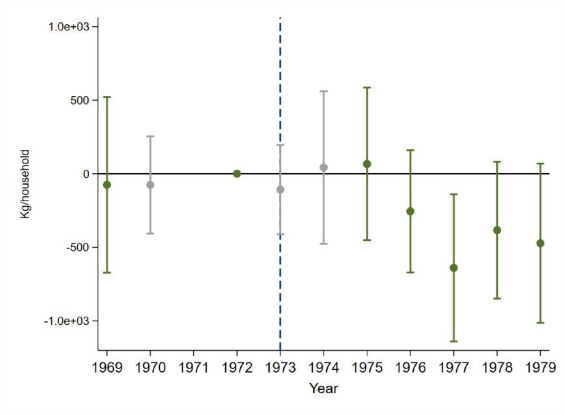


Figure A.11: Event Study of Bridge Impact on Rice Productivity: Robustness Checks 1

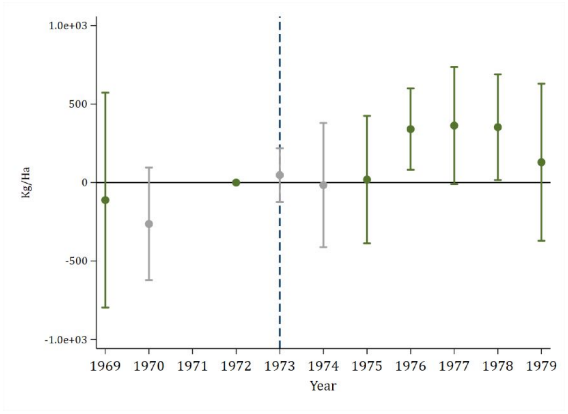


(a) Using Rice Yield

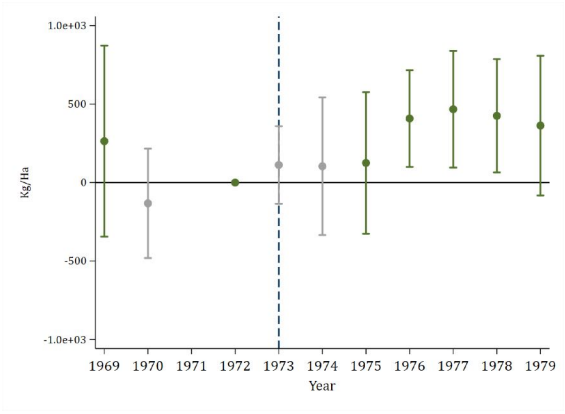


(b) Using $(1 - I_{GradeA})$

Figure A.12: Event Study of Bridge Impact on Rice Productivity: Robustness Checks 2

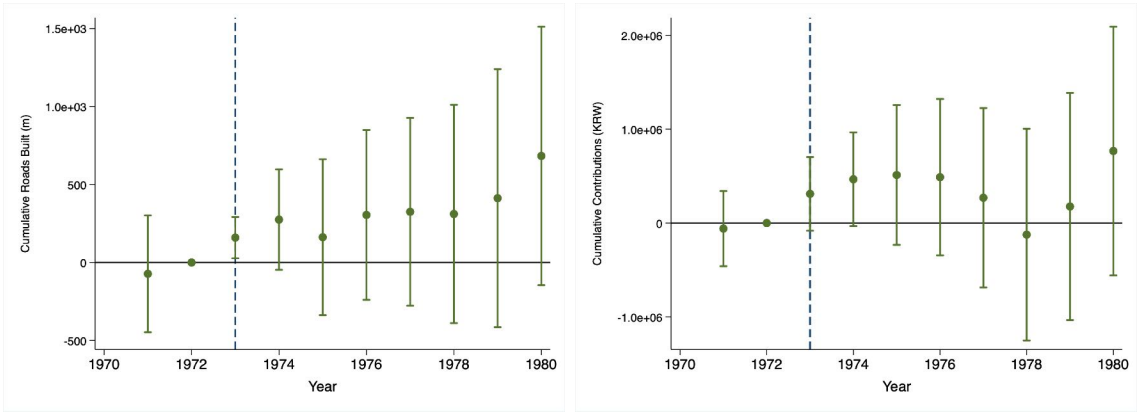


(a) Using $TopShare_i$



(b) Using $ClanShare_i$

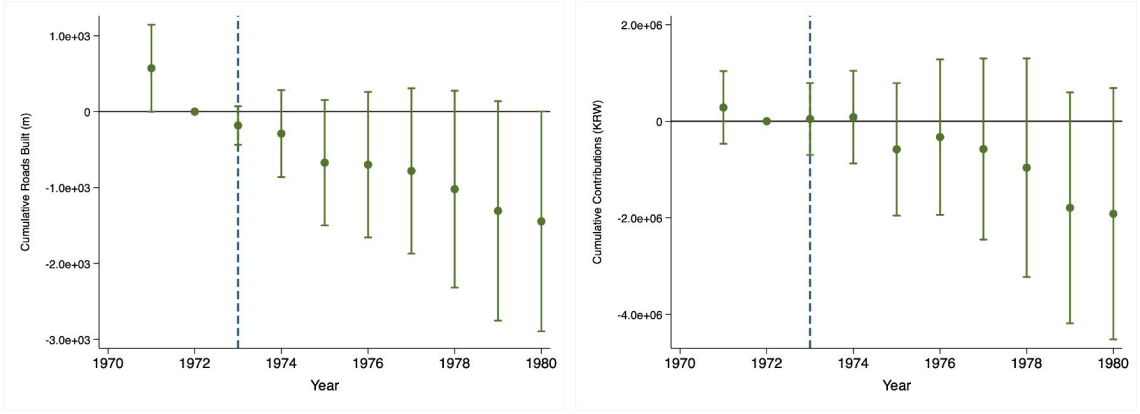
Figure A.13: Event Study of Bridge Impact on Road Construction (DiD)



(a) (b)

Notes: These figures present event study estimates of the bridge's impact on cumulative roads constructed (meters) and cumulative contribution from villagers. The vertical dashed line marks bridge construction (1973), with 1972 omitted as the baseline year. Both figures show double-difference (DD) estimates comparing connected and unconnected islands. All specifications include village and year fixed effects. Points represent coefficients with 95% confidence intervals based on standard errors clustered at the village level.

Figure A.14: Event Study of Bridge Impact on Road Construction by Social Fractionalization (DDD)



(a) (b)

Notes: These figures present event study estimates from a triple-difference model that interacts bridge access with a village being above the median for social fractionalization. The vertical dashed line marks the bridge opening (1973), with 1972 omitted as the baseline year. All specifications include village and year fixed effects. Points represent coefficients with 95% confidence intervals based on standard errors clustered at the village level.

Table A.14: Summary Statistics of the Two Main Data Sources

Panel A: Village Projects	Pooled-Years		By Year		
	Mean	SD	1971	1975	1979
	(1)	(2)	(3)	(4)	(5)
Num. of Projects	36.8	23.4	4.02	4.46	3.42
Avg. Budget per Project	$1,448	$2,146	$546	$1,182	$2,737
Share of Budget on Infrastructure	56%	33%	52%	53%	72%
% of Villages with Grade A			12%	25%	100%
Observations (*# Villages*)	5,278 (120)		528 (112)	528 (112)	429 (102)
Panel B: Village Characteristics	Pooled-Years		By Year		
	Mean	SD	1969	1975	1979
	(1)	(2)	(3)	(4)	(5)
Population	591.6	313.0	689.5	561.2	565.7
Households	111.5	59.5	114.7	113.7	109.1
Agri. Households	92.2	37.6	92.3	94.0	84.1
Cultivated Areas (hectares)	25.6	12.4	25.1	25.3	25.5
Rice Production (tons/village)	99.7	53.5	76.1	89.1	113.9
Power Tillers (units per village)	3.68	3.06	N/A	1.93	5.61
Observations (*# Villages*)	1,370 (196)		(195)	(196)	(196)

Note: This table presents summary statistics from two primary data sources used in this study. Panel A shows village project data from *History of Our Village* records (1970-1979), documenting development activities under the *New Village Movement*. Projects increased in budget size over time, and infrastructure's share of spending grew. The percentage of villages achieving highest performance grade (A) increased from 12% in 1971 to 100% by 1979. Panel B presents village characteristics from *Township Statistical Yearbooks* (1969-1979), showing demographic and agricultural trends. Despite population decline and stable cultivated area, rice production increased by 50% over the period. Technology adoption remained limited, with power tillers (mechanized farming equipment) owned by fewer than 6 households per village by 1979. Sample sizes vary across years and data sources; parentheses indicate the number of villages represented in each column. Korean Won values are converted to USD using an approximate exchange rate of 1,000 Won = 1 USD.

Table A.15: Fractionalization and Geographic & Pre-Bridge Demographic Characteristics

	Fractionalization			
	(1) I_i^{Frac}	(2) I_i^{Frac}	(3) I_i^{Frac}	(4) F_i
Panel A: Geographic Characteristics				
log(land area)	-0.08	-0.13	-0.08	-0.00
	(0.08)	(0.10)	(0.09)	(0.02)
1[stream]	-0.00	0.04	-0.01	0.00
	(0.11)	(0.10)	(0.10)	(0.02)
1[mountains]	-0.01	0.06	0.04	-0.01
	(0.13)	(0.13)	(0.14)	(0.03)
log(farmland per ag. hh.)		0.10	0.08	-0.02
		(0.36)	(0.33)	(0.04)
Cultivated area share of total land		-0.16	-0.09	0.07
		(0.37)	(0.32)	(0.06)
Rice paddy share of cultivated land		-0.70**	-0.62*	-0.07
		(0.34)	(0.37)	(0.06)
Island FEs	✓	✓		
Township FEs			✓	✓
Observations	196	196	196	196
R-squared	0.02	0.06	0.20	0.18
Panel B: Demographic Characteristics				
log(# of households)	-0.01	0.04	-0.01	0.01
	(0.10)	(0.10)	(0.09)	(0.01)
Share of agri. hh.	-0.94***	-0.94***	-0.98***	-0.17***
	(0.23)	(0.23)	(0.26)	(0.04)
Village Type:				
Fishing/Coastal	0.04	0.05	0.13	0.00
(N=16)	(0.17)	(0.17)	(0.13)	(0.02)
Semi-urban	0.11	0.08	0.03	0.01
(N=16)	(0.14)	(0.14)	(0.13)	(0.02)
Island	0.17	0.12	0.28	0.02
(N=29)	(0.22)	(0.24)	(0.21)	(0.03)
Share of pop. <14		1.64***	1.34**	0.12
		(0.57)	(0.54)	(0.09)
Share of women		-1.40*	-0.79	-0.03
		(0.74)	(0.82)	(0.18)
Age of village leader		0.00	0.00	-0.00
		(0.00)	(0.00)	(0.00)
Island FEs	✓	✓		
Township FEs			✓	✓
Observations	196	195	195	195
R-squared	0.14	0.17	0.30	0.28

Notes: This table presents two sets of regressions examining the relationship between measures of social fractionalization and geographic characteristics (Panel A) and demographic characteristics (Panel B). Columns (1)–(3) use I_i^{Frac}, an indicator for villages with above-median levels of social fractionalization, and column (4) uses F_i, a continuous measure. Village type indicators in Panel B are based on the official classification system: General Rural represents standard agricultural villages and serve as the omitted reference category; Semi-Urban represents quasi-urban settlements with populations exceeding 20,000; Mountainous represents villages with over 70% mountainous terrain; Fishing Villages represents communities where over 50% of households engage in fishing; Coastal Villages represents non-fishing coastal villages; Island Areas combines coastal island villages within 2km of shore and inland island villages, and serve as the counterfactual group in the main DDD analysis. Table A.23 reports mean values of key variables across village types for direct comparison of their characteristics.

Table A.16: Fractionalization and Distance Measures

log(Dist. to ...)	Administrative/Economic Centers		Transport Infrastructure	
	Township Office	County Office	Closest Port	Namhae Bridge
	(1)	(2)	(3)	(4)
I_i^{Frac}	0.08	0.22**	-0.33**	-0.03
	(0.15)	(0.10)	(0.15)	(0.10)
Village Chars. Controls	Yes	Yes	Yes	Yes
Village Type Dummies	Yes	Yes	Yes	Yes
Township FEs	✓	✓	✓	✓
Observations	196	170	196	170
R-squared	0.36	0.78	0.46	0.77

Notes: This table examines the relationship between kinship fractionalization (I_i^{Frac}) and distances to both administrative/economic centers and transport infrastructure (pre-existing ports and the new Namhae Bridge built in 1973). Standard errors are clustered at the legal village level. All models use the logarithm of distance as the dependent variable and include Township fixed effects to control for unobserved time-invariant geographic characteristics. The sample size decreases from 196 to 170 for the County Office (Column 2) and Namhae Bridge (Column 4) regressions because villages located on the smaller, unconnected island lack defined distance data for these destinations. The County Office is located on the larger island and the bridge connects only the larger island to the mainland. Village characteristics controls include log(land area), log(number of households), and the share of agricultural households. Village type dummies include indicators for Fishing/Coastal, Semi-urban, and Island villages, with rural agricultural villages serving as the baseline category. Full regression results with coefficients for all control variables are presented in Table A.25. Similar results hold when using the continuous measure of fractionalization (F_i), as reported in Table A.26.

Table A.17: Fractionalization and Sea Transport

	Has Port	Has Jetty	*log*(Jetty Length)
	(1)	(2)	(3)
I_i^{Frac}	0.21**	-0.03	-0.38
	(0.10)	(0.08)	(4.84)
Village Chars. Controls	Yes	Yes	Yes
Village Type Dummies	Yes	Yes	Yes
Township FEs	✓	✓	✓
Observations	196	196	70
R-squared	0.38	0.28	0.48

Notes: This table examines the relationship between kinship fractionalization (I_i^{Frac}, a dummy for above-median fractionalization) and sea transport infrastructure in Namhae County. Columns 1 and 2 use binary dependent variables (Has Port, Has Jetty). Column 3 restricts the sample to villages with jetties (70 observations) and uses log(jetty length + 1) as the dependent variable. Standard errors are clustered at the legal village level. All models include township fixed effects to control for unobserved time-invariant geographic characteristics. Village characteristics controls include log(land area), log(number of households), and share of agricultural households. Village type dummies include indicators for fishing/coastal, semi-urban, and island villages, with rural agricultural villages as the baseline. Full regression results with coefficients for all control variables are presented in Table A.27.

Table A.18: Fractionalization and Pre-Bridge Infrastructure Indicators

	Road Network				Public Services		
	Highway	State Rd.	County Rd.	Car Access	*log*(Schools)	Water	Electricity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
I_i^{Frac}	-0.03	-0.04	-0.12*	-0.03	0.03	0.01	0.16*
	(0.07)	(0.07)	(0.07)	(0.08)	(0.04)	(0.04)	(0.09)
Village Chars. Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Village Type Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Township FEs	✓	✓	✓	✓	✓	✓	✓
Observations	196	196	196	196	196	196	196
R-squared	0.44	0.37	0.47	0.15	0.18	0.09	0.21

Notes: This table examines the relationship between kinship fractionalization (I_i^{Frac}, a dummy for above-median fractionalization) and pre-bridge infrastructure indicators in Namhae County. Columns 1–4 and 6–7 use binary dependent variables (Highway, State Rd., County Rd., Car Accessibility, Water, Electricity). Column 5 uses log(number of schools + 1) as the dependent variable. Standard errors are clustered at the legal village level. All models include township fixed effects to control for unobserved time-invariant geographic characteristics. Village characteristics controls include log(land area), log(number of households), and share of agricultural households. Village type dummies include indicators for fishing/coastal, semi-urban, and island villages, with rural agricultural villages as the baseline. Full regression results with coefficients for all control variables are presented in Table A.28. Similar results hold when using the continuous measure of fractionalization (F_i, Herfindahl index of clan concentration), as reported in Table A.29.

Table A.19: Fractionalization and Economic & Socioeconomic Characteristics

Panel A: Agricultural Production & Structure

	Rice output per hh. (1969) (1)	Barley output per hh. (1969) (2)	log(special-use crop area) (3)	Rice paddies (% of arable) (4)	Share of non-agri. hh. (5)
I_i^{Frac}	-139.87*	-0.12	-0.16***	-0.03	0.08***
	(75.01)	(0.13)	(0.05)	(0.03)	(0.02)
Controls	Yes	Yes	Yes	Yes	Yes
Township FEs	✓	✓	✓	✓	✓
Observations	196	196	196	196	196
R-squared	0.36	0.34	0.55	0.41	0.54

Panel B: Livestock Assets

	log(cows per hh.) (6)	log(pigs per hh.) (7)	log(chickens per hh.) (8)	log(rabbits per hh.) (9)
I_i^{Frac}	-0.05***	0.03*	-0.17	-0.06*
	(0.02)	(0.02)	(0.12)	(0.03)
Controls	Yes	Yes	Yes	Yes
Township FEs	✓	✓	✓	✓
Observations	196	196	196	196
R-squared	0.64	0.31	0.40	0.20

Panel C: Household Amenities & Information Access

	Share of modern roofs (10)	log(TVs per hh.) (11)	log(radios per hh.) (12)	log(newspapers per hh.) (13)	Telephone access (14)
I_i^{Frac}	0.03	-0.01	0.00	-0.00	0.07
	(0.02)	(0.01)	(0.02)	(0.01)	(0.09)
Controls	Yes	Yes	Yes	Yes	Yes
Township FEs	✓	✓	✓	✓	✓
Observations	195	196	196	196	196
R-squared	0.40	0.79	0.65	0.51	0.36

Panel D: Baseline New Village Movement Indicators

	Initial village grade (15)	log(project costs) (16)	log(voluntary contrib.) (17)	log(government support) (18)	log(participants in projects) (19)
I_i^{Frac}	-0.05	0.42	0.31	0.45	-0.04
	(0.06)	(0.48)	(0.56)	(0.80)	(0.13)
Controls	Yes	Yes	Yes	Yes	Yes
Township FEs	✓	✓	✓	✓	✓
Observations	196	120	120	120	120
R-squared	0.05	0.26	0.23	0.19	0.22

Notes: This table examines the relationship between kinship fractionalization (I_i^{Frac}) and pre-bridge economic and socioeconomic characteristics. Binary dependent variables are used in Columns 10, 14, and 15; others use logarithmic measures or shares as indicated. Columns 16–19 restrict the sample to 120 observations due to data availability. Standard errors, in parentheses, are clustered at the legal village level. All models include township fixed effects to control for unobserved time-invariant geographic characteristics. Controls include log(land area), log(number of households), share of agricultural households, and village type dummies (fishing/coastal, semi-urban, island, with rural agricultural as baseline). Full results with all control coefficients for a subset of variables are in Table A.30.

Table A.20: Continuous Measures of Social Fractionalization

	(1) I_i^{Frac}	(2) F_i	(3) $TopShare_i$	(4) $ClanShare_i$
$I_i^{Frac} \times I_i^{Bridge} \times Post_t$	-352.97***	-2,243.68	822.40	651.65
	(127.68)	(1,630.61)	(593.61)	(429.42)
Demographic controls	✓	✓	✓	✓
Village & year FEs	✓	✓	✓	✓
Mean of dep. var.	1,132	1,132	1,132	1,132
Observations	1,364	1,364	1,364	1,364
Number of villages	196	196	196	196
R-squared	0.76	0.76	0.76	0.76

Notes: The dependent variable is rice output per agricultural household measured in kg. Each column presents a triple-difference estimate using different measures of social structure. Column (1) reproduces the baseline specification using a binary indicator for above-median fractionalization. Columns (2)-(4) use continuous measures: Column (2) uses the continuous fractionalization index F_i (ranging from 0 to 1); Column (3) uses the share of the single largest clan in the village (ranging from 0 to 1); Column (4) uses the combined share of all significant clans, defined as those comprising more than 10% of households. Note that columns (3) and (4) measure social homogeneity rather than fractionalization, so positive coefficients would indicate that more homogeneous villages benefit more from infrastructure. All specifications include the full set of double interactions, village and year fixed effects, and demographic controls (log of population, average household size, and share of women in the village population). Standard errors clustered at the village level are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.21: Baseline Characteristics by Kinship Fractionalization and Access to the Bridge

Kinship Fractionalization: / Eventual Access to the Bridge:	(1) $I_i^{Frac}=0$ $B_i=1$	(2) $I_i^{Frac}=1$ $B_i=1$	(3) $I_i^{Frac}=0$ $B_i=0$	(4) $I_i^{Frac}=1$ $B_i=0$	(5) All Villages
Panel A: Demographics & Basic Infra. (1972)					
Num. of villages	90	80	10	16	196
Population	626.9	719.9	818.5	796.1	688.5
Number of Households	105.0	123.2	119.5	127.5	115.0
Share of Non-agricultural HH	0.08	0.21	0.20	0.27	0.15
Avg. Num. of Schools	0.17	0.29	0.20	0.19	0.22
Modern roof share	0.31	0.35	0.31	0.36	0.33
Panel B: Agricultural Prod. & Structure (1969)					
Rice Output per Agri. HH (kg)	932	756	819	917	853
Barley Output per Agri. HH (kg)	1194	1135	1768	1725	1242
Rice Yield (kg/ha)	3227	3140	2726	2786	3130
Cash Crop Area (ha)	3.50	2.67	3.43	3.12	3.12
Number of Cash Crops Grown	4.77	4.34	5.00	4.94	4.62
Share of Arable Land as Rice Paddies	0.65	0.56	0.40	0.54	0.59
Total Cultivated Area (ha)	46.5	41.2	50.1	57.7	45.4
Panel C: Livestock Assets (1972)					
Cows per HH	0.45	0.31	0.51	0.38	0.39
Pigs per HH	0.28	0.30	0.16	0.16	0.27
Chickens per HH	9.45	7.58	5.18	3.84	8.01
Rabbits per HH	0.35	0.25	0.19	0.17	0.28
Panel D: Amenities & Info. Access (1972)					
Radios per HH	0.30	0.28	0.43	0.38	0.31
Newspapers per HH	0.13	0.10	0.05	0.06	0.11
Share of Villages with Telephone Access	0.41	0.61	0.10	0.31	0.47
Panel E: Market Access & Geographic Factors (1972)					
Distance to the Bridge (km)	22.6	25.9	N/A	N/A	24.1
Share of Car Accessible Villages	0.77	0.78	1.00	0.44	0.76
Share of Highway Accessible Villages	0.24	0.23	0.00	0.00	0.20
Share of State Road Accessible Villages	0.14	0.17	0.50	0.38	0.19
Share of County Road Accessible Villages	0.54	0.33	0.60	0.50	0.45
Distance to Closest Admin Office (km)	4.29	6.72	5.84	3.09	5.26
Distance to County Office (km)	9.6	13.9	N/A	N/A	11.6
Panel F: Baseline NVM Indicators (1972)					
Share of Grade A Villages (initial assessment)	0.16	0.10	0.10	0.13	0.13
Initial Project Budget (USD)	1824	2322	753	1645	1953
Initial Voluntary Contributions (% of cost)	0.28	0.19	0.14	0.15	0.24
Initial Project Labor Input (worker-days per capita)	2.54	1.89	1.37	1.86	2.22

Notes: This table presents mean baseline characteristics of villages in Namhae County by kinship fractionalization (I_i^{Frac}) and eventual bridge access (B_i). $I_i^{Frac}=1$ indicates above-median fractionalization (lower clan concentration, based on the Herfindahl index). $B_i=1$ indicates villages on the island connected by the 1973 Namhae Bridge. Columns 1–4 show means for subgroups: homogeneous with bridge access ($I_i^{Frac}=0$, $B_i=1$, 90 villages), fractionalized with bridge access ($I_i^{Frac}=1$, $B_i=1$, 80 villages), homogeneous without bridge access ($I_i^{Frac}=0$, $B_i=0$, 10 villages), and fractionalized without bridge access ($I_i^{Frac}=1$, $B_i=0$, 16 villages). Column 5 shows means for all 196 villages. Panels A, C–F use 1972 data; Panel B uses 1969 data. Panels cover demographics and infrastructure (A), agricultural production (B), livestock assets (C), amenities and information access (D), market access (E), and New Village Movement (NVM) indicators (F). Korean Won values are converted to USD using an approximate exchange rate of 1,000 Won = 1 USD. Distances to the bridge and county office are unavailable for unconnected villages ($B_i=0$). See Table 2 for mean comparisons with p-values.

Table A.22: Balance Test: Villages With & Without Surviving New Village Movement (NVM) Records

	With NVM Records (N = 120)	Without NVM Records (N = 76)	p-value
Panel A: Demographics & Basic Infrastructure (1972)			
Population	709.6	655.0	0.23
Number of Households	122.3	103.6	0.03
Share of Non-Agricultural Households	0.15	0.15	0.88
Avg. Number of Schools	0.23	0.21	0.83
Modern Roof Share	0.33	0.33	0.83
Share of Grade A Villages (initial assessment)	0.14	0.11	0.46
Panel B: Agricultural Production & Structure (1969)			
Rice Output per Agri. HH (kg)	876	816	0.28
Barley Output per Agri. HH (kg)	1250	1230	0.85
Rice Yield (kg/ha)	3084	3200	0.29
Special-use Crop Area (ha)	3.05	3.23	0.49
Number of Special-use Crops Grown	4.58	4.67	0.67
Share of Arable Land as Paddies	0.61	0.56	0.02
Total Cultivated Area (ha)	47.3	42.5	0.09
Panel C: Livestock Assets (1969)			
Cows per HH	0.40	0.38	0.50
Pigs per HH	0.27	0.28	0.72
Chickens per HH	7.67	8.55	0.43
Rabbits per HH	0.28	0.29	0.79
Panel D: Amenities & Information Access (1969)			
Radios per HH	0.29	0.33	0.33
Newspapers per HH	0.11	0.10	0.31
Telephone Access Share	0.49	0.43	0.43
Panel E: Market Access (1972)			
Distance to the Bridge (km)	22.7	26.7	0.03
Share of Car Accessible Villages	0.80	0.68	0.07
Highway Access Share	0.17	0.25	0.21
County Road Access Share	0.48	0.41	0.30
Distance to Admin Office (km)	5.29	5.22	0.94
Distance to County Office (km)	11.2	12.4	0.30
Panel F: Social Structure			
Clan Fractionalization Index (F_i)	0.91	0.94	0.05
Largest clan share ($TopShare_i$)	0.21	0.18	0.14

Notes: This table compares baseline characteristics of villages with (N=120) and without (N=76) surviving New Village Movement (NVM) records. During the 1970s, all villages in Namhae County participated in NVM projects and documented their activities in *History of Our Village* (*우리마을의 역사*). However, only 120 villages have records that survived and remain accessible today. These surviving records contain the detailed road construction data used in Columns 3 and 6 in Table 9. P-values are from two-sided t-tests of equal means. See Appendix Table A.21 for summary statistics by other village traits.

Table A.23: Village Characteristics by Settlement Type Before Bridge Construction

	General Rural *(N=128)*	Semi-Urban Villages *(N=16)*	Mountainous Villages *(N=6)*	Fishing Villages *(N=10)*	Coastal Villages *(N=6)*	Island Areas *(N=29)*
Panel A: Fractionalization Measures						
I_i^{Frac}	0.42	0.81	0.17	0.80	0.17	0.62
F_i	0.91	0.98	0.83	0.96	0.90	0.95
	(0.09)	(0.04)	(0.11)	(0.07)	(0.04)	(0.05)
$TopShare_i$	0.22	0.06	0.36	0.08	0.29	0.16
	(0.16)	(0.10)	(0.11)	(0.14)	(0.08)	(0.13)
$ClanShare_i$	0.32	0.10	0.51	0.16	0.43	0.20
	(0.24)	(0.17)	(0.20)	(0.30)	(0.17)	(0.20)
Panel B: Geographic Characteristics						
log(land area)	4.94	4.43	5.26	5.47	5.29	5.37
	(0.68)	(0.58)	(0.97)	(0.31)	(0.75)	(0.38)
1[stream]	0.38	0.06	0.83	0.10	0.83	0.10
1[mountains]	0.07	0.06	0.33	0.00	0.17	0.07
log(farmland per ag. hh.)	0.40	0.36	0.52	0.31	0.37	0.48
	(0.07)	(0.15)	(0.17)	(0.04)	(0.03)	(0.23)
Share of cultivated area	0.36	0.43	0.31	0.15	0.21	0.24
	(0.19)	(0.18)	(0.27)	(0.10)	(0.12)	(0.07)
Share rice paddies	0.62	0.62	0.64	0.46	0.61	0.47
	(0.13)	(0.23)	(0.10)	(0.10)	(0.13)	(0.17)
Panel C: Demographic Characteristics						
log(# of households)	4.59	5.02	4.24	4.91	4.51	4.78
	(0.41)	(0.48)	(0.42)	(0.53)	(0.49)	(0.37)
Share of agri. hh.	0.90	0.59	0.97	0.71	0.92	0.76
	(0.11)	(0.26)	(0.04)	(0.24)	(0.13)	(0.17)
Share of pop. <14	0.37	0.37	0.46	0.37	0.36	0.38
	(0.05)	(0.04)	(0.20)	(0.02)	(0.05)	(0.04)
Share of women	0.49	0.50	0.48	0.49	0.48	0.49
	(0.05)	(0.02)	(0.07)	(0.02)	(0.04)	(0.02)
Age of village leader	43.10	47.56	42.83	36.70	36.83	42.28
	(7.99)	(9.52)	(9.52)	(6.13)	(5.38)	(6.52)

Notes: This table presents means and standard deviations (in parentheses) of key village characteristics by settlement type. Village types are based on the official classification system: General Rural represents standard agricultural villages; Semi-Urban represents quasi-urban settlements with populations exceeding 20,000; Mountainous represents villages with over 70% mountainous terrain; Fishing Villages represents communities where over 50% of households engage in fishing; Coastal Villages represents non-fishing coastal villages; Island Areas combines coastal island villages within 2km of shore and inland island villages, and serve as the counterfactual group in the main DDD analysis. Most baseline characteristics differ significantly across settlement types ($p<0.01$ from F-tests of equality of means across village types, not reported on this table), except for mountainous location and village leader age.

Table A.24: Fractionalization and Geographic & Demographic Characteristics (Homogeneity Measures)

	Homogeneity Measures			
	(1)	(2)	(3)	(4)
	$TopShare_i$	$TopShare_i$	$TopShare_i$	$ClanShare_i$
Panel A: Geographic Characteristics				
log(land area)	0.02	0.03	0.03	0.00
	(0.03)	(0.04)	(0.03)	(0.04)
1[stream]	0.00	-0.01	0.01	0.01
	(0.03)	(0.03)	(0.03)	(0.05)
1[mountains]	0.03	0.01	-0.00	0.02
	(0.04)	(0.04)	(0.04)	(0.07)
log(farmland per ag. hh.)		0.09	0.08	0.08
		(0.11)	(0.11)	(0.13)
Share of cultivated area		0.00	-0.00	-0.05
		(0.13)	(0.11)	(0.15)
Share rice paddies		0.19	0.13	0.21
(% of arable)		(0.12)	(0.11)	(0.19)
Island FEs	✓	✓		
Township FEs			✓	✓
Observations	196	196	196	196
R-squared	0.02	0.06	0.19	0.28
Panel B: Demographic Characteristics				
log(# of households)	-0.03	-0.04	-0.01	0.00
	(0.03)	(0.04)	(0.03)	(0.04)
Share of agri. hh.	0.27***	0.28***	0.35***	0.55***
	(0.07)	(0.07)	(0.08)	(0.11)
Village Type:				
Fishing/Coastal	-0.03	-0.02	-0.03	-0.03
(N=16)	(0.05)	(0.05)	(0.04)	(0.08)
Semi-urban	-0.06	-0.06	-0.05	-0.02
(N=16)	(0.04)	(0.04)	(0.03)	(0.06)
Island	-0.08	-0.08	-0.10*	-0.09
(N=29)	(0.07)	(0.08)	(0.06)	(0.14)
Share of pop. <14		-0.30	-0.18	-0.20
		(0.18)	(0.16)	(0.27)
Share of women		0.17	-0.00	-0.10
		(0.25)	(0.27)	(0.44)
Age of village leader		0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)
Island FEs	✓	✓		
Township FEs			✓	✓
Observations	196	195	195	195
R-squared	0.19	0.20	0.33	0.40

Notes: This table examines the relationship between homogeneity measures and geographic characteristics (Panel A) and demographic characteristics (Panel B). Columns (1)–(3) use $TopShare_i$, defined as the share of households belonging to the largest clan in village i, while column (4) uses $ClanShare_i$, the combined share of households belonging to clans that each account for more than 10% of the village population. Village type indicators in Panel B are based on the official classification system: General Rural represents standard agricultural villages and serve as the omitted reference category; Semi-Urban

Table A.25: Fractionalization and Distance Measures

log(Dist. to ...)	Administrative/Economic Centers		Transport Infrastructure	
	Township Office	County Office	Closest Port	Namhae Bridge
	(1)	(2)	(3)	(4)
I_i^{Frac}	0.08	0.22**	-0.33**	-0.03
	(0.15)	(0.10)	(0.15)	(0.10)
Controls:				
log(land area)	0.16	-0.03	0.20**	-0.04
	(0.11)	(0.07)	(0.09)	(0.05)
log(# of hh.)	-0.02	0.16*	-0.29**	0.08
	(0.13)	(0.08)	(0.12)	(0.09)
Share of agri. hh.	-0.13	0.20	0.01	-0.17
	(0.37)	(0.26)	(0.34)	(0.22)
Village Type:				
Fishing/Coastal	0.70***	0.39***	-0.68***	0.00
	(0.22)	(0.12)	(0.19)	(0.14)
Semi-urban	-0.46	-0.23	0.22	-0.22
	(0.28)	(0.15)	(0.17)	(0.15)
Island	1.06***		-0.70***	
	(0.24)		(0.25)	
Township FEs	✓	✓	✓	✓
Observations	196	170	196	170
R-squared	0.36	0.78	0.46	0.77

Notes: This table examines the relationship between kinship fractionalization (I_i^{Frac}) and distances to both administrative/economic centers and transport infrastructure (pre-existing ports and the new Namhae Bridge built in 1973). Standard errors are clustered at the legal village level. All models use the logarithm of distance as the dependent variable and include Township fixed effects to control for unobserved time-invariant geographic characteristics. The sample size decreases from 196 to 170 for the County Office (Column 2) and Namhae Bridge (Column 4) regressions because villages located on the smaller, unconnected island lack defined distance data for these destinations. The County Office is located on the larger island and the bridge connects only the larger island to the mainland. Village characteristics controls include log(land area), log(number of households), and the share of agricultural households. Village type dummies include indicators for Fishing/Coastal, Semi-urban, and Island villages, with rural agricultural villages serving as the baseline category.

Table A.26: Continuous Measure of Fractionalization (F) and Distance Measures

	Administrative/Economic Centers		Transport Infrastructure	
log(Dist. to ...)	Township Office	County Office	Closest Port	Namhae Bridge
	(1)	(2)	(3)	(4)
F_i	-0.49	0.26	-1.37**	-0.52
	(0.74)	(0.77)	(0.62)	(0.46)
Controls:				
log(land area)	0.15	-0.03	0.19*	-0.04
	(0.11)	(0.07)	(0.10)	(0.05)
log(# of hh.)	-0.02	0.13	-0.25**	0.08
	(0.13)	(0.09)	(0.12)	(0.09)
Share of agri. hh.	-0.28	-0.03	0.11	-0.23
	(0.37)	(0.29)	(0.36)	(0.21)
Village Type:				
Fishing/Coastal	0.71***	0.41***	-0.70***	0.00
	(0.22)	(0.12)	(0.19)	(0.14)
Semi-urban	-0.45	-0.23	0.22	-0.22
	(0.28)	(0.15)	(0.17)	(0.15)
Island	1.09***		-0.78***	
	(0.25)		(0.23)	
Township FEs	✓	✓	✓	✓
Observations	196	170	196	170
R-squared	0.36	0.76	0.44	0.77

Notes: This table examines the relationship between kinship fractionalization (F_i) and distances to both administrative/economic centers and transport infrastructure (pre-existing ports and the new Namhae Bridge built in 1973). Standard errors are clustered at the legal village level. All models use the logarithm of distance as the dependent variable and include Township fixed effects to control for unobserved time-invariant geographic characteristics. The sample size decreases from 196 to 170 for the County Office (Column 2) and Namhae Bridge (Column 4) regressions because villages located on the smaller, unconnected island lack defined distance data for these destinations. The County Office is located on the larger island and the bridge connects only the larger island to the mainland. Village characteristics controls include log(land area), log(number of households), and the share of agricultural households. Village type dummies include indicators for Fishing/Coastal, Semi-urban, and Island villages, with rural agricultural villages serving as the baseline category.

Table A.27: Fractionalization and Sea Transport

	Has Port	Has Jetty	*log*(Jetty Length)
	(1)	(2)	(3)
I_i^{Frac}	0.21**	-0.03	-0.38
	(0.10)	(0.08)	(4.84)
Controls:			
log(land area)	-0.10	-0.04	-0.29
	(0.06)	(0.08)	(3.57)
log(# of hh.)	0.15*	0.23**	12.93*
	(0.08)	(0.09)	(7.13)
Share of agri. hh.	-0.06	-0.31	-10.31
	(0.22)	(0.32)	(22.28)
Village Type:			
Fishing/Coastal	0.44***	0.34*	1.09
	(0.14)	(0.18)	(3.50)
Semi-urban	-0.13	-0.27**	-7.81
	(0.12)	(0.13)	(6.41)
Island	0.50***	0.32	-2.63
	(0.16)	(0.25)	(5.49)
Township FEs	✓	✓	✓
Observations	196	196	70
R-squared	0.38	0.28	0.48

Notes: This table examines the relationship between kinship fractionalization (I_i^{Frac}, a dummy for above-median fractionalization) and sea transport infrastructure in Namhae County. Columns 1 and 2 use binary dependent variables (Has Port, Has Jetty). Column 3 restricts the sample to villages with jetties (70 observations) and uses log(jetty length + 1) as the dependent variable. Standard errors are clustered at the legal village level. All models include Township fixed effects to control for unobserved time-invariant geographic characteristics. Village characteristics controls include log(land area), log(number of households), and the share of agricultural households. Village type dummies include indicators for Fishing/Coastal, Semi-urban, and Island villages, with rural agricultural villages as the baseline category.

Table A.28: Fractionalization and Pre-Bridge Infrastructure Indicators

	Road Network				Public Services		
	Highway	State Rd.	County Rd.	Car Access	*log*(Schools)	Water	Electricity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
I_i^{Frac}	-0.03	-0.04	-0.12*	-0.03	0.03	0.01	0.16*
	(0.07)	(0.07)	(0.07)	(0.08)	(0.04)	(0.04)	(0.09)
Controls:							
log(land area)	-0.08	-0.16***	0.08*	0.03	0.01	-0.05	-0.00
	(0.06)	(0.06)	(0.04)	(0.05)	(0.03)	(0.05)	(0.06)
log(# of hh.)	0.18***	0.12	0.08	0.14	0.18***	0.05	0.13
	(0.06)	(0.08)	(0.07)	(0.09)	(0.05)	(0.05)	(0.09)
Share of agri. hh.	0.11	0.07	0.20	0.20	0.03	0.19	0.65***
	(0.16)	(0.27)	(0.21)	(0.27)	(0.12)	(0.13)	(0.21)
Village Type:							
Fishing/Coastal	-0.26***	-0.14*	0.11	-0.35***	0.11	0.03	-0.27*
	(0.09)	(0.08)	(0.13)	(0.12)	(0.09)	(0.07)	(0.14)
Semi-urban	0.16	-0.19	0.10	0.11	0.20**	0.12	0.15
	(0.14)	(0.12)	(0.10)	(0.13)	(0.09)	(0.14)	(0.11)
Island	-0.23	-0.30**	-0.13	-0.50**	0.09	-0.05	-0.22
	(0.25)	(0.14)	(0.09)	(0.24)	(0.20)	(0.04)	(0.19)
Township FEs	✓	✓	✓	✓	✓	✓	✓
Observations	196	196	196	196	196	196	196
R-squared	0.44	0.37	0.47	0.15	0.18	0.09	0.21

Notes: This table examines the relationship between kinship fractionalization (I_i^{Frac}, a dummy for above-median fractionalization) and pre-bridge infrastructure indicators in Namhae County. Columns 1–4 and 6–7 use binary dependent variables (Highway, State Rd., County Rd., Car Access, Water, Electricity). Column 5 uses log(number of schools + 1) as the dependent variable. Standard errors are clustered at the legal village level. All models include township fixed effects to control for unobserved time-invariant geographic characteristics. Village characteristics controls include log(land area), log(number of households), and share of agricultural households. Village type dummies include indicators for fishing/coastal, semi-urban, and island villages, with rural agricultural villages as the baseline.

Table A.29: Fractionalization and Pre-Bridge Infrastructure Indicators

	Road Network				Public Services		
	Highway	State Rd.	County Rd.	Car Access	*log*(Schools)	Water	Electricity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F_i	0.42	-0.17	-0.44	0.06	-0.00	-0.32	1.26**
	(0.43)	(0.30)	(0.36)	(0.48)	(0.20)	(0.29)	(0.54)
Controls:							
log(land area)	-0.07	-0.16***	0.08*	0.03	0.01	-0.05	0.01
	(0.06)	(0.06)	(0.05)	(0.05)	(0.03)	(0.05)	(0.06)
log(# of hh.)	0.17***	0.13	0.09	0.14	0.18***	0.06	0.11
	(0.06)	(0.08)	(0.07)	(0.10)	(0.05)	(0.05)	(0.09)
Share of agri. hh.	0.20	0.08	0.25	0.24	-0.00	0.14	0.70***
	(0.17)	(0.27)	(0.20)	(0.26)	(0.13)	(0.14)	(0.22)
Village Type:							
Fishing/Coastal	-0.26***	-0.14*	0.10	-0.35***	0.11	0.04	-0.27*
	(0.09)	(0.08)	(0.13)	(0.11)	(0.08)	(0.07)	(0.13)
Semi-urban	0.16	-0.19	0.10	0.11	0.20**	0.12	0.15
	(0.14)	(0.12)	(0.10)	(0.13)	(0.09)	(0.15)	(0.10)
Island	-0.24	-0.31**	-0.16*	-0.51**	0.10	-0.04	-0.20
	(0.26)	(0.14)	(0.09)	(0.24)	(0.20)	(0.04)	(0.20)
Township FEs	✓	✓	✓	✓	✓	✓	✓
Observations	196	196	196	196	196	196	196
R-squared	0.45	0.37	0.47	0.15	0.18	0.10	0.23

Notes: This table examines the relationship between kinship fractionalization (F_i, Herfindahl index of clan concentration) and pre-bridge infrastructure indicators in Namhae County. Higher F_i indicates greater clan concentration (lower fractionalization). Columns 1–4 and 6–7 use binary dependent variables (Highway, State Rd., County Rd., Car Access, Water, Electricity). Column 5 uses log(number of schools + 1) as the dependent variable. Standard errors are clustered at the legal village level. All models include township fixed effects to control for unobserved time-invariant geographic characteristics. Village characteristics controls include log(land area), log(number of households), and share of agricultural households. Village type dummies include indicators for fishing/coastal, semi-urban, and island villages, with rural agricultural villages as the baseline.

Table A.30: Fractionalization and Economic & Socioeconomic Characteristics

	Agricultural Output & Livelihoods				Household Assets & Amenities		
	Rice output per hh. (1969) (1)	Barley output per hh. (1969) (2)	Share of non-agri. hh. (3)	Share of modern roofs (4)	log(cows per hh.) (5)	log(radios per hh.) (6)	Telephone (7)
I_i^{Frac}	-139.87*	-0.12	0.08***	0.03	-0.05***	0.00	0.07
	(75.01)	(0.13)	(0.02)	(0.02)	(0.02)	(0.02)	(0.09)
Controls:							
log(land area)	154.13**	0.13	-0.04**	-0.06***	0.03***	-0.02	-0.05
	(60.23)	(0.10)	(0.02)	(0.02)	(0.01)	(0.02)	(0.08)
log(# of hh.)	-333.87***	-0.68***	0.13***	0.06**	-0.06***	-0.04	0.27***
	(102.26)	(0.23)	(0.03)	(0.03)	(0.02)	(0.03)	(0.08)
Share of agri. hh.	-871.72**	-2.03**		-0.09	0.28***	-0.16**	-0.25
	(400.74)	(0.97)		(0.08)	(0.06)	(0.08)	(0.19)
Village Type:							
Fishing/Coastal	-444.12***	-0.40**	0.10**	-0.01	-0.02	-0.02	0.07
	(104.22)	(0.17)	(0.05)	(0.04)	(0.02)	(0.03)	(0.12)
Semi-urban	-66.29	-0.44*	0.19***	0.07*	-0.02	0.07**	0.08
	(132.52)	(0.22)	(0.06)	(0.04)	(0.02)	(0.04)	(0.12)
Island	-503.36***	-0.49*	0.05	0.04	0.04	0.03	-0.20**
	(149.72)	(0.29)	(0.06)	(0.06)	(0.03)	(0.06)	(0.10)
Township FEs	✓	✓	✓	✓	✓	✓	✓
Observations	196	196	196	196	196	196	196
R-squared	0.36	0.34	0.54	0.40	0.64	0.65	0.36

Notes: This table examines the relationship between kinship fractionalization (I_i^{Frac}, a dummy for above-median fractionalization) and selected pre-bridge economic and socioeconomic characteristics in Namhae County. Columns 1–2 measure agricultural output per household (1969), Columns 3–4 use shares, Columns 5–6 use logarithmic measures, and Column 7 uses a binary dependent variable (Telephone access). Standard errors, in parentheses, are clustered at the legal village level. All models include township fixed effects to control for unobserved time-invariant geographic characteristics. Controls include log(land area), log(number of households), share of agricultural households (omitted in Column 3 due to collinearity), and village type dummies (fishing/coastal, semi-urban, island, with rural agricultural as baseline). Condensed results for these and additional outcomes are in Table A.19.

Table A.31: Full Interaction Estimates: Social Fractionalization, Infrastructure, and Productivity

	Rice Output per Agri. Household			
	(1)	(2)	(3)	(4)
$\mathbf{I_i^{Frac} \times I_i^{Bridge} \times Post_t}$	-349.67***	-361.24***	-353.34***	-357.07***
	(128.52)	(127.35)	(127.68)	(127.57)
I_i^{Frac}	189.28*	154.98*	118.72	58.68
	(112.72)	(92.73)	(93.31)	(94.30)
I_i^{Bridge}	-22.36	-260.73	-320.98	-442.34**
	(91.29)	(254.65)	(223.97)	(197.40)
$Post_t$	91.99	102.04	107.09	124.24
	(83.49)	(83.32)	(82.52)	(85.96)
$I_i^{Frac} \times I_i^{Bridge}$	-270.84**	-209.90**	-179.96*	-82.60
	(123.34)	(104.79)	(103.82)	(107.25)
$I_i^{Frac} \times Post_t$	228.25*	233.10**	233.32**	223.82*
	(119.07)	(117.89)	(117.45)	(115.16)
$I_i^{Bridge} \times Post_t$	256.14***	277.49***	270.85***	291.37***
	(89.88)	(87.88)	(87.11)	(86.65)
Mean of Y (Pre-1973)	886.0	886.0	886.0	886.0
Demographic controls	✓	✓	✓	
Socioeconomic/village controls		✓	✓	
Geographic controls			✓	
LASSO				✓
Observations	1,364	1,358	1,358	1,279
R-squared	0.22	0.30	0.32	0.36

Notes: The estimates (1) with demographic controls, and (2) with both demographic and village-level controls, (3) with geographic controls, (4) LASSO-selected controls are presented. The demographic controls include the log of population, the share of agricultural households, the share of the population greater than 14, and the share of women. The socioeconomic/village controls include the age of a village leader, the share of modified roofs, log of the number of schools, car accessibility, access to water, electricity, and phone. The geographic controls include log of total land area, share of land area that is cultivated, and log of distance to the closest public office. Standard errors are clustered at the village level.

Table A.32: The Effect of Social Fractionalization on Barley and Rice Productivity

	Barley Output per Agri. HH (kg)			Rice Baseline
	(1)	(2)	(3)	(4)
$I_i^{Bridge} \times Post_t$	136.13		206.18	188.23**
	(129.81)		(146.70)	(93.72)
$I_i^{Frac} \times Post_t$		-34.68	89.41	234.11**
		(67.61)	(152.00)	(113.29)
$I_i^{Frac} \times I_i^{Bridge} \times Post_t$			-142.86	-352.97***
			(169.35)	(127.68)
Demographic controls	✓	✓	✓	✓
Mean of Y (Pre-1973)	1,208	1,208	1,208	886.0
Observations	1,286	1,286	1,286	1,364
Number of villages	196	196	196	196
R-squared	0.49	0.49	0.49	0.76

Notes: This table presents double-difference estimates (columns 1-2) and the triple-difference specification (column 3) for barley ouput per agricultural household in kg. The baseline result for rice is repeated in column 4 for easy comparison. All specifications include village and year fixed effects, and controls for demographic characteristics: log of total village population, average household size, and share of women in the village population. *** p<0.01, ** p<0.05, * p<0.10.

Table A.33: Robustness to Alternative Fixed Effects

	Rice Output per Agricultural Household (kg)			
	(1)	(2)	(3)	(4)
$I_i^{Frac} \times I_i^{Proximity} \times Post_t$	226.13**	231.14**	228.79***	244.01***
	(91.83)	(97.24)	(83.03)	(80.54)
Fixed Effects:				
Village	✓	✓	✓	✓
Year	✓	✓	✓	✓
Township × Year		✓		
1969 Farmland Area × Year			✓	
1969 Share of Agri. HH. × Year				✓
Demographic controls	✓	✓	✓	✓
Mean of Y (Pre-1973)	886.0	886.0	886.0	886.0
Observations	1,079	1,079	1,073	1,079
Number of villages	170	170	170	170
R-squared	0.81	0.87	0.82	0.83

Notes: This table examines the stability of the triple-difference coefficient across alternative fixed effects specifications. All specifications include controls for demographic characteristics: log of total village population, average household size, and share of women in the village population. Column (1) includes only village and year fixed effects. Column (2) adds township × year fixed effects, absorbing time-varying shocks at the administrative level (25 villages per township on average). Column (3) adds farmland area × year fixed effects, allowing differential trends by initial agricultural capacity. Column (4) uses share of agricultural household in 1969 × year fixed effects, allowing trends to vary by initial specialization in agriculture. Standard errors clustered at the village level in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Table A.34: Strategic Crop Specialization Following Bridge Construction: Role of Infrastructure

	Output per Agricultural Household (tons)				$log(Output+1)$
	(1) Rice	(2) Potatoes	(3) Garlic	(4) Cabbage	(5) Silk
Panel A: Heterogeneity by Feeder Roads (The "Input/Bulk" Channel)					
$I_i^{Bridge} \times Post_t \times RoadStock_{i,t}$	-0.22	-1.68***	0.01	0.01	0.39
	(0.15)	(0.41)	(0.01)	(0.02)	(0.49)
Panel B: Heterogeneity by Market Access (The "Output/Transaction" Channel)					
$I_i^{Bridge} \times Post_t \times MarketProximity_i$	0.06**	0.00	-0.00*	0.04***	-0.01
	(0.03)	(0.02)	(0.00)	(0.01)	(0.09)
Demographic Controls	✓	✓	✓	✓	✓
Village and Year FE	✓	✓	✓	✓	✓
Log(Farmland$_{i,1972}$) × Year FE	✓	✓	✓	✓	✓
Mean of Dep. Var. (Pre-1973)	0.89	1.47	0.06	0.14	3.57
Observations (Panel A)	608	496	391	391	442
Observations (Panel B)	1,358	1,135	924	924	982

Notes: This table tests how the diversification effect in fractionalized villages is moderated by different types of infrastructure. Each coefficient is from a separate three-way interaction regression. The dependent variable is the output per agricultural household for each crop. Panel A tests the "input/bulk" channel using $RoadStock_i, t$ (cumulative km of new feeder roads). Panel B tests the "output/transaction" channel using $MarketProximity_i$ (distance to the nearest township office where local markets opened). The $RoadStock_i, t$ regressions are run on the smaller, restricted sample for which road data are available. Standard errors, clustered at the village level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.35: The Effect of Bridge Access on Livestock Ownership

	log(Livestock per Agri. HH. + 1)			
	(1) Cows	(2) Pigs	(3) Chickens	(4) Rabbits
Panel A: Average Treatment Effect (DiD)				
$I_i^{Bridge} \times Post_t$	0.08***	0.02	-0.01	0.09***
	(0.02)	(0.02)	(0.10)	(0.03)
Panel B: Heterogeneity by Social Fractionalization (DDD)				
$I_i^{Bridge} \times Post_t$ *(Low-Frac. Effect)*	0.11***	-0.01	-0.00	0.10***
	(0.03)	(0.04)	(0.14)	(0.04)
$I_i^{Bridge} \times Post_t \times I_i^{Frac}$	-0.05	0.05	0.01	-0.02
	(0.03)	(0.05)	(0.17)	(0.05)
Demographic Controls	✓	✓	✓	✓
Village and Year FEs	✓	✓	✓	✓
Log(Farmland$_{i,1972}$) × Year FE	✓	✓	✓	✓
Mean of Y (Pre-1973)	0.48	0.30	8.20	0.27
Observations	1,364	1,364	1,364	1,364
Number of Villages	196	196	196	196

Notes: This table presents the effect of bridge access on livestock ownership per agricultural household using administrative data from *Namhae County Statistical Yearbooks*. All specifications include village and year fixed effects, as well as interactions between year fixed effects and log(1972 farmland area). Demographic controls include the log of total village farmland, average household size, and share of women. The triple-interaction terms in Panel B are not statistically significant, suggesting that cohesive and fractionalized villages did not differ in their livestock investment responses to bridge access. Standard errors, clustered at the village level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.36: The Effect of Bridge Access on Media Access

	log(Number per HH. + 1)		
	(1) Newspapers	(2) TVs	(3) Radios
Panel A: Average Treatment Effect (DiD)			
$I_i^{Bridge} \times Post_t$	-0.02**	0.00	0.11***
	(0.01)	(0.01)	(0.02)
Panel B: Heterogeneity by Social Fractionalization (DDD)			
$I_i^{Bridge} \times Post_t$ *(Low-Frac. Effect)*	-0.02**	0.01	0.13***
	(0.01)	(0.01)	(0.03)
$I_i^{Bridge} \times Post_t \times I_i^{Frac}$	0.02	0.00	-0.04
	(0.02)	(0.02)	(0.04)
Demographic Controls	✓	✓	✓
Village and Year FEs	✓	✓	✓
Log(Farmland$_{i,1972}$) × Year FE	✓	✓	✓
Mean of Y (Pre-1973)	0.09	0.0009	0.35
Observations	1,285	1,285	1,285
Number of Villages	196	196	196

Notes: This table presents the effect of bridge access on media access per household using administrative data from *Namhae County Statistical Yearbooks*. The dependent variable is log(media items per household + 1) for all village households, as media access is relevant for both agricultural and non-agricultural economic activities. All specifications include village and year fixed effects, as well as interactions between year fixed effects and log(1972 farmland area). Demographic controls include the log of total village farmland, average household size, and share of women. The sample is smaller than the main analysis (1,285 vs. 1,364) due to missing media data for some years. Panel A shows the average effect from a DiD model. Panel B shows heterogeneous effects from a DDD model. While bridge access affected media adoption overall (Panel A), the triple-interaction terms in Panel B are not statistically significant, suggesting that cohesive and fractionalized villages did not differ in their media adoption responses to bridge access. Standard errors, clustered at the village level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.