Blessing or Curse for Organized Crime? The Long-Term Effects of the Energy Transition from Coal to Oil on the Yakuza *

Takuma Kamada†

June, 2026

Please Click Here for the Latest Version

Abstract

This study investigates whether industry-specific shocks propagate through the broader criminal economy when specific criminal groups are embedded in affected sectors, generating persistent changes in organized crime. It focuses on Japanese organized crime, the yakuza, and the 1960s energy transition from domestic coal to imported oil, which triggered widespread mine closures. Some yakuza groups operated in coal mining as labor brokers, protection racketeers, or contractors. I document persistence in yakuza-related conflicts following the energy transition, with greater effects in areas with historical presence of mining-linked yakuza groups and alternative economic rents. Underlying this persistence, the composition of local organized crime shifted following the transition: arrests of mining-linked yakuza fell while arrests of non-mining yakuza rose as rival yakuza groups entered coal-affected areas to contest territory. In the 21st century, areas more exposed to transition-induced mining job losses exhibit substantially higher yakuza presence. However, yakuza exclusion ordinances enacted in the 2010s partially broke this persistent cycle by restricting organizational reallocation across all yakuza groups. Taken together, negative industry-specific shocks can trigger territorial restructuring that hardens into persistent criminal geography.

*I thank Eva Gavrilova, Jun Goto, Tetsuya Hoshino, Rio Ikeuchi, Shingo Ishiguro, Hiro Ishise, Ryo Kambayashi, Satoshi Kasamatsu, Hayato Kato, Kyosuke Kikuta, Shuhei Kitamura, Tetsuya Matsubayashi, Takeshi Murooka, Eduardo Montero, Kentaro Nakajima, Hidenori Takahashi, Katsuya Takii, Mari Tanaka, Kensuke Teshima, Carlos Schmidt-Padilla, Hitoshi Shigeoka, Yuta Suzuki, Atsushi Yamagishi, as well as, seminar and conference participants at Bocconi University, Contract Theory Workshop, JAMS, Kyoto Summer Workshop on Applied Economics, Musashi University, NBER Japan Project Meeting, Osaka University, Osaka University of Economics, SWET, Universitá Cattolica, University of Tokyo, members of the Extra-Legal Governance Institute (ExLegi) at the University of Oxford, the Virtual Crime Economics (ViCE) seminar, and Waseda University for their helpful comments and discussion on this project. I thank Rio Ikeuchi for providing excellent and meticulous research assistance, and Martina Baradel and Shuhei Kitamura for providing data. I thank Grant-in-Aid from the Japan Society for the Promotion of Science (21K13283; 24K16362).

†Osaka School of International Public Policy, Osaka University. Email: kamada@osipp.osaka-u.ac.jp

1 Introduction

Organized criminal groups govern millions of people across Latin America, Asia, and Europe (Blattman et al., 2024; Hill, 2003; Gambetta, 1993; Lessing, 2021; Melnikov et al., 2020; Varese, 2001). They extract rents from both illicit markets, such as drug trafficking and extortion, and licit sectors such as agriculture and natural resources. Research examines the effects of economic shocks on organized crime, focusing on direct price fluctuations in legal commodities, shifts in industries, and indirect shocks from law-enforcement (e.g., Battiston et al., 2022; De Haro Lopez, 2023; Dell et al., 2019; Dube and Vargas, 2013; Gavrilova et al., 2019; Sobrino, 2020). While existing work focuses primarily on immediate responses, sector-specific shocks may have lasting effects when criminal groups are embedded in specific sectors. Such shocks can weaken embedded groups while creating territorial openings for rivals. This study investigates whether industry-specific shocks propagate through the broader criminal economy when specific criminal groups are embedded in affected sectors, generating persistent changes in organized crime.

To answer this question, this study exploits Japan's 1960s energy transition from domestic coal to imported oil. The 1962 liberalization of crude-oil imports, coupled with the government's acknowledgment of coal's declining competitiveness, triggered widespread mine closures (Agency for Natural Resources and Energy, 2018). This setting is well-suited for studying how sectoral shocks reshape criminal geography. First, the transition was driven by trade liberalization and energy efficiency—generating a plausibly exogenous shock concentrated in coal-mining areas while leaving aggregate labor-market conditions largely unchanged (mining comprised about 1% of the labor force). Second, the shock combines two features: one, the operations performed by the yakuza—private protection, labor brokerage, contract enforcement, and rent extraction—are largely common across sectors; the other, exposure to the coal decline was geographically heterogeneous, determined by pre-existing coal endowments. Because yakuza activity is not sector-specific, what varies across regions is not what the yakuza do but which groups are weakened and which territorial openings emerge. The spatial distribution of organized crime thus reflects the geography of the shock, not differences in criminal repertoires across regions. Third, historical data on the yakuza are unusually rich, owing in part to their legal status and well-documented involvement across economic sectors

Japanese organized crime, known collectively as the yakuza, originated in several sectors, in-

cluding gambling, peddling, black markets, coal mining, dock labor, company enforcers, rogue journalism, and pimping. The term "yakuza" is a generic term for hierarchically structured organized crime groups rather than a single unified group. In what follows, I use "mining-linked yakuza" to refer to groups with origins and operations tied to coal mining, where they operated as labor brokers, protection racketeers, or contractors. Crucially, while yakuza groups differ in their sector of origin, their operational role is largely common across sectors: providing protection, brokering labor, enforcing informal contracts, and extracting rents from local economic activity. Fast-forward to 2024, under 1992 anti-yakuza laws, 25 large yakuza syndicates—irrespective of sector of origin—are officially designated.[1] Among these 25 syndicates, only one traces its origins to coal mining. Smaller yakuza groups typically affiliate with one of these designated syndicates, which represent distinct clans. These syndicates maintain potential rivalries, while some may form alliances.

This study argues that the energy transition was an industry- and region-specific shock: it struck a single mining sector, concentrated in coal-rich areas, and directly weakened only the yakuza groups embedded in coal. Yet the roles these groups played were never coal-specific—protection, labor brokering, contracting, and dispute resolution are demanded across many local rackets. Because the declining sector was unevenly distributed in space and tied to only some criminal groups, the shock weakened incumbents in exposed areas, lowered barriers to encroachment by rivals, and triggered a persistent reallocation of criminal presence. In the long run, this sequence would lead areas more exposed to transition-induced mining job losses to exhibit greater overall yakuza presence.

To test whether Japan's energy transition reshaped organized crime, I combine historical coal-mining data with unique yakuza records. First, event-study designs show that yakuza-related territorial conflicts rose in coal-rich prefectures after the transition and persisted for decades. These effects are larger in coal-rich prefectures where mining-linked yakuza groups were historically present and where alternative economic rents outside mining remained available.[2] Coal-rich prefectures increasingly became targets of conflicts initiated by outside groups, while conflicts initiated by coal-area groups changed little, consistent with territorial entry by rivals rather than expansion by local groups. For yakuza outcomes observed in later decades, following Bazzi et al. (2023);

[1] I refer to large designated groups as yakuza syndicates and to other groups as yakuza groups.

[2] Prefectures are the first level of jurisdiction and represent an administrative division. Japan consists of 47 prefectures, with most being roughly the size of Connecticut or Delaware. However, Hokkaido, the largest prefecture, is comparable to Maine or Indiana. Municipalities (cities, towns, and villages) are nested within each prefecture. In this study, I exclude Okinawa prefecture from the analysis as it was under U.S. administration until 1972.

Duflo and Pande (2007); Sequeira et al. (2020), I construct a measure of transition-induced mining job losses. Prefectures more exposed to mining job losses experienced substantially higher yakuza presence in subsequent decades, including more members and more groups.

To explain this persistence, I trace short-run changes in yakuza activity and organizational composition. Yakuza arrests for economic-motivated crime increased following the transition. Disaggregated arrest data show arrests of mining-linked yakuza declining in coal-rich prefectures while arrests of non-mining yakuza rise, consistent with organizational reallocation; a large non-mining group entered coal-rich areas after the transition. Importantly, the energy transition is not correlated with proxies for general or yakuza-specific enforcement, partially ruling out enforcement channels (Appendix G). These pieces of evidence, along with contemporary yakuza composition, are consistent with the organizational-reallocation channel rather than expansion of mining-linked yakuza groups themselves explaining the persistence. Among the 25 large designated yakuza syndicates operating today, only one traces its origins to coal mining, suggesting that non-mining groups came to dominate formerly coal-rich areas.

To further validate that industry-specific shocks trigger organizational reallocation, I exploit yakuza exclusion ordinances (YEOs) enacted between 2010–2012. Unlike the coal shock, which weakened mining-linked groups and allowed rivals to fill the vacuum, the YEOs constrain all yakuza groups uniformly by sanctioning citizens who do business with any group (Hoshino and Kamada, 2020). Consistent with the organizational-reallocation channel, the transition's persistent effects on the yakuza weaken after YEO enactment.

At a finer spatial scale, supplementary analysis from Fukuoka Prefecture—an area with historically high coal-mining and yakuza activity—suggests spatial propagation: non-mining municipalities closer to former mining towns exhibit more business establishments (construction, restaurants, real estate, and infrastructure) and more yakuza offices in later decades.

This study advances our understanding of the economics of crime and contributes to broader literature on historical persistence in three important ways. First, this study advances research on economic shocks and organized crime by distinguishing structural economic change from transitory price shocks, and by isolating the role of geographic exposure heterogeneity that is tied to specific criminal groups. Existing work examines the effects of economic shocks on organized crime and conflict, including changes in crop legality and drug-market disruptions (e.g., Angrist and Kugler,

2008; Castillo et al., 2020; Chimeli and Soares, 2017), temporary resource price shocks (Bazzi and Blattman, 2014; Dube et al., 2016), and both structural differences in resource endowments (Buonanno et al., 2015; Dimico et al., 2017) and new discoveries (Berman et al., 2017; Lei and Michaels, 2014). Most of this work focuses on contemporaneous or short-run effects within a fixed territorial structure. I show instead that a structural, geographically heterogeneous shock—the decline of coal mining, concentrated in coal-endowed regions—produced persistent increases in yakuza presence decades later. Because yakuza services are common across sectors, the rents lost in coal did not disappear from the criminal economy but were left for rivals to capture, so regional variation in exposure to the coal decline maps into regional variation in long-run criminal outcomes.

Second, this study contributes to research on the expansion of organized crime. Research links territorial expansion to forcible movement of criminal group members (Dipoppa, 2024; Varese, 2011; Paolo and Matteo, 2014; Sviatschi, 2022), enforcement (Dell, 2015), or positive demand shocks (Sobrino, 2020). For instance, Dell (2015) shows that enforcement increases violence as rival groups enter affected areas to contest weakened incumbent criminal groups. This study complements this literature by documenting organizational reallocation as a channel generating persistent expansion. As mining-linked groups lost the rents sustaining their control, the barriers to entry in coal-rich areas fell, and rival non-mining groups moved in to capture the rents that remained. The initial structure of organized crime thus shaped its long-run configuration: territories once controlled by groups tied to a declining sector became the most contestable, and other groups grew. Thus, the idea that declining exclusivity raises contestability complements work on rivalry and market structure among criminal groups (Brown et al., 2021; Bruhn, 2021).

Lastly, research examines the persistent effects of historical events and institutions on development (e.g., Acharya et al., 2024; Acemoglu et al., 2001; Nunn, 2020) and the role of geography in shaping development (Diamond, 1997; Kitamura and Lagerlöf, 2020). Importantly, understanding historical roots provide an opportunity to design a better contemporary public policy (e.g., Lowes and Montero, 2021; Nunn, 2020). I show how the nature of economic shocks shapes their long-run impact: the industry-specific energy transition triggered organizational reallocation as weakened groups were replaced by rivals, producing higher long-run yakuza presence. By contrast, the YEOs, which restrict revenue sources for all yakuza groups uniformly, disrupt such reallocation and partially mitigate the persistent effects of the energy transition on the yakuza.

The rest of this paper is organized as follows. Section 2 offers background information on the yakuza and the link between the energy transition and the yakuza. Section 3 presents the data, identification strategies, and results for three sets of analyses. Section 4 summarizes robustness checks, alternative explanations, and additional results. Section 5 concludes.

2 Institutional Background

2.1 Yakuza

I provide background information about the yakuza to understand the institutional context for the current investigation.[3]

Mining-Linked Yakuza Groups. While gamblers (*bakuto*), peddlers (*tekiya*), and black-market racketeers/enforcers (*guren-tai*) comprised most yakuza groups (e.g., National Police Agency, 1978), others were classified by sectors like mining, dock labor, corporate intimidation (*kaisha goro*), rogue journalists (*shinbun goro*), and pimping. Of particular interest here are yakuza groups involved in the coal mining industry. In mining areas, yakuza groups rooted in the coal-mining industry and racketeers/enforcers predominated (Iwai, 1963). These groups served either as labor brokers, as protection racketeers, or as contractors. For example, some evolved from mining-camp bosses and acted as labor brokers managing worker recruitment, whereas others were retained informally by mining companies as protection racketeers to break strikes and suppress union activity. The presence of mining-linked yakuza groups was primarily driven by higher coal mining availability during the pre-transition period (Appendix C), which I identify using arrest records of mining-linked yakuza groups. When controlling for coal mining availability, other demographic and economic factors show little correlation with the presence of these groups, suggesting that mining operations drove demand for yakuza services—consistent with research on natural resources and organized crime (Buonanno et al., 2015; Dimico et al., 2017; Gambetta, 1993).

Contemporary Yakuza Syndicates. In the contemporary period, under anti-yakuza laws enacted in 1992, the Public Safety Commission designates large yakuza groups based on specific

[3]This review is not comprehensive (See Hill (2003, 2004) for a more comprehensive review).

criteria.[4] Forming or joining yakuza groups is *not* illegal in Japan due to the Freedom of Association (Article 21 of the Japanese Constitution). However, their economic activities are strictly prohibited under the anti-yakuza laws. As of 2024, there are 25 designated yakuza syndicates in Japan.[5] Among those 25 syndicates, there is only one syndicate with its origin in coal mining.

Activities of Yakuza. The yakuza's economic activities include both legal and illegal income sources, with their services adapting to changing social and economic conditions (Hill, 2003). During Japan's post-war economic boom, the yakuza engaged in protection racketeering, extortion, gambling, and entertainment businesses, while also operating in various industries such as construction. The yakuza gained power in construction through labor dispatch and subcontracting, managing workers and providing materials. During this period, despite their diverse origins, yakuza groups expanded beyond their original sectors, though expansion capacity likely depended on group scale. This mobility was possible because some yakuza activities, including labor brokering, protection, contracting, and dispute resolution, were not specific to any one industry. In the 1970s, the yakuza moved into methamphetamine distribution and extortion schemes targeting businesses through spurious outcaste group (*burakumin*) advocacy.[6] The yakuza extorted businesses by falsely claiming to represent outcaste communities and threatening to accuse companies of discrimination. The 1980s saw further expansion into land sharking and illegal high-interest lending. However, yakuza exclusion ordinances enacted across prefectures from 2010 to 2012 prohibited non-yakuza citizens from assisting them, making it difficult for the yakuza to conduct businesses that relied on non-yakuza individuals and businesses (Hoshino and Kamada, 2020, 2026).[7] I examine some of these yakuza's economic opportunities in relation to the energy transition, as a channel through which the energy transition has shaped the yakuza.

[4] The criteria are (i) an organization has a hierarchical structure, (ii) members of an organization have criminal records, and (iii) members make a living through violence.

[5] About 96% of yakuza members belong to one of these designated yakuza syndicates (National Police Agency, 2009, 2014)

[6] Despite the formal abolition of the status system, Yamagishi and Sato (2025) document that neighborhoods historically inhabited by *buraku* communities have lower land prices.

[7] While the anti-yakuza laws are direct enforcement by targeting yakuza economic activities, the yakuza exclusion ordinances are indirect enforcement by prohibiting non-yakuza individuals and businesses from providing benefits to the yakuza. There is no quantitative assessment of their relative effectiveness. However, because yakuza revenues depend on lawful citizens and firms, leveraging enforcement that constrains these counterparties is a plausible and potentially effective strategy.

Yakuza Group Expansion. In the 1960s and 1970s, major yakuza groups like the Yamaguchi-gumi and Inagawa-kai expanded by violently absorbing smaller groups (National Police Agency, 1989). Their expansion aimed to scale up economic activities and establish tribute payments from affiliated groups through territorial conquest rather than the migration of yakuza members. While consolidation can reduce violence, large yakuza groups actively used violence as a strategic tool to expand their territory and power. My analysis considers the role of the target and attacker of conflicts, and it also examines whether the Yamaguchi-gumi, the largest yakuza group with its origin in dock labor and a coal-scarce prefecture, expanded into coal-rich prefectures.

2.2 Energy Transition

This section outlines the 1960s energy transition from coal to oil in Japan, drawing on Agency for Natural Resources and Energy (2018). Post-World War II, Japan regulated oil imports due to limited foreign currency. As the economy grew, trade liberalization pressure increased, leading to the "Outline of the Trade and Foreign Exchange Liberalization Plan" in June 1960 and crude oil import liberalization in October 1962. Panel A in Figure 1 shows actual and counterfactual trends in crude oil import quantities.[8] Actual oil imports increased more rapidly after 1962 compared to the counterfactual trajectory.

During this period, the coal industry attempted to streamline its operations to compete with oil, which was increasingly recognized as a more efficient energy source. Despite these efforts, the coal mining industry deteriorated. In 1962, the government's "Coal Mining Investigation Team" concluded that coal could not compete with heavy oil. This shifted coal policy from pursuing price competitiveness to managing the industry's decline while minimizing social disruption.

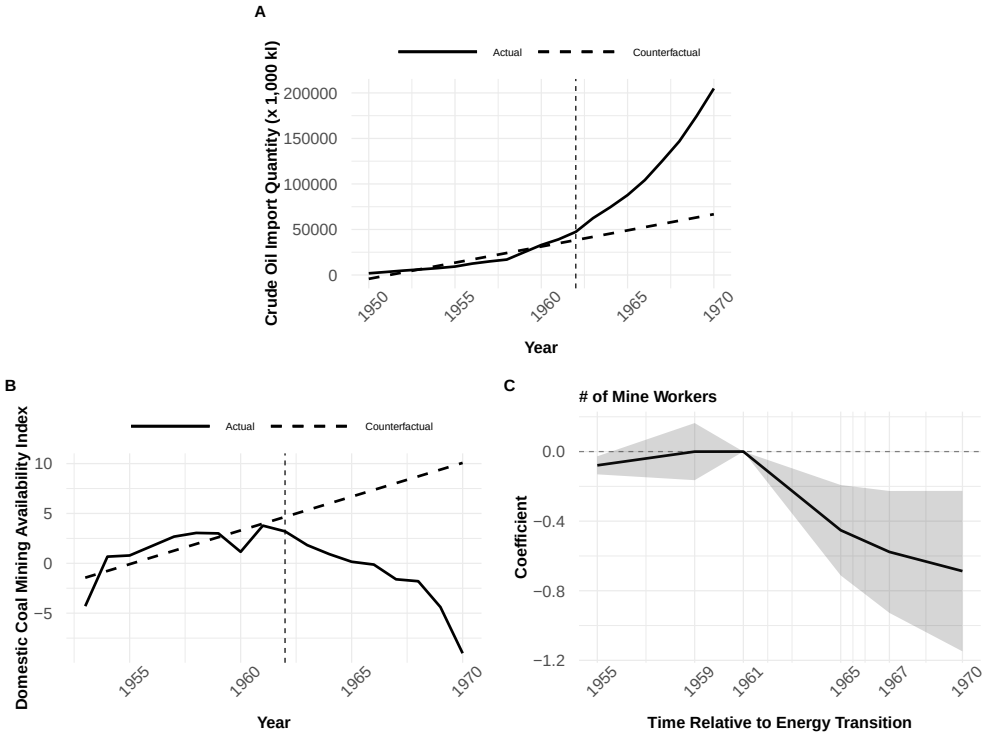
These developments—trade liberalization of oil and recognition of coal's non-competitiveness—constitute the energy transition that led to the coal mining industry's decline. Panel B in Figure 1 shows trends in domestic coal mining availability, revealing a sharp decrease after 1962.[9] Panel C presents event-study estimates of the transition's effects on mine workers. A one standard deviation increase in coal mining availability leads to a 0.57 worker decrease per 100 workers post-transition (53% decline from baseline). These findings confirm the energy transition as a negative demand

[8] The counterfactual trends are obtained by fitting linear trends to pre-1962 data and projecting subsequent values.

[9] This index combines coal mining areas, number of lots, and production (see Section 3.1 for details and Appendix A for individual trends).

shock to mining.

Figure 1: Trends in Crude Oil Import Quantity, Domestic Coal Mining, and Mine Workers



Data Source and Note: (Panel A) Crude oil import quantities (source: the Ministry of Economy, Trade and Industry). (Panel B) Coal mining availability index consists of coal mining areas, the number of coal mining lots, and the amount of coal production (source: the Japan Statistical Yearbook). (Panel C) **Outcome**: the number of mine workers relative to 100 total workers, where the total workers are fixed in the pre-transition period (source: the Japan Statistical Yearbook). **Mean of dep. var. in the pre-transition period**: 1.067.

2.3 Consequences of Energy Transition on Yakuza

This section links the 1960s coal-to-oil transition to persistent changes in yakuza geography through organizational reallocation and territorial contestation.

The Coal-to-Oil Transition and Mining-Linked Yakuza. The energy transition reduced coal mining jobs, providing a negative business demand shock to mining-linked yakuza groups that operated as labor brokers for worker recruitment, protection racketeers for labor disputes, or contractors. When coal rents collapsed, mining-linked yakuza groups lost their primary revenue source and likely weakened substantially.

Some mining-linked groups may have attempted to adapt by diversifying into alternative busi-

nesses. Consistent with this account, a former mining-linked yakuza group that had operated in coal mining was forced to shift into unlicensed taxi operations, clubs, and entertainment in the 1960s–70s (Yamahira, 2018). However, such adaptation was likely difficult for most mining-linked groups, which operated at small scale with limited capacity for economic expansion into new sectors. In the long run, mining-linked yakuza groups largely disappeared from positions of dominance: among the 25 large designated yakuza syndicates operating today, only one traces its origins to coal mining.

Organizational Reallocation and Territorial Entry. The transition likely eroded mining-linked groups' position as "stationary bandit"—controlling workers, firms, and dispute-resolution rents through territorial revenue streams (Olson, 1993). However, rather than mining-linked groups becoming roving bandits, the composition of local organized crime groups may have shifted: as mining-linked groups contracted, non-mining groups likely expanded in coal-rich areas. This expansion may have operated through two channels: (i) growth of non-mining groups already present in coal-rich prefectures and (ii) entry of groups based outside coal areas to contest territory previously dominated by mining-linked yakuza groups.

Although mining revenues disappeared, other economic activities—gambling, labor brokering in construction, extortion schemes targeting businesses through spurious outcaste group advocacy—continued to generate opportunities for criminal extraction. These remaining rents likely created incentives for rival groups to enter and contest territory as mining-linked groups weakened.

Territorial Contestation and Persistent Conflict. Establishing control over territory and economic rackets is costly and time-consuming, as criminal groups must entrench power and negotiate territorial boundaries with stakeholders such as local yakuza groups, local businesses, and community networks. The decline in incumbents' territorial exclusivity lowered the barriers to entry, making coal-rich areas disproportionately contestable by outside groups, while territories held by coal-area groups changed little. This asymmetry would reflect territorial entry by rivals rather than expansion by weakened local groups. Given entering groups' difficulty achieving stable arrangements, these conflicts likely persisted for decades.

These conflicts may have followed two paths. First, multiple groups may have continued to op-

erate in the same territory while competing over limited resources, each accepting smaller benefits. This would have led to greater fragmentation of yakuza groups. Second, groups may have engaged in prolonged contests to expel or absorb rivals. This would have increased concentration of yakuza groups. Either way, the initial shock would create path dependence: coal-rich prefectures would have experienced longer-lasting contestation over territory.

Long-Run Consequences: Persistent Yakuza Presence. Through this sequence—mining-linked groups decline, non-mining rivals enter to contest territory, conflicts persist as new control arrangements are established—the energy transition would have permanently reshaped criminal geography. Areas more exposed to mining job losses would exhibit higher yakuza presence decades later. The near-complete disappearance of mining-linked groups—only one mining-origin syndicate remains among 25 designated syndicates today—suggests the extent of this organizational reallocation.

3 Data, Research Designs, and Empirical Results

Overview of Analyses. I use three complementary approaches. First, event-study designs document the evolution of yakuza-related conflicts following the energy transition. I then turn to annual data around 1962 to study immediate responses—changes in yakuza activity and composition consistent with reallocation dynamics—that help explain why persistent effects emerge. Second, I construct a measure of transition-induced mining employment (Bazzi et al., 2023; Duflo and Pande, 2007; Sequeira et al., 2020) to examine whether this exposure predicts long-run yakuza activities. Third, as supplementary analysis, I examine spatial variation within Fukuoka Prefecture—historically coal-intensive and yakuza-active—to test whether proximity to former mining areas correlates with contemporary yakuza presence. I conduct the first two analyses at the prefecture level, Japan's main administrative divisions analogous to U.S. states (47 prefectures total; I exclude Okinawa, which was under U.S. administration until 1972). The third analysis uses municipal-level data from Fukuoka.

Throughout each analysis, I provide data and empirical designs in relevant sections. Table 1 presents, along with data sources, summary statistics of the variables used in the main text.

Table 1: Summary Statistics

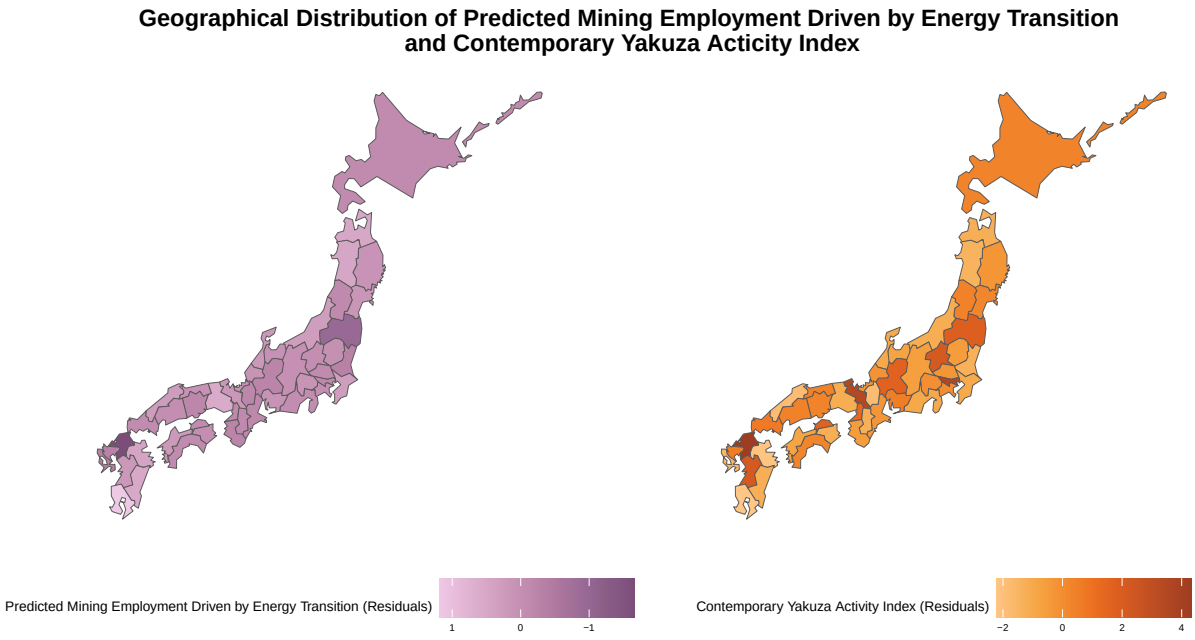
			Mean	Std.Dev.
Data Source	**Unit**	**Yakuza Data for Panel-Level Analysis**		
Wikipedia	Prefecture-by-Time	Yakuza Conflict (1920-2010)	0.078	0.268
Wikipedia	Prefecture-by-Time	Inter-Prefecture Target (Pre-Post: 1920-1950, 1960-2010)	0.180	0.386
Wikipedia	Prefecture-by-Time	Inter-Prefecture Attacker (Pre-Post: 1920-1950, 1960-2010)	0.095	0.295
Wikipedia	Prefecture-by-Time	Intra-Prefecture Target (Pre-Post: 1920-1950, 1960-2010)	0.170	0.377
Wikipedia	Prefecture-by-Time	Intra-Prefecture Attacker (Pre-Post: 1920-1950, 1960-2010)	0.117	0.323
Crime Statistics	Prefecture-by-Time	Yakuza Arrest Property Crime (1957-1970)	11.099	9.200
Crime Statistics	Prefecture-by-Time	Yakuza Arrest Violent Crime (1957-1970)	27.670	17.662
Crime Statistics	Prefecture-by-Time	Yakuza Arrest in Mining Sector (1957-1970)	0.177	0.805
Crime Statistics	Prefecture-by-Time	Yakuza Arrest among Racketeers (1957-1970)	13.846	13.007
Crime Statistics	Prefecture-by-Time	Yakuza Arrest in Other Sectors (1957-1970)	28.224	20.189
Yamaguchi-gumi Daikaibo	Prefecture-by-Time	Yamaguchi-gumi Expansion (1955-1970)	0.373	0.484
		Yakuza Data for Cross-Sectional Analysis		
Statistical Survey on Correction by the Ministry of Justice	Prefecture-by-Time	Yakuza Incarceration (Total) (2006-2019)	1.191	1.019
Statistical Survey on Correction by the Ministry of Justice	Prefecture-by-Time	Yakuza Incarceration (Top-Ranking Yakuza Members) (2006-2019)	0.367	0.325
Statistical Survey on Correction by the Ministry of Justice	Prefecture-by-Time	Yakuza Incarceration (Regular Yakuza Members) (2006-2019)	0.648	0.618
Statistical Survey on Correction by the Ministry of Justice	Prefecture-by-Time	Yakuza Incarceration (Unknown Rank Yakuza Members) (2006-2019)	0.176	0.293
Prefectural Police Departments	Prefecture-by-Time	Yakuza Members (2008-2014)	43.089	20.656
White Paper on Crime	Prefecture	Yakuza Arrests (2013)	11.925	8.082
White Paper on Crime	Prefecture	Yakuza Arrests (1974)	311.956	191.044
Matsumoto (1968)	City	Yakuza Members by City (1967)	13.653	6.480
Ninkyo-Dainyakka (1987)	Prefecture	Yakuza Members (1951, Placebo)	53.170	86.576
Boryokudan Josei/White Paper on Crime	Prefecture-by-Time	# of Designated Yakuza Syndicates (1996, 2008)	2.989	1.706
	Prefecture-by-Time	Yakuza HHI (2008-2013)	0.427	0.297
Nihon Yakuza Map (2002)	Prefecture	# of Yamaguchi-gumi Affiliated Groups (2002)	2.326	6.225
Nihon Yakuza Map (2002)	Prefecture	# of Yakuza Syndicates' Headquarters (2002)	0.427	0.297
	Prefecture	Indicator for Yakuza Syndicate Formed After 1962	0.109	0.311
	Prefecture	Indicator for Yakuza Syndicate Formed Before 1962 (Placebo)	0.173	0.379
Ninkyo-Dainyakka (1987)	Prefecture	# of Yakuza Groups (1951, Placebo)	24.5	30.396
		Panel Data on Mining		
Japan Statistical Yearbook	Prefecture-by-Time	Mine Workers (1955, 1959, 1961, 1965, 1967, 1970)	0.929	1.380
		Cross-Sectional Data on Mining		
Japan Statistical Yearbook	Prefecture	# of Coal Mining Lots	77.425	209.899
Japan Statistical Yearbook	Prefecture	Coal Mining Areas	16117.49	47812.72
Japan Statistical Yearbook	Prefecture	Coal Production (Ton)	1033493	3348076
		Time-Series Data on Crude Oil		
Ministry of Economy, Trade and Industry	Time	Crude Oil Import Quantities by Year	59.484	60.505
		Data for Municipal-level Analysis in Fukuoka		
Yakuza Office Street View Search	Municipality	Presence of Yakuza Offices (2023) (Extensive Margin)	0.208	0.406
Yakuza Office Street View Search	Municipality	# of Yakuza Offices (2023) (Intensive Margin)	0.430	1.078
Fukuoka Prefectural Police Department	Municipality-by-Time	(Reported) violent Crime (2007-2019)	56.122	31.469
Fukuoka Prefectural Police Department	Municipality-by-Time	(Reported) property Crime (2007-2019)	867.55	465.466
Establishment and Enterprise Census	Municipality-by-Time	# of Business Establishments in Construction (1971, 1981, 1991, 2001, 2012)	271.452	275.4264
Establishment and Enterprise Census	Municipality-by-Time	# of Business Establishments in Restaurants (1971, 1981, 1991, 2001, 2012)	1000.411	1663.645
Establishment and Enterprise Census	Municipality-by-Time	# of Business Establishments in Real Estate (1971, 1981, 1991, 2001, 2012)	164.819	285.040
Establishment and Enterprise Census	Municipality-by-Time	# of Business Establishments in Infrastructure (1971, 1981, 1991, 2001, 2012)	5.0472	7.7198
Japan Mining Archive	Municipality	Minimum Distance to a Historical Mining Site	6172.848	6903.5
Japan Mining Archive	Municipality	# of Historical Mining Sites	1.1111	2.5262

Notes: Yakuza-related (arrest, incarceration, members) variables, and reported-crime variables: the number of the variable of interest per 100,000 people. For yakuza arrests in 1974, it is per 1,000,000 people. Yakuza Members by City (1967) is per 10,000 people and contains data for 82 large cities. **Worker-related variables:** the number of workers of interest per 100 total workers. **Crude oil import quantities:** originally measured in thousands of kiloliters (kL). For improved readability, I divided this value by 1000, converting the unit to millions of kiloliters (ML).

Figure 2 maps predicted mining employment driven by the energy transition and contemporary yakuza activity across prefectures. I construct predicted mining employment following Bazzi et al. (2023) and Sequeira et al. (2020) (Section 3.2) and create a yakuza activity index using principal component analysis of post-2000 yakuza variables. The correlation coefficient between these variables is approximately -0.6 after residualizing with respect to geographic covariates and region fixed effects, indicating prefectures with lower predicted mining employment (i.e., greater mining

job losses due to the energy transition) have higher yakuza activities today.[10]

Figure 2: Geographical Distribution of Predicted Mining Employment Driven by Energy Transition and Contemporary Yakuza Index



Note: Each outcome is the residual of regressing the outcome on geographic covariates and region fixed effects.

3.1 Panel-Level Analysis

In this section, I use prefecture-level panel data to examine the effects of the energy transition on yakuza arrests and conflicts over time.

Coal Mining Availability (Prefectural Level Data). I use three measures of coal mining availability: (i) coal mining areas, (ii) the number of coal mining lots (land areas where excavation, mining, and production are permitted by mining right holders), and (iii) coal production amounts. These measures are highly correlated ($\rho \approx 0.9$). For this reason and also to mitigate measurement error, I construct a coal mining availability index using principal components analysis of standardized pre-transition data, then standardize the resulting index to mean = 0 and standard deviation = 1.[11] Appendix A shows the index distribution and individual components. As robustness checks,

[10] Japan is divided into seven regions: Hokkaido-Tohoku, Kanto, Chubu, Kansai, Chugoku, Shikoku, and Kyushu.

[11] Before using a principal components analysis, I standardize each measure to mean = 0 and standard deviation = 1.

I use each variable individually as cross-sectional variation (Appendix M).

Yakuza Conflicts (Prefecture-by-Decade-Level Data). I construct panel data on yakuza conflicts from Wikipedia, covering major conflicts between groups from the 1920s to 2010s. I verified information using yakuza-related books and websites, coding the timing, location, involved groups, and headquarters locations for all participants. Given the rarity of conflicts, I aggregate data at the prefecture-decade level with binary indicators for conflict occurrence, combining the 1920s-1930s and 2000s-2010s periods due to limited observations. Even with this aggregation, the small number of conflicts precludes count models, limiting the analysis to binary outcomes.

The data identifies attacking and targeted groups, and I generate four indicators: (i) inter-prefecture target (a group targeted by an outside prefecture group), (ii) inter-prefecture attacker (a group attacking an outside prefecture group), (iii) intra-prefecture target (a group targeted within its own prefecture), and (iv) intra-prefecture attacker (a group attacking within its own prefecture). I merge headquarters locations of both attacking and targeted groups with mining availability data. Due to limited observations per conflict category, I focus on pre-transition (1920-1950) and post-transition (1960-2010) periods, creating a panel of 92 observations (46 prefectures $\times$ 2 periods).

Yakuza Arrests (Prefecture-by-Year-Level data). I use annual panel data on yakuza arrests from Crime Statistics, with the end period determined by data availability. Since yakuza membership is not illegal in Japan, police can readily identify members. The outcome variable is yakuza arrest cases per 100,000 people (denominator fixed at 1960 census) for property crimes (theft, fraud) and violent crimes (robbery, murder, assault, threat, extortion).

The data identifies arrests across sectors. Because I am interested in understanding the shift in yakuza group compositions, I focus on mining-linked yakuza arrests (those originating in mining as well as racketeers/enforcers) and arrests from other sectors. Yakuza groups traditionally displayed their affiliations openly, making sectoral identification straightforward for authorities.

Since arrest data reflects both yakuza behavior and police enforcement practices, I account for enforcement effects through robustness checks that examine both general and yakuza-specific enforcement measures (Appendix G). I also discuss how enforcement-based explanations are not

consistent with the key empirical findings (Section 4).

Territorial Presence of Large-Scale Yakuza Group (Prefecture-by-Year-Level data). During the 1960s and 1970s, large-scale groups (the Yamaguchi-gumi, Sumiyoshi-kai, and Inagawa-kai) expanded their territories. Due to data limitations, I focus on the Yamaguchi-gumi, originating in dock labor from a coal-scarce prefecture (Hyogo). The measure is a binary indicator of the group's territorial presence by prefecture and year, examining whether this largest yakuza group expanded into coal-rich prefectures following the transition. This measure is available for 1955, 1960, 1962, 1966, and 1970.

Baseline Specification. To identify energy transition's effects, I use event-study specification exploiting cross-sectional variation in coal mining availability and time variation before and after the transition:

$$\mathsf{yakuza}_{i,r(i),t} = \sum_{\tau=k}^{l} \alpha_\tau [\mathsf{mine}_i \times \mathbb{1}(t=\tau)] + \mu_i + \lambda_{r(i),t} + \epsilon_{i,r(i),t}, \tag{1}$$

where $\mathsf{yakuza}_{i,r(i),t}$ represents the outcome of interest (yakuza arrests per 100,000, conflict indicator, indicator for the presence of the yamaguchi-gumi) in prefecture i, region r, and time t. Event-study dummies, $\mathbb{1}(t=\tau)$, span k to l (conflicts: 1920-2010; arrests: 1957-1970; territorial presence: 1955-1970.[12] mine_i is coal mining availability. α_τ are time-varying coefficients capturing transition effects relative to reference periods (1950 for conflicts, 1961 for arrests, 1960 for territorial presence). μ_i and $\lambda_{r(i),t}$ are prefecture fixed effects and region-by-time fixed effects, respectively. $\epsilon_{i,r(i),t}$ is the error term. I cluster standard errors at the prefecture level to account for the serial correlation in the error term. All the analyses use weighted least squares (WLS) with population in the 1960 census year as weights, thus giving more weight to prefectures with larger populations.

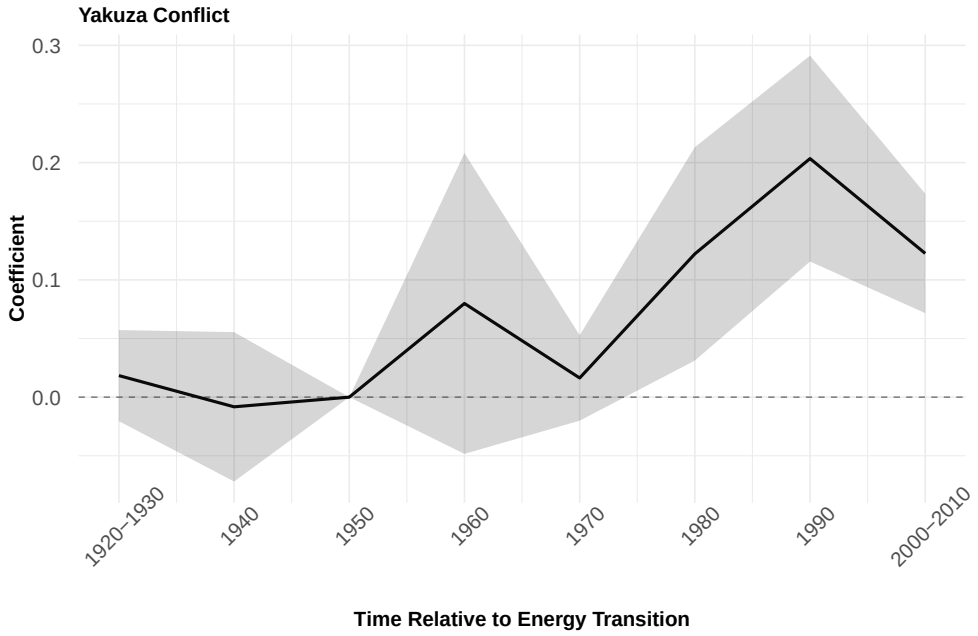
The identifying assumption is parallel trends: in the absence of the energy transition, outcomes would change at similar rates in coal-rich and coal-scarce prefectures. To indirectly check the assumption, coefficients on lead treatment variables need to be indistinguishable from zero. However, with continuous coal mining availability, a stronger parallel trends assumption is required (Callaway et al., 2024). This means that the outcomes in coal-scarce prefectures serve as the coun-

[12] Japan is divided into seven regions: Hokkaido-Tohoku, Kanto, Chubu, Kansai, Chugoku, Shikoku, and Kyushu.

terfactual outcomes for those in coal-rich prefectures, and coal-rich prefectures would have had the same treatment effect as coal-scarce prefectures. I perform complementary checks: a predicted treatment variable for long-term conflict analysis (Appendix K), Bartik reduced-form analysis using crude oil imports for short-term effects (Appendix I), binary event-study specifications (Appendix N).

Results: Long-Term Effects on Yakuza Conflict. I begin by documenting persistence in yakuza-related conflicts following the energy transition. Figure 3 reports event-study estimates (Eq. 1) using decade-level data with the 1950s as the reference period. Post-transition, conflicts rise more in coal-rich than coal-scarce prefectures, and this gap persists for roughly half a century. A one standard deviation increase in coal mining availability raises conflict likelihood by 10 percentage points post-transition. Notably, there is a drop in conflict likelihood during the 1970s. This might reflect increased crackdowns on yakuza following earlier conflicts, which could reduce violence through deterrence and/or incapacitation. However, incapacitation may have countervailing effects: yakuza members released from prison may subsequently have shorter time horizons and lower opportunity costs for engaging in conflicts. Appendix G examines the robustness of these results to enforcement measures; Appendix K uses a predicted treatment variable to examine long-term effects.

Figure 3: Long-Term Effects on Yakuza Conflict



Unit of analysis: prefecture-by-decade. **Time period/data points:** 1920-2010 (decade). The 1920s and 1930s are combined due to scarcity of data, and the 2010s is merged with the 2000s. **Observations:** 460. **Outcome:** a binary indicator for yakuza conflict. **Mean of dep. var. in the pre-transition period**: 0.043. **Standard errors:** clustered at the prefecture level.

Channels for Conflict. I examine two complementary channels for increased yakuza conflicts: (i) Yakuza groups from coal-rich prefectures were more likely targeted by outside groups than to initiate conflicts, and (ii) conflict effects depended on historical presence of mining-linked yakuza groups and alternative economic opportunities for yakuza activities beyond coal mining.

Results: Conflict Channels—Targets vs. Attackers. I disaggregate conflicts into four categories: (i) inter-prefecture target (group targeted by an outside prefecture group), (ii) inter-prefecture attacker (group attacking an outside prefecture group), (iii) intra-prefecture target (group targeted within its prefecture), and (iv) intra-prefecture attacker (group attacking within its prefecture).[13]

Table 2 presents results across these categories (Columns 1-4, respectively). The coefficient is significant only for inter-prefecture target conflicts, indicating that yakuza groups in coal-rich prefectures became conflict targets from outside groups. A one standard deviation increase in

[13]Due to scarce conflict data, disaggregated categories have fewer observations, limiting event-study analysis.

coal mining availability raises the likelihood of these groups being targeted by approximately 13 percentage points. I find little evidence that coal-rich prefecture groups initiated more conflicts against outside groups or engaged in more intra-prefecture conflicts. This indicates that during the post-transition period, yakuza groups in coal-rich prefectures became targets of conflicts initiated by groups from outside their prefectures but did not become more aggressive themselves.

Table 2: Channel for Yakuza Conflicts: Targets or Attackers of Conflicts

	(1)	(2)	(3)	(4)
Dep.Var.:	Conflict			
Origin:	Different Prefecture		Same Prefecture	
Role:	Target	Attacker	Target	Attacker
Coal Mining Availability × Post	0.1277***	0.0611	0.0152	0.0655
	(0.0361)	(0.0538)	(0.0184)	(0.0545)
Prefecture Fixed Effects	x	x	x	x
Division-by-Time Fixed Effects	x	x	x	x
Baseline Mean of Dep. Var.	0.0638	0.0425	0.127	0.0638
Observations	92	92	92	92
R-squared	0.6697	0.864	0.825	0.892

Notes: Significance at the 1%, 5%, and 10% levels indicated by ***, **, and *, respectively. Standard errors clustered at the prefecture level in parentheses. **Unit of analysis:** prefecture-by-prepost. **Time period:** 1920-1950 (pre) and 1960-2010 (post). **Outcome:** Column (1): Inter-prefecture target. Column (2): Inter-prefecture attacker. Column (3): Intra-prefecture target. Column (4): Intra-prefecture attacker

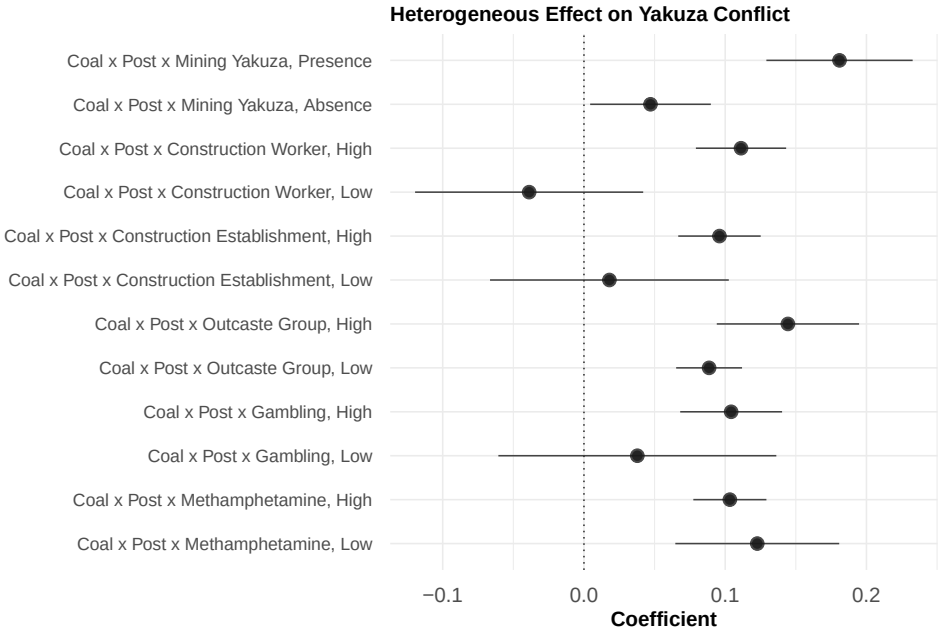
Results: Conflict Channels by Initial Characteristics. I examine heterogeneous effects of the energy transition on conflicts based on pre-existing characteristics: mining-linked yakuza presence and alternative economic opportunities. Based on Section 2, I analyze: (i) presence of mining-linked yakuza groups, (ii) proportion of construction workers, (iii) construction establishments, (iv) proportion of the outcaste group, (v) public gambling sites, and (vi) methamphetamine arrests. Variables are divided into above/below median (except for mining-linked yakuza presence, which is defined as prefectures that recorded any arrests of these groups before 1962).

Figure 4 shows point estimates with 95% confidence intervals. The energy transition increased conflicts more in coal-rich prefectures where mining-linked yakuza groups were historically present. The heterogeneous effects across other characteristics indicate that the transition's effects on conflicts are generally larger in prefectures with alternative economic rents available to yakuza. Coal-

rich prefectures with high levels of construction workers, construction establishments, and outcaste populations show significantly higher conflict likelihood. For public gambling sites, prefectures with high levels show larger coefficients (0.104 vs. 0.037), but this difference is not statistically significant at conventional levels (with p value of 0.172). Methamphetamine arrests show no differential effect.

Taken together, these results suggest that following the energy transition, yakuza groups from coal-scarce prefectures targeted yakuza groups in coal-rich prefectures where mining-linked yakuza power had declined but alternative economic opportunities existed.

Figure 4: Heterogeneous Effects on Yakuza Conflict

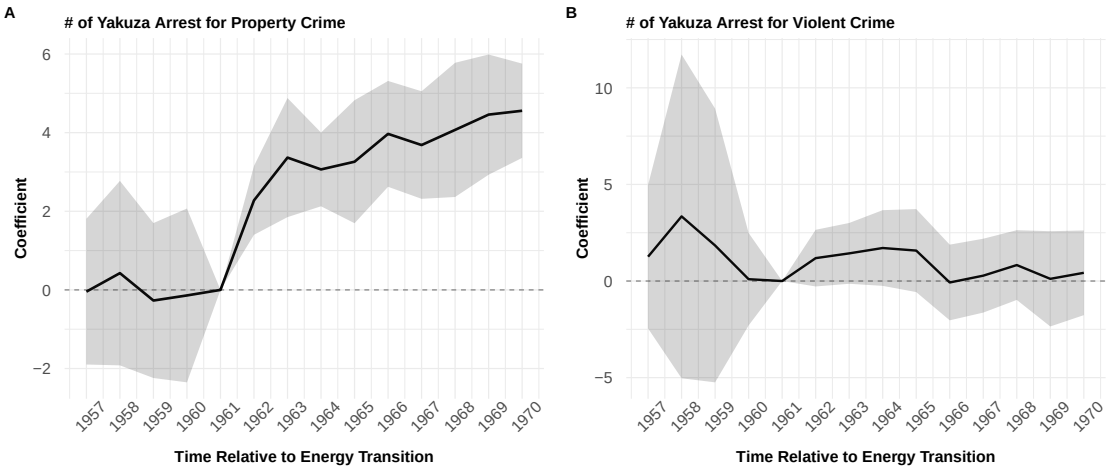


Unit of analysis: prefecture-by-decade. **Time period/data points:** 1920-2010 (decade). **Observations:** 460. **Outcome:** a binary indicator for yakuza conflict. **Mean of dep. var. in the pre-transition period**: 0.043. **Standard errors:** clustered at the prefecture level. **Moderator Z of interest**: divided by above median or below median (except for the presence of mining-associated yakuza groups, see Yakuza Arrests (Prefecture-by-Year-Level data) in Section 3). $y_{i,r(i),t} = \alpha_0 mine_i \times post_t \times Z_i^{high} + \alpha_1 mine_i \times post_t \times Z_i^{low} + \alpha_2 Z_i^{high} \times post_t + \mu_i + \lambda_{r(i),t} + \epsilon_{i,r(i),t},$. **P-value of Joint Significance Test of Two Coefficients**: 0.000 (Mining Yakuza), 0.0009 (Construction Worker), 0.098 (Construction Establishment), 0.044 (outcaste Group), 0.172 (Gambling), 0.200 (Methamphetamine).

Short-Run Effects on Yakuza Activities and Organizational Composition. I now turn to annual yakuza arrest data to examine short-run effects of the energy transition. Figure 5 shows event-study estimates for yakuza arrests per 100,000 people (property crime in Panel A, violent

crime in Panel B). Before 1962, there are minimal differential trends between coal-rich and coal-scarce prefectures. After 1962, yakuza property crime arrests increased more in coal-rich prefectures, with effects persisting over 10 years. A one standard deviation increase in coal mining availability leads to about 3.6 additional property crime arrests per 100,000 people—a 30% increase relative to the baseline mean. This pattern is not observed for violent crime.

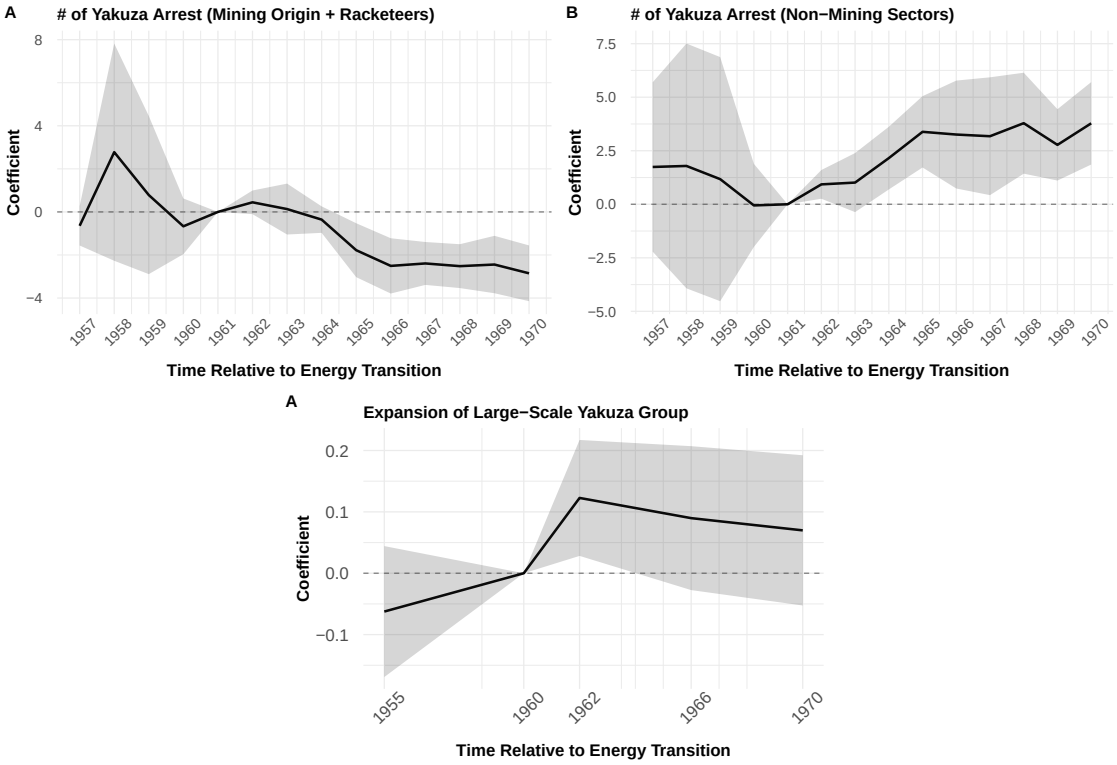
Figure 5: Short-Term Effects on Yakuza Activities



Unit of analysis: prefecture-by-year. **Time period:** 1957-1970 (annually). **Observations:** 644. **Outcome:** # of yakuza arrests for property crime and violent crime per 100,000 people. **Mean of dep. var. (property crime) in the pre-transition period**: 11.588. **Mean of dep. var. (violent crime) in the pre-transition period**: 27.670. **Standard errors:** clustered at the prefecture level.

To understand whether this increase reflects organizational reallocation, I examine arrests disaggregated by yakuza sector of origin. Figure 6 presents event-study estimates showing contrasting patterns: mining-linked yakuza arrests (mining origin and racketeers/enforcers) declined post-transition (Panel A), while arrests of yakuza from other sectors increased (Panel B). Panel C focuses on the Yamaguchi-gumi, the largest yakuza group originating from dock labor in a coal-scarce prefecture. While showing an upward pre-trend, the group's expansion in coal-rich prefectures accelerated after the transition. These results indicate a shift in yakuza group composition: as mining-linked yakuza declined, non-mining yakuza expanded into coal-rich prefectures.

Figure 6: Yakuza Group Composition and Expansion



Unit of analysis: prefecture-by-year. **Time period: Panel A-B**: 1957-1970 (annually). **Panel C**: 1955, 1960, 1962, 1966, 1970. **Observations: Panel A-B**: 644. **Panel C:** 230. **Outcome: Panel A-B**: # of yakuza arrests in the mining-originated groups + racketeers, and in other sectors per 100,000 people. **Panel C**: a binary indicator for the presence of the yamaguchi-gumi. **Panel A: Mean of dep. var. (mining origin + racketeers) in the pre-transition period**: 20.702. **Panel B: Mean of dep. var. (other sectors) in the pre-transition period**: 27.636. **Panel C: Mean of dep. var. (expansion of large-scale yakuza group) in the pre-transition period**: 0.148. **Standard errors:** clustered at the prefecture level.

Ruling Out Alternative Explanations and Supporting Evidence for Organization Reallocation. Several pieces of evidence support the organizational-reallocation interpretation and rule out alternative explanations. First, coal-rich prefectures experienced decreased labor disputes following the transition, consistent with mining-linked yakuza losing their mining-industry revenues (Appendix F). Second, the energy transition shows null effects on non-yakuza arrests for property crime (Appendix H), ruling out a simple opportunity-cost channel where displaced miners joined yakuza groups. This is further supported by evidence that former mine workers transitioned to construction or welfare rather than crime (Appendix E).

Ruling Out Enforcement-Based Explanations. These results could reflect changes in enforcement rather than actual yakuza activity. To address this concern, I show that the energy transition did not alter enforcement levels—neither general enforcement nor yakuza-specific measures—during this period. Moreover, the results on yakuza arrests remain robust when controlling for pre-transition police presence interacted with year fixed effects (Appendix G). Lastly, an alternative account for the short-term increase in yakuza arrests is that as mining-linked yakuza groups lost power, they were less able to bribe police officers, leading to more arrests. However, if this were the case, we would expect to see an increase specifically in arrests of mining-linked yakuza members (both those directly involved in mining and those among racketeers). Moreover, mining-yakuza groups typically operated on a small scale, making it unlikely they could influence police behavior at the prefecture level.

3.2 Time-Aggregated Bartik-Style Mining Exposure and Contemporary Yakuza (Cross-Sectional Design)

I investigate medium- and long-run effects of the energy transition on multiple yakuza outcomes using cross-sectional exposure to mining job losses.

Construction of Predicted Mining Employment Driven by Energy Transition Following Bazzi et al. (2023); Duflo and Pande (2007); Sequeira et al. (2020), I construct a Bartik-style exposure of mining employment based on crude oil import growth interacting with local coal-mining availability. Rising oil imports act as a negative demand shifter in coal-rich prefectures. I estimate: $\mathsf{mine\,emp}_{i,r(i),t} = \beta_1 \left(\mathsf{mine}_{i,t} \times \mathsf{oil\,imports}_t\right) + \beta_2\, \mathsf{mine}_{i,t} + \mu_i + \delta_{r(i),t} + \varepsilon_{i,r(i),t}$. The interaction $\mathsf{mine}_{i,t} \times \mathsf{oil\,import}_t$ captures how oil-import shocks differentially affect mining employment by the local availability of coal mining. Mining employment is measured as mine workers per 100 total workers from the Japan Statistical Yearbook, using the 1961 population as the denominator.[14] I then construct the predicted mining employment by averaging the interaction effects over time: $\widehat{\mathsf{predicted\ mine\ emp}}_i = \frac{1}{T}\sum_{t=1}^{T} \widehat{\beta}_1\, \mathsf{mine}_{i,t} \times \mathsf{oil\ import}_t$. This differs from the canonical Bartik design, which typically uses time-invariant cross-sectional shares; see Appendix B. Table A2 reports estimates.

[14] The Yearbook reports unique values for mine workers in 1955, 1959, 1961, 1965, 1967, and 1970. Data: link.

To credibly estimate the effects of $\widehat{\text{predicted mine emp}}_i$, two conditions are required. The first is exogeneity: conditional on geography, pre-existing demographic and economic characteristics are largely uncorrelated with $\widehat{\text{predicted mine emp}}_i$ (Table A3). The second is exclusion restriction: $\widehat{\text{predicted mine emp}}_i$ affects yakuza outcomes only through mining job losses. While Appendix E shows the energy transition increased construction workers, this should be interpreted as a consequence of declining mine workers rather than a direct effect of the energy transition itself.

Yakuza Outcomes (Panel and Cross Section). I focus on measures of yakuza members and yakuza syndicates. For members, the main outcome is incarcerated yakuza per 100,000 people (2006–2019), covering high-ranking, regular, and unknown-rank members from the 25 designated syndicates and their affiliates. According to my interview with the Ministry of Justice, the "unknown rank" category includes (i) peripheral members, (ii) those transitioning between ranks, or (iii) members affiliated with non-yakuza criminal groups. Specifically, these non-yakuza criminal groups are often called *hangure*, emergent organized crime groups distinct from traditional yakuza. They are loosely organized, less hierarchical, and not subject to anti-yakuza laws.

For yakuza syndicates, I use the number of designated syndicates (1996, 2008) and the Herfindahl–Hirschman Index (HHI) of yakuza competition (2008–2013) (see Brown et al. (2021) for a similar construction of the HHI-based gang competition measure). Construction details are in Appendix T. For the yakuza HHI, I subtract the index from 1, so higher values indicate greater fragmentation among yakuza syndicates.

For supplementary outcomes, I use both panel and cross-sectional yakuza data. The panel data includes yakuza members per 100,000 people (2008-2014) from 37 prefectures, but its unbalanced nature limits it to supplementary analysis. Cross-sectional measures include: yakuza arrests per 100,000 people (2013), arrests per 1,000,000 people (1974, in crude categories)[15], yakuza members per 10,000 people across 82 cities (1967, in crude categories)[16], yakuza syndicate headquarters (2002), Yamaguchi-gumi affiliated groups (2002), and an indicator that equals one if a prefecture has the headquarters of a designated yakuza syndicate formed after 1962.

Lastly, I examine three placebo outcomes: (i) yakuza members per 100,000 people (1951), (ii) yakuza groups (1951), and (iii) indicator that equals one if a prefecture has the headquarters of a

[15] categories: 0-200, 201-300, 301-400, 401-500, 501-600, 601-800, and 800+. Midpoint values used.
[16] categories: 1.25, 3.75, 6.25, 8.25, 8.75, 12.5, 17.5, and 20.

designated yakuza syndicate formed before 1962[17]. These placebo outcomes test temporal effects—if the 1960s energy transition had causal effects, these outcomes should not correlate with the treatment variable. Data sources and summary statistics are in Table 1.

Empirical Design. Using $\widehat{\text{predicted mine emp}}_i$, I examine the effects of mining job losses induced by the energy transition on yakuza measures. I estimate (2) for outcomes available in panels and (3) for outcomes available only in cross-sections:

$$\text{yakuza}_{i,r(i),t} = \tilde{\pi}_0 + \tilde{\pi}_1 \widehat{\text{predicted mine emp}}_i + \tilde{\pi}_2 X_i + \tilde{\gamma}_{r(i),t} + \tilde{\eta}_{i,r(i),t}, \tag{2}$$

$$\text{yakuza}_{i,r(i)} = \pi_0 + \pi_1 \widehat{\text{predicted mine emp}}_i + \pi_2 X_i + \gamma_{r(i)} + \eta_{i,r(i)}. \tag{3}$$

The coefficients of interest are $\tilde{\pi}_1$ and π_1. The variable $\widehat{\text{predicted mine emp}}_i$ is the predicted change in the share of mine workers due to the energy transition; lower values indicate lower mining employment (i.e., greater job losses). Thus, if job losses raise yakuza activity, $\tilde{\pi}_1$ and π_1 should be negative (as $\widehat{\text{predicted mine emp}}_i$ decreases, yakuza measures increase). $\gamma_{r(i)}$ and $\tilde{\gamma}_{r(i),t}$ denote region fixed effects and region-by-time fixed effects, respectively. X_i is a vector of time-invariant prefecture characteristics (latitude, longitude, land area, elevation, mountainous area share, Sea of Japan indicator, and the number of ports established before 1962). $\eta_{i,r(i)}$ and $\tilde{\eta}_{i,r(i),t}$ are error terms. I use prefecture-clustered standard errors for (2) and robust standard errors for (3).

For panel outcomes, I also estimate heterogeneity by the Yakuza Exclusion Ordinances (YEOs):

$$\begin{aligned}\text{yakuza}_{i,r(i),t} = \ddot{\pi}_0 + \ddot{\pi}_1 \widehat{\text{predicted mine emp}}_i + \ddot{\pi}_2 \widehat{\text{predicted mine emp}}_i \times \text{yeo}_{i,t} \\ + \ddot{\pi}_3 \text{yeo}_{i,t} + \ddot{\pi}_4 X_i + \ddot{\gamma}_{r(i),t} + \ddot{\eta}_{i,r(i),t}.\end{aligned} \tag{4}$$

Here, $\ddot{\pi}_1$ is the persistent effect of the energy-transition exposure in the pre-YEO period ($\text{yeo}_{i,t} = 0$). $\ddot{\pi}_2$ is the *change* in this effect after YEO enactment. In other words, before the enactment of the YEOs, the effect of mining job losses due to the energy transition should be large (more negative) ($\ddot{\pi}_1 < 0$), but after the YEOs, the effects should be smaller (less negative) ($\ddot{\pi}_2 > 0$). Enactment dates for the YEOs are reported in Appendix T.

[17] Prefectures with both pre- and post-1962 syndicates are double-counted.

Results: Predicted Mining Employment from Energy Transition and Contemporary Yakuza. Table 3 presents estimates of the effect of predicted mining employment driven by the energy transition on yakuza measures. Panels A-E present different outcomes across four specifications: Column (1) bivariate relationship; Column (2) adds region-by-time fixed effects; Column (3) adds geographic controls; Column (4) adds mining job losses × YEOs interaction. Panel F (designated yakuza syndicates) excludes YEO analysis due to limited sample period (1996-2008). Note that lower treatment values indicate lower mining employment (i.e., greater job losses), so negative coefficients represent increased yakuza activities.

For yakuza incarceration (total, high-ranking, and regular members), coefficients are consistently negative and significant, except for Column (1) in Panel B. In Column 3, a one SD increase in mining job losses correlates with 0.5 higher incarceration per 100,000 overall (26% above mean), 0.2 for high-ranking (54%), and 0.24 for regular (30%). For yakuza syndicates, similar increases correlate with 0.189 higher HHI (42%) and 1.5 more syndicates (50%).

Column (4) tests heterogeneous effects exploiting the YEOs. The energy transition allowed yakuza to substitute into other groups, but the YEOs restricted this by constraining all yakuza activities. The results reveal varying effects across member types. For high-ranking members, the interaction term (mining job losses × YEOs) is insignificant, suggesting strong organizational commitment and high exit costs prevent responsiveness to YEOs. By contrast, for regular members, the interaction term is positive and significant, indicating lower organizational attachment makes them more responsive to changing incentives under the YEOs. For unknown-rank members, the interaction term is negative while the main effect remains insignificant. This result potentially indicates members transitioning out of syndicates post-YEO and being classified as unknown rank if arrested during transition. These results suggest that reducing yakuza service demand can mitigate the energy transition's persistent effects by limiting substitution opportunities, with effectiveness varying by organizational commitment.

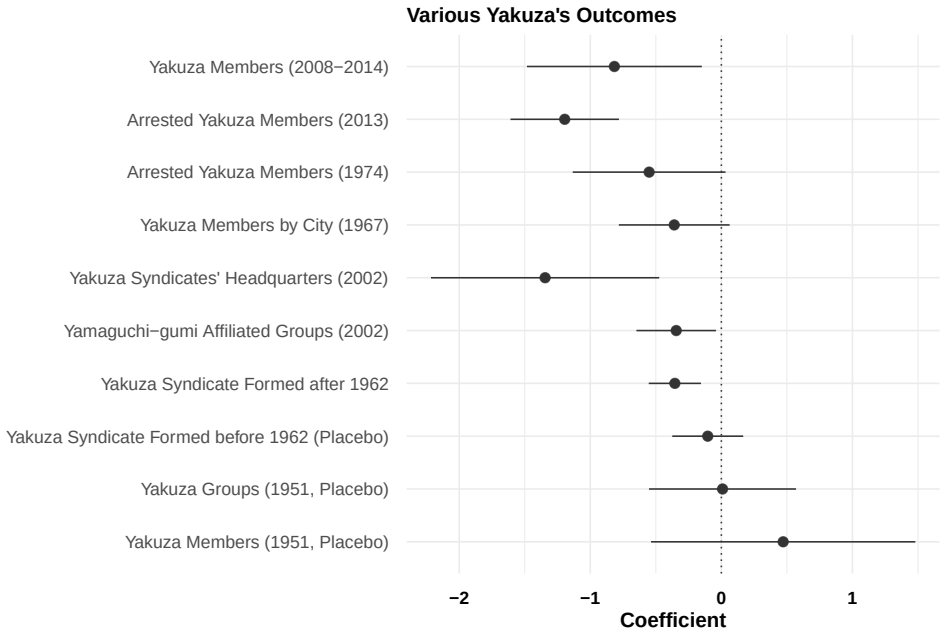
Table 3: Predicted Mining Employment (Energy Transition) and Contemporary Yakuza

	(1)	(2)	(3)	(4)
Panel A: Total Yakuza incarceration (2006-2019)				
Predicted Mining Employment (Energy Transition)	-0.1172*	-0.2391***	-0.5190***	-0.6492***
	(0.0597)	(0.0515)	(0.0774)	(0.0918)
Predicted Mining Employment (Energy Transition) × YEO				0.1865***
				(0.0435)
Observations	644	644	644	644
R-squared	0.0293	0.6310	0.6858	0.6969
Panel B: High-ranking Yakuza Incarceration (2006-2019)				
Predicted Mining Employment (Energy Transition)	-0.0201	-0.0568*	-0.2668***	-0.2680***
	(0.0414)	(0.0313)	(0.0334)	(0.0355)
Predicted Mining Employment (Energy Transition) × YEO				0.0008
				(0.0103)
Observations	644	644	644	644
R-squared	0.0076	0.5894	0.7177	0.7179
Panel C: Regular Yakuza Member Incarceration (2006-2019)				
Predicted Mining Employment (Energy Transition)	-0.1122***	-0.1786***	-0.2460***	-0.3887***
	(0.0217)	(0.0232)	(0.0451)	(0.0592)
Predicted Mining Employment (Energy Transition) × YEO				0.2039***
				(0.0359)
Observations	644	644	644	644
R-squared	0.0666	0.6371	0.6667	0.6997
Panel D: Unknown Rank Yakuza Incarceration (2006-2019)				
Predicted Mining Employment (Energy Transition)	0.0150**	-0.0037	-0.0062	0.0074
	(0.0056)	(0.0040)	(0.0298)	(0.0313)
Predicted Mining Employment (Energy Transition) × YEO				-0.0182***
				(0.0066)
Observations	644	644	644	644
R-squared	0.0087	0.3298	0.3791	0.3819
Panel E: Yakuza HHI (2008-2013)				
Predicted Mining Employment (Energy Transition)	-0.0610***	-0.0451**	-0.1891***	-0.1919***
	(0.0173)	(0.0205)	(0.0464)	(0.0462)
Predicted Mining Employment (Energy Transition) × YEO				0.0038**
				(0.0018)
Observations	276	276	276	276
R-squared	0.1124	0.4902	0.6947	0.6948
Panel F: # of Designated Yakuza Syndicates (1996,2008)				
Predicted Mining Employment (Energy Transition)	-0.4684***	-0.4950***	-1.5344***	
	(0.0994)	(0.1270)	(0.1991)	
Observations	92	92	92	
R-squared	0.1447	0.6150	0.7889	
Geographic Controls	-	-	x	x
Division-time FE	-	x	x	x

Notes: Total Yakuza incarceration Incarceration: the number of yakuza incarceration per 100,000 people. **High-ranking Yakuza Incarceration**: the number of incarcerated high-ranking yakuza members per 100,000 people. **Regular Yakuza Member Incarceration:** the number of incarcerated regular yakuza members per 100,000 people. **Unknown Rank Yakuza Incarceration**: the number of incarcerated yakuza members with unknown rank per 100,000 people. **Yakuza HHI:** defined as $1 - HHI$ indicating a higher value = more fragmentation among different yakuza syndicates. **Geographic controls:** i.e., latitude, longitude, land area, elevation, the amount of mountains, whether a prefecture is located on the Sea of Japan, the number ports established before 1962. Significance at the 1%, 5%, and 10% levels indicated by ***, **, and *, respectively. Standard errors are clustered at the prefecture level.

Figure 7 presents estimates and 95% confidence intervals for disaggregated outcomes, assessing medium- and long-term effects. To facilitate interpretation, all continuous measures are standardized to have a mean of 0 and a standard deviation of 1. Across all relevant measures, prefectures experiencing greater mining job losses exhibit higher yakuza activities in the 1970s, 1990s, and 2000s-2010s, although some estimates are less precise. Notably, the number of yakuza groups affiliated with the Yamaguchi-gumi, the largest yakuza syndicate, is higher in prefectures with greater mining job losses, suggesting group expansion in these areas. Null effects or an opposite-signed coefficient for placebo outcome measured before the energy transition or unrelated to the yakuza further strengthens the credibility of the results.

Figure 7: Estimates and 95% Confidence Intervals: Various Yakuza's Activities



Note: All continuous variables are standardized to mean = 0 and standard deviation = 1. **Observations**: 46 for all outcomes except for **Yakuza Members by City (1967)** and **Yamaguchi-gumi Affiliated Groups**. **Yakuza Members by City (1967)**: based on 82 cities. **Yamaguchi-gumi Affiliated Groups**: 45 with Hyogo prefecture excluded, where the headquarter of the Yamaguchi-gumi is located. **Yakuza syndicate formed after (resp. before) 1962**: binary outcome. **Specification:** region fixed effects, and geographic controls (i.e., latitude, longitude, land area, elevation, the amount of mountains, whether a prefecture is located on the Sea of Japan, the number ports established before 1962)

Heterogeneity, Alternative Explanations, and Robustness. I examine heterogeneous effects to understand mechanisms underlying persistence, consider alternative explanations, and as-

sess robustness. First, Appendix J shows that the energy transition generated persistent increases in yakuza presence primarily in coal-rich prefectures with both historical presence of mining-linked yakuza groups and alternative economic rents available. This result corroborates the heterogeneous effects of the transition on yakuza-related conflicts, presented earlier. Second, I rule out alternative explanations based on confounding factors. Appendix O examines whether historical or contemporary economic, demographic, or law enforcement conditions explain the persistent effects of predicted mining employment losses on yakuza presence. I find little evidence that these factors drive the results. Third, I assess robustness to unobserved heterogeneity. Appendix P applies Oster's (2019) coefficient stability approach and shows that unobserved factors would need to be 3 to 14 times more influential than observed covariates to explain away the results for most outcomes.

3.3 Municipal-Level Analysis

Prefecture-level results show that coal-rich prefectures experienced increased yakuza activity, especially where alternative economic opportunities existed. To examine this at finer scale, I use municipal-level data from Fukuoka—historically known for both coal mining and yakuza activity. I relate each municipality's distance to municipalities with historical mining establishments and number of such establishments to current yakuza offices, crime measures, and establishments in sectors with likely yakuza involvement. I expect the following: (i) mining municipalities may have faced overall economic or population decline and offered little incentive for yakuza expansion, while (ii) nearby non-mining municipalities could experience the emergence of new industries through geographic displacement or new entry, making them attractive targets for yakuza expansion.

I source data on yakuza office from "Yakuza Office Street View Search" (Appendix T), violent and property crimes (2007-2019) from Fukuoka Prefectural Police, and business establishments by sector (1972, 1981, 1991, 2001, 2012) from Fukuoka Prefecture's official website. Historical mining establishments (as of 1961) are from Japan Mining Archive, with minimum distances calculated to municipalities with mining establishments.[18] I estimate:

$$\mathsf{yakuza}_{i,r} = \alpha_0 + \alpha_1 \ln \mathsf{dist}_i + \alpha_2 \# \text{ mining est}_i + \alpha' X_i' + \delta_r^b + \epsilon_{i,r}, \tag{5}$$

$$\mathsf{crime}_{i,r,t} = \tilde{\alpha}_0 + \tilde{\alpha}_1 \ln \mathsf{dist}_i + \tilde{\alpha}_2 \#\text{mining est}_i + \beta' X_i' + \tilde{\delta}_r^b + \tilde{\delta}_t^b + \tilde{\epsilon}_{i,r,t}, \tag{6}$$

[18] For municipalities with border changes due to mergers, I use current boundaries.

$$\mathsf{establishment}_{i,r,t} = \ddot{\alpha}_0 + \sum_{t=1971}^{2012} \ddot{\alpha}_t^{dist} \ln \mathsf{dist}_i \times \mathbb{1}_t + \sum_{t=1971}^{2012} \ddot{\alpha}_t^{est} \#\mathsf{mining\ \ est}_i \times \mathbb{1}_t + \beta' X_i' + \tilde{\delta}_r^b + \tilde{\delta}_t^b + \tilde{\epsilon}_{i,r,t}, \tag{7}$$

In equation 5, $\mathsf{yakuza}_{i,r}$ is either the presence of yakuza offices (extensive margin) or the number of yakuza offices (intensive margin) in municipality i; in equation 6, $\mathsf{crime}_{i,r,t}$ is either the number of violent or property crimes per 100,000 residents; in equation 7, $\mathsf{establishment}_{i,r,t}$ is the number of establishments for a particular sector, such as construction, in municipality i and year t. $\ln \mathsf{dist}_i$ is the log of the minimum distance from municipality i to a municipality with a historical mining establishment, while $\#\,\mathsf{mining\ \ est}_i$ is the number of historical coal mining establishments.[19] X_i includes latitude, longitude, and land area. δ_r^b ($\tilde{\delta}_r^b$) and $\tilde{\delta}_t^b$ represent region-by-mining-presence fixed effects and year-by-mining-presence fixed effects, respectively, where Fukuoka prefecture is divided into three regions r (i.e., Fukuoka, Kitakyushu, Chikuho-Chikugo).[20][21] Region-by-mining-presence fixed effects allow for comparing varying distances among non-mining municipalities, and varying numbers of mining establishments among mining municipalities within each region.

α_1 (resp. $\tilde{\alpha_1}$) is expected to be negative and captures the distance effect on the outcome of interest among municipalities without a coal mining establishment within a region (resp. within a region and time), while α_2 (resp. $\tilde{\alpha_2}$) is expected to be null or negative and captures the effect of the number of historical mining establishments on the outcome of interest among municipalities with a coal mining establishment within a region (resp. within a region and time).[22] For equation 7, to better understand the medium and long run effects, I allow for the effects ($\ddot{\alpha}_t^{dist}$, $\ddot{\alpha}_t^{est}$) to vary across specific periods: 1971, 1981, 1991, 2001, and 2012.

Due to the proximity of municipalities to historical coal mining establishments, spatial correlation likely exists between observations. To account for this spatial correlation, I use Conley spatial

[19] For municipalities with at least one coal mining establishment, taking the log of the distance variable generates missing values. I replace those missing values with zero after the logarithm transformation.

[20] According to government statistics, Fukuoka is divided into four regions: Fukuoka, Kitakyushu, Chikuho, and Chikugo. However, because 14 out of 15 municipalities in the Chikuho region have historical coal mining establishments, there is little variation in the region. Thus, I combine the Chikuho and Chikugo regions, which are adjacent to one another, to have more variation for estimation.

[21] Region-by-mining-presence fixed effects and time-by-mining-presence fixed effects are interaction terms of region and time (year) fixed effects, respectively, and a dummy variable, $\mathsf{mining\ \ est}_i$, that indicates whether a municipality has a historical mining establishment. To be sure, $mining\,est_i$ is the extensive margin, and $\#mining\,est_i$ is the intensive margin of historical mining establishments.

[22] By construction, note that α_1 (resp. $\tilde{\alpha_1}$) is not estimable if $\mathsf{mining\,est}_i \neq 0$, and α_2 (resp. $\tilde{\alpha_2}$) is not estimable if $\mathsf{mining\ \ est}_i = 0$.

standard errors with a 28 km window (Conley, 1999). The 28 km cutoff is determined by the maximum value of the minimum distance between a municipality and a municipality with a historical coal mining establishment. This ensures that all municipalities within the specified distance from a mining municipality are considered in the spatial correlation calculation. Furthermore, I apply a Bartlett kernel of distance to allow for distance decay within the error term between municipalities within the cutoff.

Results: Distance to Coal Mining and Yakuza Offices, Crime, and Channels. Table 4 provides the estimation results. Panel A shows the results for contemporary yakuza offices and crime measures. Specifically, Columns (1) show the result for the presence of yakuza offices (extensive margin); Columns (2) shows the results for the number of yakuza offices (intensive margin); Columns (3-4) show the results for violent and property crime outcomes, respectively. Panel B shows the results for potential channels; Columns (1-4) show the results for the number of establishments for construction, restaurants, real estate, and infrastructure, respectively.

Panel A reveals that the coefficients on the log of distance to a municipality with historical coal mining establishments are negative for both the extensive and intensive margins of yakuza offices, as well as violent crime rates. This indicates that the closer a municipality is to a municipality with historical mining establishments, the more yakuza offices it has. Specifically, for the extensive margin of yakuza offices, municipalities that are one percent closer have a 0.512 percentage point higher likelihood of the presence of yakuza offices. For the intensive margin, municipalities that are one percent closer have approximately 0.015 more yakuza offices. Regarding crime measures, being one percent closer is associated with about 0.2 more violent crimes and roughly 1.7 more property crimes per 100,000 residents. However, the coefficients for the number of coal mining establishments are not statistically significant for all outcomes, with only marginal significance observed for the intensive margin of yakuza offices.

Panel B reveals that municipalities in closer proximity to a municipality with a historical mining establishment have a higher number of business establishments in the construction, restaurant, real estate, and infrastructure sectors in the medium and long run. The time-varying coefficients on the log of distance are statistically significant across the examined periods, indicating an expansion of these business establishments near municipalities with historical coal mining presence. However,

with the exception of infrastructure, the time-varying coefficients on the number of historical coal mining establishments are not statistically significant. The findings support the idea that business establishments have expanded in municipalities closer to those with a historical coal mining presence, and this effect persists over the medium and long term. Consequently, yakuza groups extend their territorial influence.

Table 4: Coal Mining Proximity and Yakuza Offices, Crime, and Channels

PANEL A	(1)	(3)	(1)	(2)
Dep.Var.:	Yakuza Office		Violent Crime	Property Crime
	Extensive Margin	Intensive Margin		
log of Distance to a Coal Mining Establishment	-0.5142***	-1.5417***	-27.5426***	-168.6246**
	(0.1304)	(0.4057)	(6.6238)	(84.7584)
# of Coal Mining Establishments	-0.0161	-0.0604*	0.3065	10.3443
	(0.0098)	(0.0330)	(0.7318)	(9.4984)
Region x Mining-Presence Fixed Effects	x	x	x	x
Covariate	x	x	x	x
Observations	72	72	936	936
R-squared	0.2485	0.1672	0.118	0.0700
Sample Period	As of 2023		2007-2019	
PANEL B	(1)	(3)	(1)	(2)
Dep.Var.:	# of Establishments			
	Construction	Restaurants	Real Estate	Infrastructure
log of Distance to a Coal Mining Establishment × 1971	-151.7474**	-1,028.0475***	-272.5330***	-2.0947
	(72.8872)	(383.4713)	(67.3316)	(2.8744)
log of Distance to a Coal Mining Establishment × 1981	-267.5601***	-1,171.2689***	-222.9883***	-4.5193***
	(87.8223)	(402.4294)	(75.7512)	(1.0041)
log of Distance to a Coal Mining Establishment × 1991	-350.6493***	-2,909.9056***	-236.0296***	-4.2389***
	(106.4057)	(1,003.5030)	(79.5416)	(1.3640)
log of Distance to a Coal Mining Establishment × 2001	-309.0986***	-2,681.4960***	-125.6823*	-10.8191***
	(113.3589)	(915.8410)	(75.4602)	(3.0827)
log of Distance to a Coal Mining Establishment × 2012	-346.7691***	-1,333.0610***	-210.0195**	-6.6509***
	(97.7807)	(471.0122)	(93.6973)	(2.0866)
# of Coal Mining Establishments × 1971	-2.2513	19.5740	-2.3442	0.5657***
	(8.5963)	(44.1757)	(6.9774)	(0.1449)
# of Coal Mining Establishments × 1981	1.5426	3.3293	-7.1495	0.6669***
	(9.4854)	(43.2001)	(8.0943)	(0.1716)
# of Coal Mining Establishments × 1991	3.1085	2.2794	-3.7061	0.5370***
	(9.8260)	(80.1627)	(8.2759)	(0.1533)
# of Coal Mining Establishments × 2001	4.9928	9.4239	-0.9379	0.2997**
	(9.7624)	(61.7406)	(6.7009)	(0.1222)
# of Coal Mining Establishments × 2012	0.7961	-1.5371	-0.2703	-0.2761**
	(9.2427)	(43.2384)	(7.4993)	(0.1238)
Region x Mining-Presence Fixed Effects	x	x	x	x
Year x Mining-Presence Fixed Effects	x	x	x	x
Covariate	x	x	x	x
Observations	360	360	360	360
R-squared	0.2079	0.1112	0.0571	0.2426
Sample Period	1971, 1981, 1991, 2001, 2012			

Notes: Yakuza Office (Extensive Margin): the presence of yakuza offices (a binary outcome). **Yakuza Office (Intensive Margin):** # of yakuza offices. **Violent Crime Rates:** # of violent crime per 100,000 residents. **Property Crime Rates:** # of property crime per 100,000 residents. **# of Construction Establishments:** # of establishments in the construction sector. **# of Restaurants:** # of establishments in the accommodations, eating and drinking service sector. **# of Real Estate:** # of establishments in the real estate activity sector. **# of Infrastructure:** # of establishments in the electricity, gas, heat supply and water sector. Significance at the 1%, 5%, and 10% levels indicated by ***, **, and *, respectively. Conley standard errors in parentheses.

4 Summary of Robustness Checks, Alternative Explanations, and Other Results

While I relegate the details to the relevant appendices, this section provides a summary of robustness checks, alternative explanations, and additional results.

Table 5: Summary of Robustness Checks

	Results	Appendix
Alternative Designs		
Alternative Design for Short-Run Effects (Bartik reduced-form)	✓	Appendix I
Alternative Design for Long-Term Conflict Analysis (predicted treatment)	✓	Appendix K
Binary Indicator of Coal Mining Availability	✓	Appendix N
Measurement		
Alternative Coal Mining Measurement (areas / lots / production)	✓	Appendix M
Estimator / Specification / Sensitivity Analysis		
Alternative Estimator (OLS vs. WLS)	✓	Appendix L
Robustness to Unobserved Confounders (Oster)	✓ (3–14×)	Appendix P
Leave-One-Out by Division	✓	Appendix Q
Alternative Sample (exclude zero-availability prefectures)	*Mixed*	Appendix R
Robustness to Observed Covariates (Bartik cross-section)	✓	Appendix O
Municipal-Level (Fukuoka) Robustness		
Alternative Outcome (industry employment; YakuzaWiki offices)	✓	Appendix S
Alternative Standard Errors (Conley cutoffs; cluster at mining level)	✓	Appendix S
Alternative Covariates (exclude geographic controls)	✓	Appendix S
Alternative Estimators (OLS, WLS-2005, PPML, logit)	✓	Appendix S
Alternative Distance Measure (binary below-median distance)	✓	Appendix S

Summary of Alternative Explanations and Other Results

Substitution to Natural Gas / Oil Sectors: Coal-rich prefectures might have shifted to oil processing using synthetic or imported oil, leading workers to transition to oil sectors or natural gas, which would underestimate mining job losses (i.e., more negative). Appendix D shows little evidence of substitution to the oil/gas sector.

Energy Transition as a Negative Business Demand Shock for Mining-Linked Yakuza: To bolster the interpretation that the energy transition deprived mining-linked yakuza of income sources from the mining industry, Appendix F shows that labor disputes decreased in coal-rich prefectures post-transition. This result is consistent with mining-linked yakuza losing a key revenue source: intervening in mining-industry labor disputes to settle conflicts, such as their involvement in the 1959-1960 Miike coal mine labor dispute (Hyodo, 1981).

Energy Transition Effects on Broader Population vs. Yakuza-Specific Effects: If the energy transition was a shock to a large population, generating a large number of unemployed people, the results could reflect general income effects on overall crime rates rather than yakuza-specific mechanisms. I examine this possibility by testing whether the effects extend beyond yakuza groups. First, Appendix H uses total and non-yakuza arrests for property crime and show that effects are entirely driven by yakuza-specific arrests, not non-yakuza arrests, consistent with the lack of the opportunity cost channel. Second, Appendix E shows that the energy transition did not change overall unemployment rates at the prefecture level.

Why Coal Miners Did Not Join Yakuza Groups: Null effects on unemployment rates and the lack of evidence for an opportunity cost channel, where coal miners would join yakuza groups or commit property crime, requires explanation. Appendix E shows that coal-rich prefectures experienced increases in the share of construction workers and welfare recipients. This indicates that former mine workers transitioned into construction or enrolled in welfare programs, maintaining employment or social support that preserved the opportunity cost of crime and reduced incentives to join yakuza groups or engage in property crime.

Enforcement Explanations for Yakuza Arrests: An increase in yakuza arrest following the energy transition could be due to an increase in enforcement. Appendix G eliminates this channel by regressing enforcement measures on the treatment in a DiD regression. I also include the number of police officers in the pre-energy transition period interacted with year fixed effects in some of my specifications as a robustness check.

Another potential explanation for the short-term increase in yakuza arrests could be that as mining-linked yakuza groups lost power, they were less able to bribe police officers, leading to more arrests. However, if this were the case, we would expect to see an increase specifically in arrests of mining-linked yakuza members (both those directly involved in mining and those among racketeers). Moreover, mining-yakuza groups typically operated on a small scale, making it unlikely they could influence police behavior at the prefecture level.

For contemporary yakuza outcomes, Appendix O assesses the robustness of the findings by controlling for contemporary police force size in the regression model.

Alternative Explanations for the Persistent Effect: The persistent effects of the energy transition on contemporary yakuza outcomes might be explained by resulting long-term economic decline. Appendix O evaluates this channel by including contemporary economic and demographic variables to test whether they attenuate the transition's effects, though these likely constitute bad controls (Angrist and Pischke, 2008). However, it finds little evidence that these economic channels explain the persistent effect. Instead, Appendix J finds that the energy transition's effects on the yakuza are observed in coal-rich prefectures with historical presence of mining-associated yakuza groups and alternative economic opportunities for yakuza beyond coal mining.

5 Conclusion

This study investigates how industry-specific economic shocks generate persistent changes in organized crime through organizational reallocation and territorial contestation. Exploiting Japan's 1960s coal-to-oil energy transition, I document persistence in yakuza-related conflicts following the energy transition. These effects are greater in coal-rich prefectures where mining-linked yakuza groups were historically present but alternative economic rents remained available. In the 21st century, prefectures more exposed to transition-induced mining job losses exhibit substantially higher yakuza presence—more members and more groups. To understand the mechanisms, I trace short-run impacts: mining-linked groups weakened while non-mining yakuza groups expanded. A large-scale non-mining yakuza group entered coal-rich areas to contest territory. To validate that industry-specific shocks enable organizational reallocation, I exploit yakuza exclusion ordinances enacted in 2010-2012, which constrain all yakuza groups uniformly by sanctioning citizens who do business with any group. I find the transition's effects on the yakuza weakened after the enactment of the YEOs.

The findings offer three broader insights into how industry-specific economic shocks affect organized crime. First, when criminal groups embedded in legitimate sectors weaken due to industry-specific shocks, rival groups may enter affected areas if alternative rents remain available by lowering the barriers that protect incumbents' territories.

Second, the nature of an economic shock—not only its size but whether it is transitory or structural, and how heterogeneously it is distributed across local economies—shapes its long-run

impact on organized crime. The industry-specific energy transition weakened only mining-linked groups, enabling organizational reallocation as rival groups filled the vacuum. Yakuza exclusion ordinances restricted all yakuza groups uniformly through sanctions on citizens doing business with any yakuza organization (Hoshino and Kamada, 2026), preventing organizational reallocation and partially attenuating the transition's persistent effects. However, broader interventions also have limitations. While YEOs reduce traditional yakuza membership (Hoshino and Kamada, 2020), they inadvertently encourage fraud networks involving collaboration between yakuza and non-yakuza criminal groups (Hoshino and Kamada, 2026). This shift represents movement into forms of crime conducted outside traditional yakuza structures. Understanding how to prevent such substitution across the broader criminal economy—not just within organized crime groups—remains an important direction for future research.

Third, the analysis offers insights into contemporary energy transitions. Research has identified involvement of Mexican drug trafficking organizations in oil theft (Battiston et al., 2022). As economies transition away from fossil fuels, we might observe organizational reallocation among criminal groups embedded in extractive industries. Whether such transitions generate persistent changes in criminal geography likely depends on the availability of alternative criminal opportunities and the industry-specific versus uniform nature of the transition.

Despite organized crime typically thriving in contexts with weak institutions, this study documents increased yakuza activities during Japan's economic boom (mid-1950s to 1970s). While the yakuza case has distinctive features, the mechanisms identified in this study—organizational reallocation following industry-specific shocks, territorial contestation over remaining rents, and persistence through durable territorial control—may operate in other contexts where criminal groups specialize across sectors and compete for territorial dominance.

References

Acemoglu, Daron, Simon Johnson, and James A Robinson. 2001. "The Colonial Origins of Comparative Development: An Empirical Investigation." *American Economic Review* 91:1369–1401.

Acharya, Avidit, Matthew Blackwell, and Maya Sen. 2024. "Historical Persistence." *The Oxford Handbook of Historical Political Economy* p. 117.

Agency for Natural Resources and Energy. 2018. "Part 1: Energy Situation and Main Measures (Dai-ichibu: Energy wo Megutu Jokyo to Omona Taisaku)." In *Annual Report on Energy for FY2017 (Energy White Paper 2018) (Reiwa Gannendo Energy ni Kansuru Nennji Hokoku)*. Agency for Natural Resources and Energy.

Angrist, Joshua D and Adriana D Kugler. 2008. "Rural Windfall or a New Resource Curse? Coca, Income, and Civil Conflict in Colombia." *The Review of Economics and Statistics* 90:191–215.

Angrist, Joshua D and Jörn-Steffen Pischke. 2008. *Mostly harmless econometrics: An empiricist's companion*. Princeton university press.

Battiston, Giacomo, Gianmarco Daniele, Marco Le Moglie, and Paolo Pinotti. 2022. "Fueling Organized Crime: The Mexican War on Drugs and Oil Thefts." *CEPR Discussion Paper* .

Bazzi, Samuel and Christopher Blattman. 2014. "Economic Shocks and Conflict: Evidence from Commodity Prices." *American Economic Journal: Macroeconomics* 6:1–38.

Bazzi, Samuel, Andreas Ferrara, Martin Fiszbein, Thomas Pearson, and Patrick A Testa. 2023. "The Other Great Migration: Southern Whites and the New Right." *The Quarterly Journal of Economics* 138:1577–1647.

Berman, Nicolas, Mathieu Couttenier, Dominic Rohner, and Mathias Thoenig. 2017. "This Mine is Mine! How Minerals Fuel Conflicts in Africa." *American Economic Review* 107:1564–1610.

Blattman, Christopher, Gustavo Duncan, Benjamin Lessing, and Santiago Tobón. 2024. "Gang Rule: Understanding and Countering Criminal Governance." *Forthcoming at Review of Economic Studies* .

Brown, Zach Y, Eduardo Montero, Carlos Schmidt-Padilla, and Maria Micaela Sviatschi. 2021. "Market Structure and Extortion: Evidence from 50,000 Extortion Payments." *Forthcoming at Review of Economic Studies* .

Bruhn, Jesse. 2021. "Competition in the Black market: Estimating the Causal Effect of Gangs in Chicago." *Working Paper* .

Buonanno, Paolo, Ruben Durante, Giovanni Prarolo, and Paolo Vanin. 2015. "Poor Institutions, Rich Mines: Resource Curse in the Origins of the Sicilian Mafia." *Economic Journal* 125:F175–F202.

Callaway, Brantly, Andrew Goodman-Bacon, and Pedro HC Sant'Anna. 2024. "Difference-in-Differences with a Continuous Treatment." Technical report, National Bureau of Economic Research.

Castillo, Juan Camilo, Daniel Mejía, and Pascual Restrepo. 2020. "Scarcity without Leviathan: The Violent Effects of Cocaine Supply Shortages in the Mexican Drug War." *Review of Economics and Statistics* 102:269–286.

Chimeli, Ariaster B and Rodrigo R Soares. 2017. "The Use of Violence in Illegal Markets: Evidence from Mahogany Trade in the Brazilian Amazon." *American Economic Journal: Applied Economics* 9:30–57.

Conley, Timothy G. 1999. "GMM Estimation with Cross Sectional Dependence." *Journal of Econometrics* 92:1–45.

De Haro Lopez, Itzel. 2023. "Avocados: Mexico's Green Gold. The US Opioid Crisis and its Impact on Mexico's Drug Cartel Violence." *Working Paper* .

Dell, Melissa. 2015. "Trafficking Networks and the Mexican Drug War." *American Economic Review* 105:1738–1779.

Dell, Melissa, Benjamin Feigenberg, and Kensuke Teshima. 2019. "The Violent Consequences of Trade-induced Worker Displacement in Mexico." *American Economic Review: Insights* 1:43–58.

Diamond, Jared. 1997. *Germs and Steel: The Fates of Human Societies, Vintage*. W W Norton & Co Inc.

Dimico, Arcangelo, Alessia Isopi, and Ola Olsson. 2017. "Origins of the Sicilian Mafia: The Market for Lemons." *Journal of Economic History* 77:1083–1115.

Dipoppa, Gemma. 2024. "How Criminal Organizations Expand to Strong States: Local Agreements and Migrant Exploitation in Northern Italy." *Journal of Politics* .

Dube, Oeindrila, Omar García-Ponce, and Kevin Thom. 2016. "From Maize to Haze: Agricultural Shocks and the Growth of the Mexican Drug Sector." *Journal of the European Economic Association* 14:1181–1224.

Dube, Oeindrila and Juan F Vargas. 2013. "Commodity Price Shocks and Civil Conflict: Evidence from Colombia." *The Review of Economic Studies* 80:1384–1421.

Duflo, Esther and Rohini Pande. 2007. "Dams." *The Quarterly Journal of Economics* 122:601–646.

Gambetta, Diego. 1993. *The Sicilian mafia: The Business of Protection*. Harvard University Press, Cambridge, MA.

Gavrilova, Evelina, Takuma Kamada, and Floris Zoutman. 2019. "Is Legal Pot Crippling Mexican Drug Trafficking Organisations? The Effect of Medical Marijuana Laws on US Crime." *The Economic Journal* 129:375–407.

Hill, Peter BE. 2003. *The Japanese Mafia: Yakuza, Law, and the State*. Oxford University Press.

Hill, Peter BE. 2004. "The Changing Face of the Yakuza." *Global Crime* 6:97–116.

Hoshino, Tetsuya and Takuma Kamada. 2020. "Third-Party Policing Approaches against Organized Crime: an Evaluation of the Yakuza Exclusion Ordinances." *Journal of Quantitative Criminology* .

Hoshino, Tetsuya and Takuma Kamada. 2026. "Indirect Enforcement and the Transformation of Organized Crime: Evidence from the Yakuza." *Working Paper* .

Hyodo, Tsutomu. 1981. *Modern Labor Movement (Gendai no Rodo Undo)*. Tokyo: University of Tokyo Press.

Iwai, Hiroaki. 1963. *The Structure of Pathological Groups: A Study of Boss-Follower Groups (Byori Shudan no Kozo: Oyabun Kobun Shudan Kenkyu)*. Seishin Shobo.

Kamishima, Yasuhiro and Takenori Inoki. 2018. "Labor Economy in Postwar Japan: 1945-1973." In *History of the Japanese Economy, Vol. 5: Contemporary 1 - From the Sino-Japanese War to the High Growth Period (1937-1972)*, edited by Kyoji Fukao, Naofumi Nakamura, and Masaki Nakabayashi, pp. 87–115, 126–128. Iwanami Shoten.

Kitamura, Shuhei and Nils-Petter Lagerlöf. 2020. "Geography and State Fragmentation." *Journal of the European Economic Association* 18:1726–1769.

Lei, Yu-Hsiang and Guy Michaels. 2014. "Do Giant Oilfield Discoveries Fuel Internal Armed Conflicts?" *Journal of Development Economics* 110:139–157.

Lessing, Benjamin. 2021. "Conceptualizing Criminal Governance." *Perspectives on Politics* 19:854–873.

Lowes, Sara and Eduardo Montero. 2021. "The Legacy of Colonial Medicine in Central Africa." *American Economic Review* 111:1284–1314.

Melnikov, Nikita, Carlos Schmidt-Padilla, and Maria Micaela Sviatschi. 2020. "Gangs, Labor Mobility and Development." Technical report, National Bureau of Economic Research.

National Police Agency. 1978. "White Paper on Police (Keisatsu Hakusho)."

National Police Agency. 1989. "White Paper on Police (Keisatsu Hakusho)."

National Police Agency. 1996. "White Paper on Crime (Hanzai Hakusho)."

National Police Agency. 2009. "Trends in the Yakuza (Boryokudan Josei)."

National Police Agency. 2014. "Trends in the Yakuza (Boryokudan Josei)."

Nunn, Nathan. 2020. "The Historical Roots of Economic Development." *Science* 367:eaaz9986.

Olson, Mancur. 1993. "Dictatorship, Democracy, and Development." *American Political Science Review* 87:567–576.

Oster, Emily. 2019. "Unobservable Selection and Coefficient Stability: Theory and Evidence." *Journal of Business & Economic Statistics* 37:187–204.

Paolo, Buonanno and Pazzona Matteo. 2014. "Migrating Mafias." *Regional Science and Urban Economics* 44:75–81.

Sequeira, Sandra, Nathan Nunn, and Nancy Qian. 2020. "Immigrants and the Making of America." *The Review of Economic Studies* 87:382–419.

Sobrino, Fernanda. 2020. "Mexican Cartel Wars: Fighting for the U.S. Opioid Market." *Working Paper* .

Sviatschi, Maria Micaela. 2022. "Spreading Gangs: Exporting US Criminal Capital to El Salvador." *American Economic Review* 112:1985–2024.

Varese, Federico. 2001. *The Russian Mafia: Private Protection in a New Market Economy*. OUP Oxford.

Varese, Federico. 2011. *Mafias on the Move: How Organized Crime Conquers New Territories*. Princeton University Press.

Yamagishi, Atsushi and Yasuhiro Sato. 2025. "Persistent Stigma in Space: 100 Years of Japan's Invisible Race and Their Neighborhoods." *Review of Economics and Statistics* pp. 1–46.

Yamahira, Shigeki. 2018. *18 Legendary Yakuza Members (Densetsu no Yakuza 18 Nin)*. East Press.

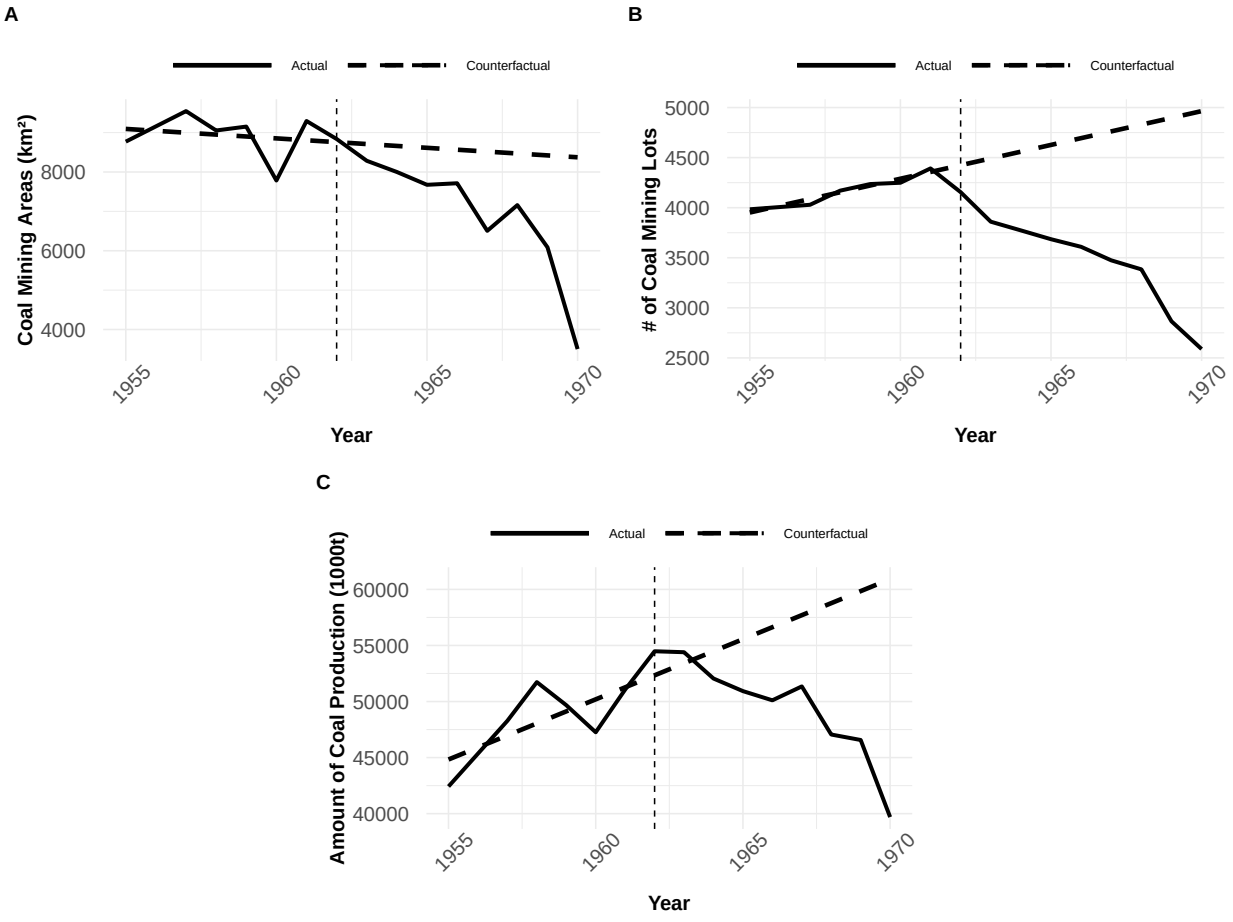
APPENDIX

A Coal Mining Measures: Trends and Regional Distribution

Overall Trends of Individual Coal Mining Measures

In the main text, I present the overall trends of the coal mining availability index. This subsection examines the specific trends for each coal mining measure: coal mining areas (Panel A), mining lots (Panel B), and coal production volume (Panel C). During the pre-transition period, an upward trend in coal production is observed, potentially due to the industry's efforts to streamline operations. However, the post-transition period exhibits a significant decline in coal production despite these earlier efforts.

Figure A1: Overall Trends of Each Coal Mining Measure



Geographic Distribution of Coal Mining Measures across Prefectures

This subsection presents the distribution of the coal mining availability index and its individual components, including coal mining areas, mining lots, and coal production volume.

Table A1: Distribution of Coal Mining Measures across Prefectures

Prefecture	Coal Mining Availability Index	Coal Mining Areas	Coal Mining Lots	Amount of Coal Production
Aichi	-0.3477806	0	0	0
Akita	-0.2215352	7005	41	79750
Aomori	-0.3393403	577	3	0
Chiba	-0.3477806	0	0	0
Ehime	-0.3377817	599	3	64
Fukui	-0.3093768	2173	13	4638
Fukuoka	3.177384	106487	641	17000000
Fukushima	0.6347933	41036	267	2446227
Gifu	-0.3431514	137	2	354
Gunma	-0.3477767	0	0	40
Hiroshima	-0.3477806	0	0	0
Hokkaido	5.147648	284664	1177	14900000
Hyogo	-0.3477806	0	0	0
Ibaraki	0.010899	11432	78	1472606
Ishikawa	-0.3427659	254	2	16
Iwate	-0.2916332	3188	18	35714
Kagawa	-0.3477806	0	0	0
Kagoshima	-0.3477806	0	0	0
Kanagawa	-0.3477806	0	0	0
Kochi	-0.3469971	51	0	0
Kumamoto	0.0183611	22706	106	259998
Kyoto	-0.3363683	720	4	0
Mie	-0.3354733	371	5	11763
Miyagi	-0.3400671	579	2	867
Miyazaki	-0.3424993	388	2	0
Nagano	-0.2880401	2413	24	21676
Nagasaki	1.526483	98832	387	5207535
Nara	-0.3420453	406	2	473
Niigata	-0.3247187	1082	9	3050
Oita	-0.3384218	666	3	0
Okayama	-0.318819	1454	10	14579
Osaka	-0.3477806	0	0	0
Saga	1.403955	105345	437	2689889
Saitama	-0.3477806	0	0	0
Shiga	-0.3477806	0	0	0
Shimane	-0.3200659	1800	9	2217
Shizuoka	-0.3477806	0	0	0
Tochigi	-0.3477628	0	0	179
Tokushima	-0.3286597	1225	6	2017
Tokyo	-0.3477806	0	0	0
Tottori	-0.3413099	414	2	275
Toyama	-0.3247399	2278	4	319
Wakayama	-0.3297983	651	7	19337
Yamagata	-0.235437	6300	33	123311
Yamaguchi	0.6642115	35350	261	3242808
Yamanashi	-0.3357835	820	4	51

B Explanation for Construction of Mining Job Losses due to Energy Transition with Bartik-type Design and Estimation Result

Explanation

To capture mining job losses due to energy transition, I exploit Bartik-type variation with crude oil import quantities over time, that interacts with time-varying coal mining availability across prefectures and time. That is, I include the interaction term of time-varying coal mining availability index $mine_{i,t}$, and crude oil import quantities over time $oil\ import_t$:

$$\mathsf{mine\,emp}_{i,r(i),t} = \beta_1 \left(\mathsf{mine}_{i,t} \times \mathsf{oil\,imports}_t\right) + \beta_2\, \mathsf{mine}_{i,t} + \mu_i + \delta_{r(i),t} + \varepsilon_{i,r(i),t} \tag{8}$$

The key component of this equation is the interaction term $\mathsf{mine}_{i,t} \times \mathsf{oil\ \ import}_t$, which captures the differential effects of oil import quantities on mining employment by the local availability of coal mining. I then construct a predicted treatment variable: $\widehat{\mathsf{predicted\ \ mine}}\ \ \mathsf{emp}_i = \frac{1}{T}\sum_{t=1}^{T} \widehat{\beta}_1\, \mathsf{mine}_{i,t} \times \mathsf{oil\ \ import}_t$. This variable represents the average predicted change in the share of mine workers for each prefecture over the study period, induced by the energy transition as proxied by changes in oil import quantities.

This approach differs slightly from the standard Bartik-type design. Typically, such designs exploit the interaction of time-invariant cross-sectional variation with time variation. However, in this case, using a time-invariant measure of coal mining availability (mine_i) would lead to a problem. Because $\widehat{\mathsf{mine\ \ workers}}_{i,t} = \widehat{\beta}_1\, \mathsf{mine}_i \times \mathsf{oil\ \ import}_t$ is the product of constant terms ($\widehat{\beta}_1$ and mine_i) and a time-varying term ($\mathsf{oil\ \ import}_t$), $\widehat{\mathsf{mine\ \ emp}}_{i,t}$ is just a constant multiple of $\mathsf{oil,\ import}_t$. Thus, when $\widehat{\mathsf{mine\ \ emp}}_{i,t}$ is averaged across time for the Bartik-style analysis, the resulting treatment variable, $\widehat{\mathsf{predicted\,ming\,emp}}_i$, would result in perfect collinearity with mine_i. To avoid this issue, I use $\mathsf{mine}_{i,t}$, which varies both across prefectures and over time.

This approach follows Bazzi et al. (2023); Sequeira et al. (2020), who construct a time-invariant cross-sectional instrumental variable by averaging out a predicted variable over time from panel data: they exploit aggregate immigration flows that change over time and time-varying railroad expansion across counties.

Estimation Result

Table A2 represents the estimation result from equation 8. The coefficient is negative and statistically significant, indicating that during this period, when crude oil import quantities were rising, coal-rich prefectures experienced a greater decrease in the share of mine workers compared to coal-scarce prefectures. From 1955 to 1970, oil import quantities increased from 9 ML to 204 ML. This indicates that a one standard deviation increase in coal mining availability leads to a decrease of approximately 0.85 mine workers per 100 total workers when oil import quantities increase by 195 ML. This translates to a 78% decrease relative to the baseline mean of the outcome in 1955 (1.0189 mine workers per 100 total workers).

Table A2: Bartik Reduced-Form Estimate

Dep.Var.:	Mine Workers
Coal Mining Availability × Oil Import Quantity	-0.0044***
	(0.0011)
Coal Mining Availability (Time-Varing)	x
Prefecture Fixed Effects	x
Division-by-Time Fixed Effects	x
R-squared	0.9874
Observations	276
Sample Years	1955, 1959, 1961, 1965, 1967 ,1970

Notes: Data on import quantity is originally measured in thousands of kiloliters (kL). For improved readability, I divided this value by 1000, converting the unit to millions of kiloliters (ML). Significance at the 1%, 5%, and 10% levels indicated by ***, **, and *, respectively. Standard errors clustered at the prefecture level.

C Balance Test

This section tests (i) covariate balance of predicted mining employment and (ii) historical presence of mining-linked yakuza groups.

I regress the predicted mining employment variable on prefecture-level characteristics, including geographic characteristics and historical demographic and economic measures from before the energy transition, conditional on geographic covariates and region fixed effects. Table A3 indicates that most covariates are not significantly associated with predicted mining employment. One exception is the coefficient on the total number of public gambling sites, which is marginally significant. Overall, these results support the exogeneity of predicted mining employment driven by the energy transition.

Table A3: Balance Test for Predicted Mining Employment

Variable	Coefficient	Standard Error	R-squared
Prop. of Male Population	-0.1141	(0.0923)	0.8446
Prop. of Korean Population	-0.1465	(0.1434)	0.8449
Prop. of Urban Population	-0.0577	(0.0873)	0.8401
Prop. of Population Aged 15-29	-0.1139	(0.0879)	0.8469
Prop. of Households on Welfare	-0.0292	(0.2257)	0.8386
Prop. of Outcaste Population	-0.1429	(0.1619)	0.8443
# of Total Gambling Sites	-0.2668*	(0.1493)	0.8818
Methamphetamine Arrest Rates	0.0226	(0.0956)	0.8385
Prop. of Construction Workers	-0.2286	(0.1544)	0.8628
Manufacturing total rate	-0.0206	(0.0150)	0.8495
Observations		46	
Geographic Covariates		x	
Division FE		x	

Notes: Significance at the 1%, 5%, and 10% levels indicated by ***, **, and *, respectively. Robust standard errors in parentheses. All covariates are measured in the pre-transition period and standardized to mean = 0 and standard deviation = 1. Each row represents a regression result of $\widehat{mine, workers}_i = \beta_0 + \beta_1 Z_i + \beta_2 X_i + \gamma_{r(i)} + \epsilon_i$, where $\widehat{mine, workers}_i$ is mining job losses due to the energy transition, Z_i is the variable of interest, X_i is geographic controls, and $\gamma_{r(i)}$ is region fixed effects.

D Substitution to Natural Gas / Oil Sectors

Upon the energy transition, oil became the primary source of energy. It is therefore possible that prefectures that relied on coal mining became those that processed oil. While crude oil is extremely rare to extract in Japan, processing oil can be done via synthetic or imported oil. If this was the case, mine workers may have transitioned into these sectors, and thus the current estimate of mining job losses would be a lower bound (i.e., more negative). To address this concern, I include an additional interaction term between the number of oil/natural gas areas and year dummies in the DiD regression. Table A4 shows the result, indicating that no substitution to the natural gas/oil sector occurred.

Table A4: Substitution to Natural Gas / Oil Sectors

Dep.Var.:	Mine Workers
Coal Mining Availability × Post	-0.5462**
	(0.214)
Natural Gas/ Petroleum × Post	0.0115
	(0.0190)
Observations	276
R-squared	0.9617

E Industry Substitution, Welfare Recipients, and Unemployment

Table A5 provides summary statistics for variables used in Appendices E and F.

Table A5: Summary Statistics for Variables Used in Appendix E and F

		Mean	Std.Dev.
Japan Statistical Yearbook	Construction Workers (1955, 1959, 1961, 1965, 1967, 1970)	4.885	2.025
Japan Statistical Yearbook	Manufacturing Workers (1955, 1959, 1961, 1965, 1967, 1970)	17.761	9.991
Japan Statistical Yearbook	Welfare Recipients (1960, 1961, 1965, 1967, 1970)	22.074	8.477
Census	Unemployment Rates (1955, 1960, 1965, 1970)	0.027	0.022
Japan Statistical Yearbook	Labor Disputes(1966-1970)	0.011	0.009
Japan Statistical Yearbook	Union Members (1956-1969)	16.802	6.500

Notes: Worker-related variables: the number of workers of interest, labor disputes, union members per 100 total workers. **Welfare recipients:** The Japan Statistical Yearbook provided by Hitotsubashi University reports welfare recipients as monthly averages for 1967 and 1970, but as annual totals for 1960, 1961, and 1965. To maintain consistency, I multiply the monthly averages by 12 for the years 1967 and 1970 to convert them to annual figures.

To rule out the possibility that the short-run effects on the yakuza reflect lower opportunity costs faced by displaced mine workers, I test whether mine workers transitioned to legitimate alternative industries or welfare programs. If workers could effectively switch to alternative sectors or access welfare benefits, joining yakuza groups may have been less necessary. To test this, I estimate the DiD and Bartik specifications with the outcomes being the share of workers in relevant low-skilled industries: (i) construction, (ii) manufacturing, (iii) infrastructure, and two additional measures: (iv) welfare recipient rates and (v) unemployment rates. For Bartik specifications, because crude oil import quantities were increasing during this period, which serves as a negative demand shifter in coal-rich areas, a negative coefficient implies a decrease in the outcome of interest.

Table A6 provides DiD (Panel A) and Bartik reduced-form (Panel B) estimates. Column (1) shows the result for mine workers; Column (2) for construction workers; Column (3) for manufacturing workers; Column (4) for welfare recipient rates; Column (5) for unemployment rates. All the results are consistent across panels. That is, mine workers decreased in the post-transition period, decreased when oil import quantities were increasing. This decrease was partially offset by increases in construction employment and welfare recipients, while manufacturing employment and unemployment rates showed minimal changes. Specifically, a one standard deviation increase in coal mining availability leads to a 0.546 decrease in mine workers per 100 total workers post-transition (a 46.7% reduction relative to the baseline mean). Simultaneously, it generates an increase of 0.263 construction workers per 100 total workers (approximately 8% above the baseline mean). Additionally, the same increase in coal mining availability results in 2.268 more welfare recipients per 100 residents (a 10% increase relative to the baseline mean). For mining workers who left the industry, approximately 60% had been employed in skilled, semi-skilled, and unskilled occupations, and rather than finding new jobs individually, they tended to be re-employed in groups with their former colleagues (Kamishima and Inoki, 2018). These findings suggest that some former mine

workers likely pursued two primary alternatives following the energy transition: employment in the construction industry or enrollment in welfare programs. As a result, joining a yakuza group was not likely necessary.

Table A6: Industry Substitution, Welfare Recipients, and Unemployment

PANEL A	(1)	(2)	(3)	(4)	(5)
Dep.Var.:	Mine Workers	Construction Workers	Manufacturing Workers	Welfare Recipients	Unemployment
Coal Mining Availability × Post	-0.5456**	0.2627***	0.1931	2.268*	-0.0168
	(0.2145)	(0.1477)	(0.3584)	(1.133)	(0.0210)
R-squared	0.9491	0.9368	0.9678	0.9678	0.9330
PANEL B	(1)	(2)	(3)	(4)	(5)
Dep.Var.:	Mine Workers	Construction Workers	Manufacturing Workers	Welfare Recipients	Unemployment
Coal Mining Availability × Oil Import Quantity	-0.0039**	0.0140**	0.0006	0.0071**	-0.0444
	(0.0016)	(0.0004)	(0.0015)	(0.0026)	(0.0362)
R-squared	0.9461	0.9349	0.9678	0.9678	0.9450
Observations	276	276	276	276	184
Sample Periods		1955, 1959, 1961, 1965, 1967, 1970		1960, 1961, 1965, 1967, 1970	1955, 1960, 1965, 1970

Notes: Notes: Data on import quantity is originally measured in thousands of kiloliters (kL). For improved readability, I divided this value by 1000, converting the unit to millions of kiloliters (ML).

F Labor Disputes and Union Members

To bolster the interpretation that the energy transition deprived mining-linked yakuza of their income sources, this section examines whether labor disputes and union members decreased in coal-rich areas. While the data does not identify whether labor disputes and union members are specific to the coal mining industry, a decrease in these outcomes specific to coal-rich prefectures should be indicative of changes of these outcomes in the coal mining industry, especially when considered in combination with other evidence, such as the substitution effect in the construction industry in Appendix E.

Table A7 shows difference-in-differences and Bartik reduced-form estimates. Note that for labor disputes, data is only available after 1966; therefore, I can only provide results based on the Bartik reduced-form estimation. For labor disputes, from 1966 to 1970, import quantities increased from 104ML to 204ML (millions of kiloliters). This indicates that a one standard deviation increase in coal mining availability leads to a decrease of approximately 0.01 labor dispute cases per 100 total workers when oil import quantities increase by 100 ML. This translates to a nearly 10% decrease relative to the baseline mean of the outcome in 1966 (0.013). Union membership indicates a decreasing trend in coal-rich areas but the coefficient is not statistically significant. A decrease in labor disputes is consistent with the premise that the energy transition deprived mining-linked yakuza of a possible income source.

Table A7: Labor Disputes and Union Members

PANEL A	(1)	(2)
Dep.Var.:	Dispute Rate	Union Membership
Coal Mining Availability × Post		-0.0514
		(0.1215)
R-squared		0.9330
PANEL B	(1)	(2)
Dep.Var.:	Dispute Rate	Union Membership
Coal Mining Availability × Oil Import Quantity	-0.0001***	-0.0003
	(0.0000)	(0.0011)
R-squared	0.6339	0.9329
Observations	276	644
Sample Period	1966-1970	1956-1969

Notes: Data on import quantity is originally measured in thousands of kiloliters (kL). For improved readability, I divided this value by 1000, converting the unit to millions of kiloliters (ML).

G Evaluating Enforcement Channel

An increased in yakuza arrests may be explained by a change in enforcement level. In fact, from 1964 to 1970, enforcement against the yakuza increased in response to the escalation of yakuza-related conflicts (Hill, 2003). To address this possibility, I conduct two sets of analyses. First, I regress enforcement measures on the treatment variable. The results suggest that the treatment variable is not correlated with those enforcement measures. Second, I include an enforcement variable as a regressor when examining yakuza-related arrests and conflicts.

First, I run the same DiD specification as before and use two outcomes: (i) the number of police officers per capita and (ii) community enforcement against the yakuza. Community enforcement can be either local government ordinances to crackdown on the yakuza or local civil-associations' effort to flight against the yakuza.

Table A8 shows the results. The coefficients in both columns are not statistically significant, indicating that enforcement likely took place irrespective of areas with varying degrees of coal mining availability.

Table A8: Enforcement Measures

	(1) # of Police Officers	(2) Community Enforcement
Coal Mining Availability × Post	-96.371	-0.0235
	(60.592)	(0.0283)
Observations	184	644
R-squared	0.783	0.818
Period	1955,1960, 1965,1970	1957-1970

Second, I explicitly account for enforcement measures in regressions of yakuza outcomes. First, for yakuza arrests and conflicts in panel-level analysis, I control for the interaction term between the number of police officers per capita measured in the pre-transition period and year fixed effects. Second, for contemporary yakuza outcomes in Bartik-style analysis, I control for the number of police officers per capita measured in the pre-transition period. However, the enforcement level in contemporary periods might differ across prefectures with varying degrees of coal mining availability. The contemporary enforcement level is a "bad control" in the sense that it is affected by the energy transition, and one should not condition on it in a regression model (Angrist and Pischke, 2008). With this caveat in mind, I examine how the results are robust to its inclusion. I measure contemporary enforcement as the number of police officers per capita between 1975-1990, as one of my outcomes, data on the number of designated yakuza syndicates, begins in 1996. Table A9 presents the results. The results are robust to the inclusion of both historical and contemporary enforcement level. For Bartik-style analysis, the size of the coefficients is almost the same with and without the contemporary enforcement level. One exception is that for yakuza members, the size of the coefficients drops by half with the inclusion of contemporary enforcement.

Table A9: Effects of the Energy Transition on Yakuza Outcomes Conditional on Enforcement Measures

Dep.Var.:	(1) Yakuza Arrest Property Crime	(2) Yakuza Arrest Violent Crime	(3) Yakuza Conflict	(4) Yamaguchi-gumi Expansion	(5) Yakuza Incarceration Total	(6) Yakuza Incarceration Total	(7) Yakuza Incarceration High-ranking	(8) Yakuza Incarceration High-ranking	(9) Yakuza Incarceration Regular	(10) Yakuza Incarceration Regular	(11) Yakuza Incarceration Unknown	(12) Yakuza Incarceration Unknown	(13) Yakuza HHI	(14) Yakuza HHI	(15) # of Designated Yakuza Syndicates	(16) # of Designated Yakuza Syndicates
Coal Mining Availability × Post	3.4332***	-0.5434	0.1040***	0.1288***												
	(0.4242)	(1.6812)	(0.0151)	(0.0302)												
Predicted Mining Employment (Energy Transition)					-0.5207***	-0.4566***	-0.2672***	-0.2396***	-0.2476***	-0.2116***	-0.0059	-0.0054	-0.1891***	-0.1817***	-1.5325***	-1.3942***
					(0.0778)	(0.0825)	(0.0330)	(0.0353)	(0.0464)	(0.0470)	(0.0295)	(0.0312)	(0.0463)	(0.0467)	(0.1997)	(0.1799)
Observations	644	644	460	230	644	644	644	644	644	644	644	644	276	276	92	92
R-squared	0.6573	0.7841	0.4218	0.7792	0.6871	0.7084	0.7185	0.7531	0.6692	0.6858	0.3795	0.3796	0.6947	0.6986	0.7893	0.8200
Historical Police per Capita	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Contemporary Police per Capita						x		x		x		x		x		x

H Non-Yakuza Arrest

This section examines whether the energy transition affected broader populations beyond the yakuza. Specifically, displaced coal miners may have faced reduced opportunity costs of crime, increasing their income-generating criminal activity.

Table A10 presents the results. Column (1) shows total arrests for property crime (i.e., theft and fraud), which include both yakuza and non-yakuza arrests. Column (2) shows yakuza arrests, and Column (3) shows non-yakuza arrests. The results indicate that the effects are entirely driven by yakuza arrests, with no statistically significant effects on** non-yakuza arrests. While the point estimate for non-yakuza arrests (13.3) is larger than for yakuza arrests (3.6), this reflects differences in baseline rates. The baseline rate for yakuza arrests is 11.6 per 100,000, while for non-yakuza arrests it is 573.8 per 100,000. Thus, a one standard deviation increase in coal mining availability increases yakuza arrests by 3.6 per 100,000, 31.4% increase relative to the baseline mean. In contrast, the non-yakuza estimate of 13.3 represents only 2.3% relative to the baseline mean and is not statistically significant.

Table A10: Placebo Exercise: Non-Yakuza Arrests for Property Crime

PANEL A	(1)	(2)	(3)
Dep.Var.:	Total Arrests	Yakuza Arrests	Non-Yakuza Arrests
		Property Crime	
Coal Mining Availability × Post	16.9668	3.6402***	13.3266
	(14.8640)	(0.4839)	(14.5016)
Baseline Mean of Dep. Var.	585.436	11.588	573.848
Observations	644	644	644
R-squared	0.8169	0.6544	0.8139

I Short-Term Effects on Yakuza: Bartik Reduced-Form Estimates

This section replicates the DiD results using the Bartik specification. Table A11 shows the Bartik reduced-form estimates for yakuza arrests for property and violent crime. Column (1) shows the baseline results. As before, because crude oil import quantities were increasing during this period, a positive coefficient implies higher yakuza activities.

Table A11: Bartik Reduced-Form Estimates: Yakuza's Engagement in Property and Violent Crime

	(1)	(2)
Dep.Var.:	Property Crime	Violent Crime
Coal Mining Availability × Oil Import Quantity	0.0273***	-0.0076
	(0.0029)	(0.0121)
Observations	644	644
R-squared	0.6476	0.7814

J Long-Term Effects by Initial Characteristics: Bartik-Style Analysis

This section examines how initial characteristics moderate the long-term effects of energy transition on contemporary yakuza outcomes. This analysis complements previous findings and helps understand underlying mechanisms for the persistent effects. I examine the same characteristics as in the heterogeneous effects analysis of yakuza conflict: (i) presence of mining-associated yakuza groups, (ii) construction workers, (iii) construction establishments, (iv) outcaste group, (v) public gambling sites, and (vi) methamphetamine arrests. All variables are dichotomized at their median into high and low categories, except for the presence of mining-associated yakuza groups (see Yakuza Arrests (Prefecture-by-Year-Level data) in Section 3). For each moderator, I estimate the energy transition's effects separately for coal-rich prefectures with high and low values, and report the p-value for the joint significance test of these coefficients.

Table A12 presents the results. Panels A-E show different contemporary outcomes, ranging from total yakuza incarceration to the number of designated yakuza syndicates. Each column represents a different moderator. Each result section contains two coefficients - for example, Column (1) shows: mining job losses due to energy transition $\times$ mining yakuza (presence) and mining job losses due to energy transition $\times$ mining yakuza (absence). The results are broadly consistent with the heterogeneous effects observed in yakuza conflict (Figure 4). The heterogeneous effects are particularly robust for three characteristics: the presence of mining-associated yakuza groups, construction workers, and construction establishments. Methamphetamine stands as a notable exception to these patterns.

Table A12: Long-Term Effects by Initial Characteristics: Bartik-Style Analysis

Z:	(1) Mining Yakuza	(2) Construction Workers	(3) Construction Establishments	(4) Outcaste Group	(5) Gambling	(6) Methamphetamine
Panel A: Total Yakuza incarceration (2006-2019)						
Predicted Mining Employment (Energy Transition) × Z High	-0.650***	-0.561***	-0.579***	-0.551***	-0.474***	-0.086
	(0.185)	(0.087)	(0.094)	(0.124)	(0.124)	(0.244)
Predicted Mining Employment (Energy Transition) × Z Low	0.144**	0.068	-0.006	-0.424**	-0.589**	-0.481***
	(0.057)	(0.206)	(0.302)	(0.196)	(0.283)	(0.086)
P-value of Joint Significance Test:	0.0001	0.0031	0.0679	0.5882	0.7238	0.0862
Observations	644	644	644	644	644	644
Panel B: High-ranking Yakuza Incarceration (2006-2019)						
Predicted Mining Employment (Energy Transition) × Z High	-0.365***	-0.267***	-0.287***	-0.311***	-0.266***	-0.055
	(0.066)	(0.024)	(0.023)	(0.037)	(0.036)	(0.083)
Predicted Mining Employment (Energy Transition) × Z Low	-0.003	-0.015	-0.006	-0.159***	-0.177**	-0.253***
	(0.021)	(0.064)	(0.091)	(0.057)	(0.076)	(0.021)
P-value of Joint Significance Test:	0.0000	0.0002	0.0027	0.0212	0.3024	0.0147
Observations	644	644	644	644	644	644
Panel C: Regular Yakuza Member Incarceration (2006-2019)						
Predicted Mining Employment (Energy Transition) × Z High	-0.239**	-0.278***	-0.268***	-0.244***	-0.172***	-0.076
	(0.093)	(0.057)	(0.054)	(0.071)	(0.063)	(0.150)
Predicted Mining Employment (Energy Transition) × Z Low	0.112***	0.041	-0.076	-0.241**	-0.441***	-0.222***
	(0.038)	(0.118)	(0.188)	(0.116)	(0.157)	(0.052)
P-value of Joint Significance Test:	0.0002	0.0096	0.3228	0.9804	0.1372	0.3095
Observations	644	644	644	644	644	644
Panel D: Unknown Rank Yakuza Incarceration (2006-2019)						
Predicted Mining Employment (Energy Transition) × Z High	-0.045	-0.017	-0.024	0.004	-0.037	0.046
	(0.061)	(0.030)	(0.040)	(0.036)	(0.044)	(0.074)
Predicted Mining Employment (Energy Transition) × Z Low	0.034**	0.042	0.076	-0.024	0.029	-0.007
	(0.016)	(0.057)	(0.065)	(0.056)	(0.080)	(0.034)
P-value of Joint Significance Test:	0.1812	0.1929	0.0890	0.5829	0.5172	0.3513
Observations	644	644	644	644	644	644
Panel E: Yakuza HHI (2008-2013)						
Predicted Mining Employment (Energy Transition) × Z High	-0.283***	-0.236***	-0.184***	-0.242***	-0.158**	-0.315***
	(0.086)	(0.046)	(0.056)	(0.064)	(0.064)	(0.104)
Predicted Mining Employment (Energy Transition) × Z Low	-0.041**	-0.223***	-0.380***	-0.208***	-0.313***	-0.178***
	(0.019)	(0.078)	(0.115)	(0.054)	(0.102)	(0.048)
P-value of Joint Significance Test:	0.0037	0.8333	0.0561	0.6172	0.2048	0.1000
Observations	276	276	276	276	276	276
Panel F: # of Designated Yakuza Syndicates (1996,2008)						
Predicted Mining Employment (Energy Transition) × Z High	-2.178***	-1.578***	-1.474***	-1.876***	-1.342***	-1.561***
	(0.361)	(0.226)	(0.241)	(0.277)	(0.299)	(0.518)
Predicted Mining Employment (Energy Transition) × Z Low	-0.291**	-1.465***	-2.002***	-1.406***	-1.551***	-1.474***
	(0.116)	(0.425)	(0.514)	(0.277)	(0.482)	(0.192)
P-value of Joint Significance Test:	0.0000	0.7787	0.2866	0.1309	0.7380	0.8431
Observations	92	92	92	92	92	92
Geographic Controls	x	x	x	x	x	x
Division-time FE	x	x	x	x	x	x
Z	x	x	x	x	x	x

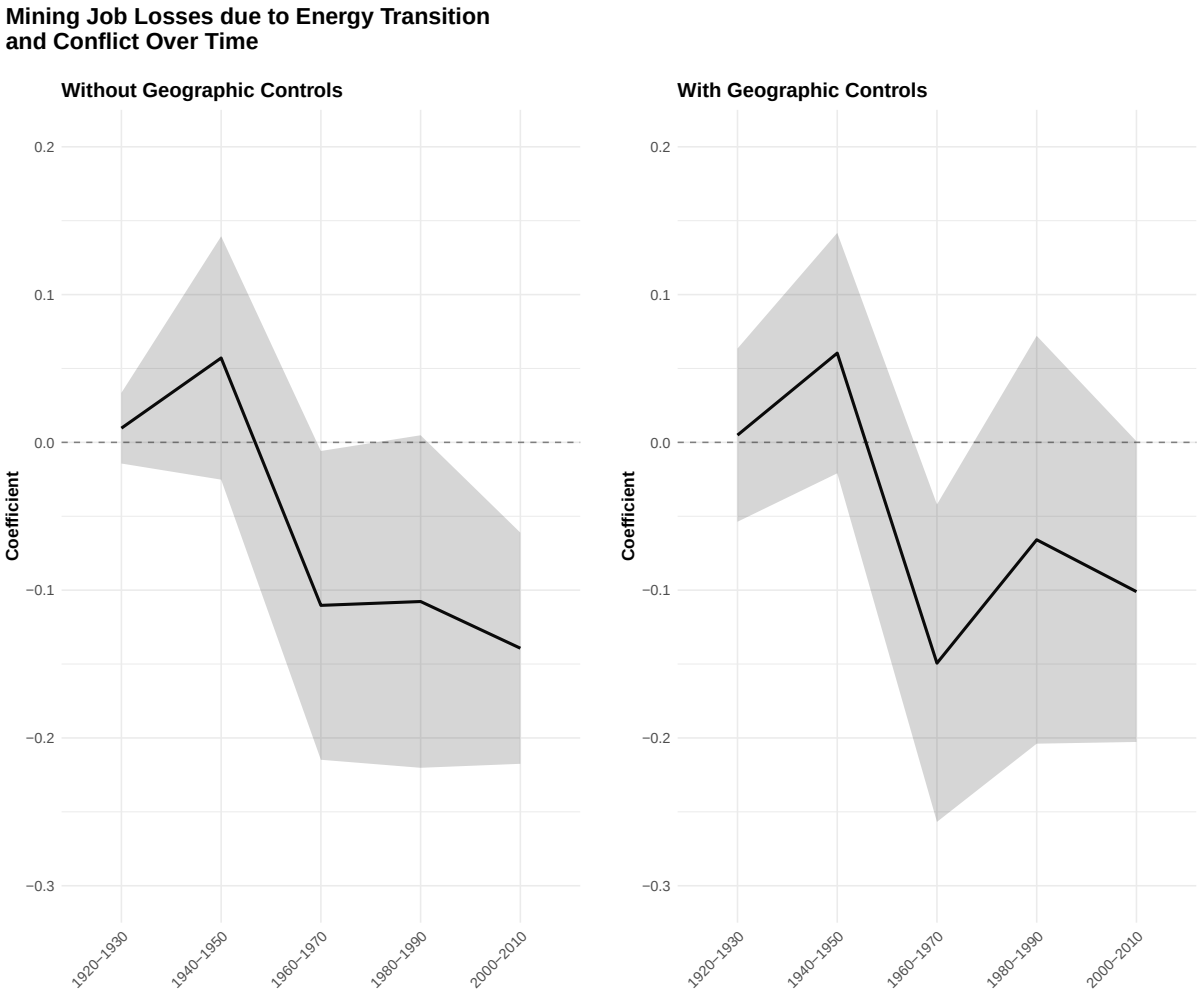
K Long-Term Effects on Yakuza Conflict: Alternative Approach using Variable on Mining Job Losses due to Energy Transition

This section explores the long-term effects on yakuza conflict using an alternative approach. The extended timespan of conflict data presents two challenges: (i) conducting Bartik analysis is problematic due to oil shocks in the 1970s. This complicates the interpretation of estimated coefficients when using oil import data over a longer period. (ii) The parallel trends assumption may not hold over an extended timeframe.

To address these issues, I supplement the main event-study analysis with a predicted treatment variable. This variable captures mining job losses resulting from the energy transition, using oil import quantities from 1955 to 1970 (see Section 3.2). Using this variable, I estimate the effects of mining job losses on yakuza conflict separately for five two-decade periods: 1920-1930, 1940-1950, 1960-1970, 1980-1990, and 2000-2010. I include region-by-time fixed effects and estimate the model both with and without geographic controls.

Note that since lower values of the variable indicate greater job losses, a negative coefficient indicates a higher likelihood of yakuza conflict. The findings generally support the main event study results. From the 1920s to the 1950s, the coefficients are small and sometimes in the opposite direction. However, from the 1960s onward, the coefficients become negative (indicating a higher likelihood of yakuza conflict) and larger in magnitude. When geographic controls are included, the estimates become less precise but maintain the overall trend.

Figure A2: Estimates using Variable on Predicted Mining Employment (Energy Transition)



L Robustness to Alternative Estimator

In the main text, throughout the analyses, I use weighted least squares (WLS) with population in the 1960 census year as weights. I use ordinary least squares (OLS) as an alternative estimator in this section. Figure A3 (for panel-level analysis) and Table A13 (for Bartik-style analysis) provide the results, indicating that they are not sensitive to this alternative estimator.

Figure A3: Alternative Estimator: OLS

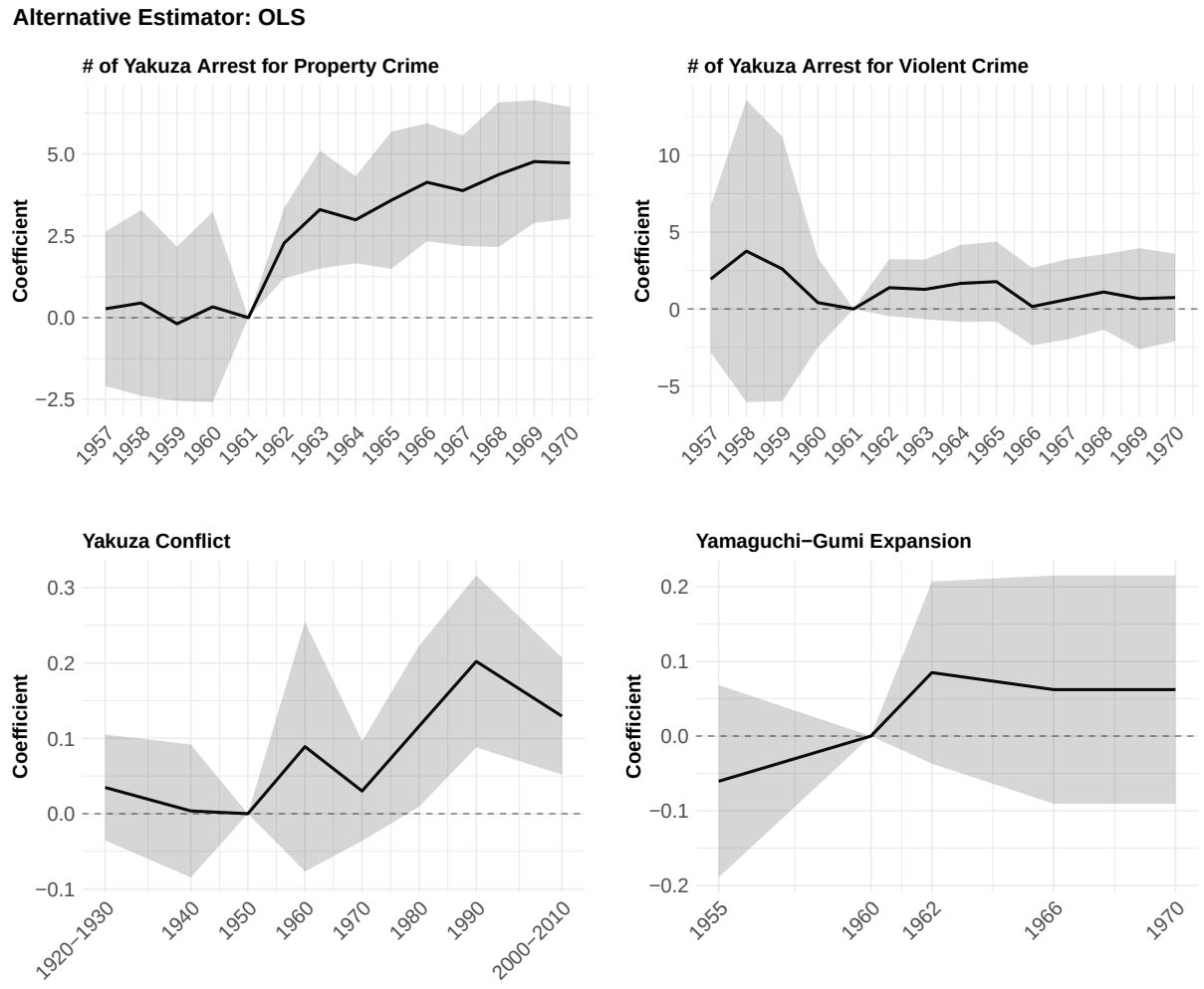


Table A13: Alternative Estimator: OLS

Dep.Var.:	Yakuza Incarceration				Yakuza Syndicates	
	Total	High-ranking	Regular	Unknown	HHI	# of Designated
Predicted Mining Employment (Energy Transition)	-0.4829***	-0.2350***	-0.2518***	0.0039	-0.2060***	-1.5344***
	(0.1051)	(0.0509)	(0.0563)	(0.0395)	(0.0527)	(0.1991)
Observations	644	644	644	644	92	276

M Robustness to Alternative Measures of Coal Mining Availability

This section examines robustness to alternative measurements of coal mining availability. Up to this point, I have used a composite index of cross-sectional variation in coal mining availability, which comprises three measurements: (i) coal mining areas, (ii) the number of coal mining lots, and (iii) the production of coal in the pre-transition period. I use this composite index because (i) these three measures are highly correlated with one another ($\rho \approx 0.9$) and (ii) the composite index can mitigate some measurement error. Figure A4 (for panel-level analysis) and Table A14 (for Bartik-style analysis) examine each of these measures separately to show that the observed results are not driven by a specific component of the index. For the Bartik-style analysis, the variable representing coal mining job losses due to the energy transition is constructed using each of these measures individually.

Figure A4: Alternative Measures of Coal Mining Availability

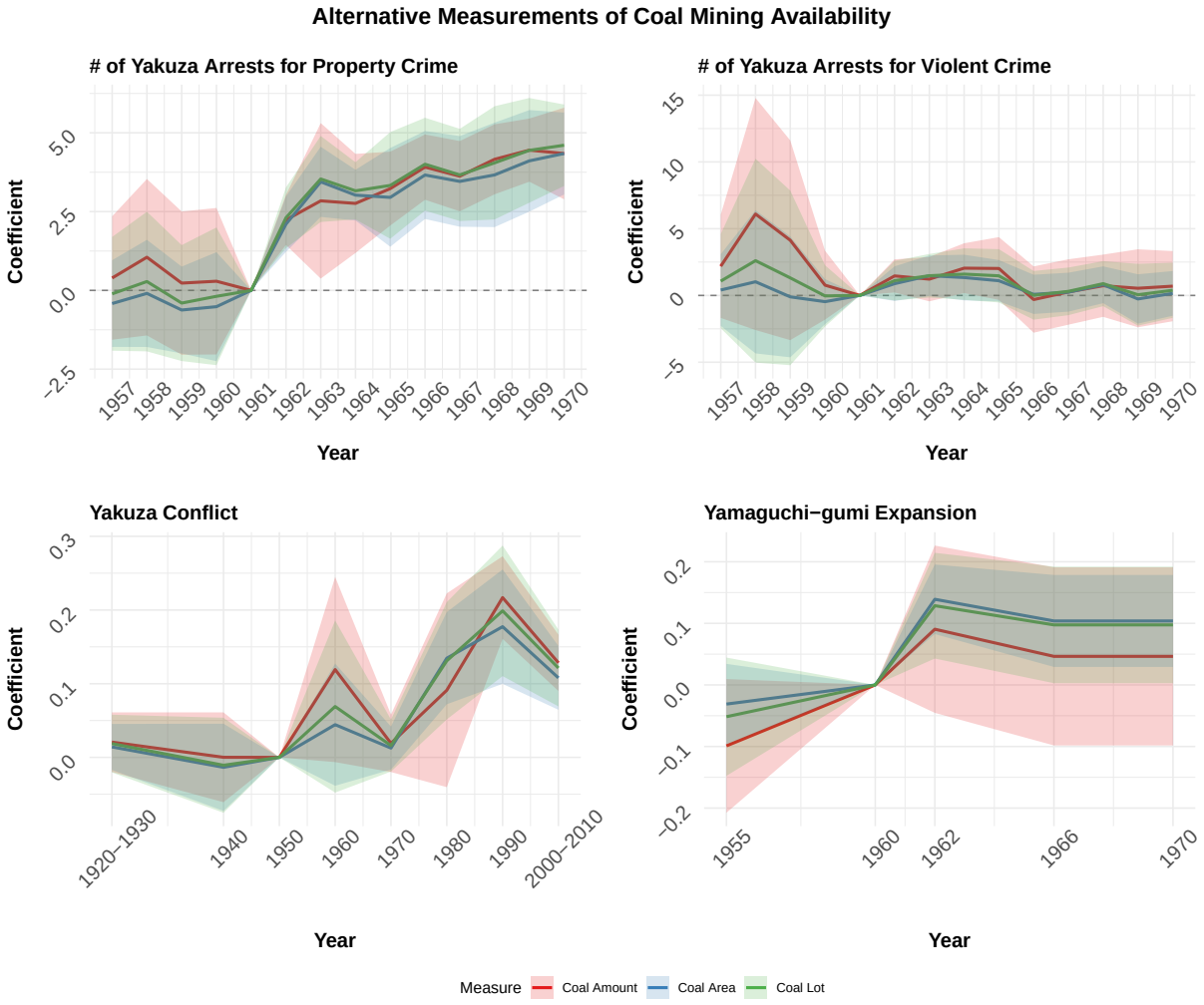


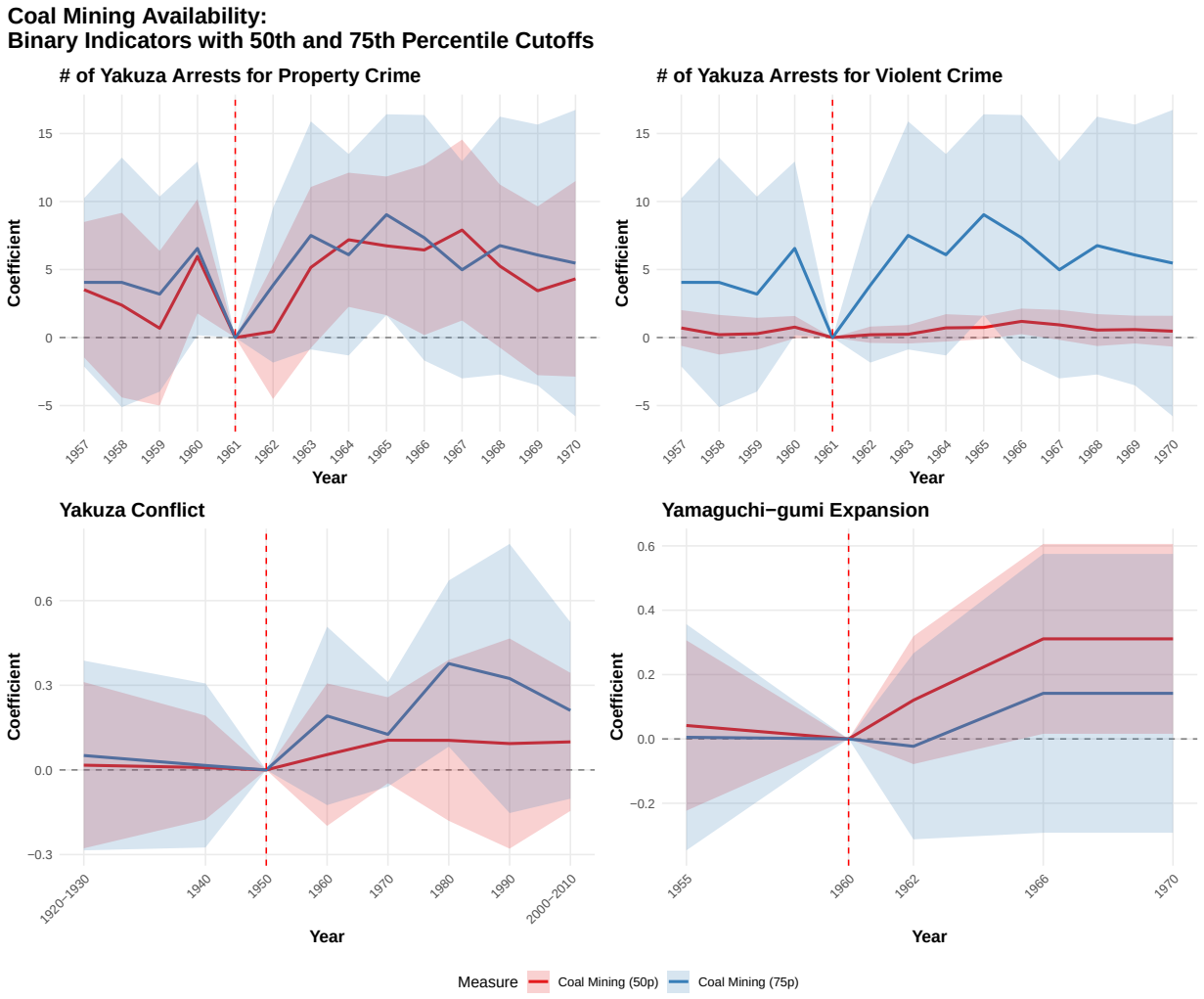
Table A14: Alternative Measures of Coal Mining Availability

Dep.Var.:	Yakuza Incarceration				Yakuza Syndicae	
	Total	High-ranking	Regular	Unknown	# of Designated	HHI
PANEL A						
Predicted Mining Employment (Energy Transition)	-0.4731***	-0.2171***	-0.2575***	0.0015	-1.5121***	-0.2039***
(Constructed with Coal Lot)	(0.1038)	(0.0565)	(0.0500)	(0.0413)	(0.2150)	(0.0515)
PANEL B						
Predicted Mining Employment (Energy Transition)	-0.5561***	-0.2403***	-0.3095***	-0.0063	-1.9598***	-0.2569***
(Constructed with Coal Area)	(0.1948)	(0.0876)	(0.0988)	(0.0556)	(0.3556)	(0.0742)
PANEL C						
Predicted Mining Employment (Energy Transition)	-0.3561***	-0.1950***	-0.1700***	0.0089	-1.1158***	-0.1423***
(Constructed with Coal Amount)	(0.0820)	(0.0260)	(0.0484)	(0.0263)	(0.1866)	(0.0425)
Observations	644	644	644	644	92	276

N Robustness to Binary Indicators of Coal Mining Availability

This section examines the robustness of the main results using binary indicators of coal mining availability. These indicators are created using 50th and 75th percentile cutoffs of the coal mining availability index.

Figure A5: Binary Indicators of Coal Mining Availability



O Robustness to Observed Covariates

This section examines robustness to the inclusion of other covariates. In the main text, I focus on a parsimonious specification with prefecture fixed effects and region-by-time fixed effects for panel-level analysis, and geographic controls and region fixed effects for Bartik-style analysis. For the latter, this practice is partly justified by a balance test where the constructed treatment variable is not correlated with pre-transition demographic and economic covariates.

In addition to the inclusion of enforcement measurements, this section examines the inclusion of two other types of covariates: (i) population compositions and (ii) economic conditions. For Bartik-style analysis, I also include contemporary covariates. As noted before, the caveat of this approach is the presence of bad controls (Angrist and Pischke, 2008).

Table A15: Robustness to Historical Covariates × Year FE in Panel-Level Analysis

	Male Pop	Korean Pop	Urban Pop	Pop 15-29	Welfare	Outcaste Pop	Gambling
Panel A: Property Crime							
Coal Mining Availability × Post	3.4156***	3.1522***	3.2407***	3.3210***	3.4878***	2.3733***	2.3007***
	(0.4661)	(0.5436)	(0.4878)	(0.5688)	(0.3889)	(0.8392)	(0.7157)
Panel B: Violent Crime							
Coal Mining Availability × Post	-0.5002	-0.9359	-0.5400	-0.3619	-0.2187	-1.5239	-1.6045
	(1.6667)	(1.8530)	(1.6895)	(1.4559)	(1.4015)	(2.0417)	(1.9115)
Panel C: Yamaguchi-gumi Expansion							
Coal Mining Availability × Post	0.1287***	0.1383***	0.1289***	0.1262***	0.1198***	0.1482***	0.1701***
	(0.0300)	(0.0293)	(0.0307)	(0.0332)	(0.0362)	(0.0399)	(0.0378)
Panel D: Conflict							
Coal Mining Availability × Post	0.1180***	0.1044***	0.1058***	0.1071***	0.1049***	0.1038***	0.1130***
	(0.0163)	(0.0157)	(0.0158)	(0.0166)	(0.0155)	(0.0148)	(0.0186)

Table A16: Robustness to Past Covariates in Bartik-style Analysis

	Male Pop	Korean Pop	Urban Pop	Pop 15-29	Welfare	Outcaste Pop	Gambling
Panel A: Total Yakuza Incarceration							
Predicted Mining Employment (Energy Transition)	-0.4714***	-0.5004***	-0.4373***	-0.4143***	-0.4921***	-0.5420***	-0.3768***
	(0.0912)	(0.0910)	(0.0887)	(0.1056)	(0.0757)	(0.0846)	(0.1333)
Panel B: High-ranking Yakuza Incarceration							
Predicted Mining Employment (Energy Transition)	-0.2407***	-0.2659***	-0.2350***	-0.2272***	-0.2500***	-0.2633***	-0.1948***
	(0.0379)	(0.0351)	(0.0330)	(0.0368)	(0.0199)	(0.0329)	(0.0416)
Panel C: Regular Yakuza Member Incarceration							
Predicted Mining Employment (Energy Transition)	-0.2148***	-0.2396***	-0.1965***	-0.1870***	-0.2377***	-0.2645***	-0.1491**
	(0.0516)	(0.0496)	(0.0502)	(0.0616)	(0.0494)	(0.0491)	(0.0621)
Panel D: Unknown Rank Yakuza Incarceration							
Predicted Mining Employment (Energy Transition)	-0.0159	0.0051	-0.0057	0.0000	-0.0044	-0.0142	-0.0329
	(0.0324)	(0.0282)	(0.0340)	(0.0325)	(0.0299)	(0.0312)	(0.0443)
Panel E: Yakuza HHI							
Predicted Mining Employment (Energy Transition)	-0.1801***	-0.1897***	-0.1767***	-0.1859***	-0.1906***	-0.2309***	-0.1867***
	(0.0470)	(0.0473)	(0.0496)	(0.0493)	(0.0444)	(0.0445)	(0.0566)
Panel F: # of Designated Yakuza Syndicates							
Predicted Mining Employment (Energy Transition)	-1.3506***	-1.5584***	-1.3876***	-1.4721***	-1.5314***	-1.7452***	-1.2997***
	(0.1755)	(0.1987)	(0.1854)	(0.2125)	(0.1892)	(0.2285)	(0.2668)

Table A17: Robustness to Contemporary Covariates in Bartik-Style Analysis

	Welfare	Unemployment	Divorce Rates	HS Graduates	Population
Panel A: Total Yakuza Incarceration					
Predicted Mining Employment (Energy Transition)	-0.3853***	-0.4778***	-0.4585***	-0.4511***	-0.4512***
	(0.1251)	(0.0969)	(0.0952)	(0.1315)	(0.0889)
Panel B: High-ranking Yakuza Incarceration					
Predicted Mining Employment (Energy Transition)	-0.1899***	-0.2200***	-0.2237***	-0.2547***	-0.2298***
	(0.0275)	(0.0288)	(0.0328)	(0.0455)	(0.0327)
Panel C: Regular Yakuza Incarceration					
Predicted Mining Employment (Energy Transition)	-0.1945**	-0.2272***	-0.2196***	-0.1970**	-0.2034***
	(0.0778)	(0.0583)	(0.0559)	(0.0751)	(0.0481)
Panel D: Unknown Rank Yakuza Incarceration					
Predicted Mining Employment (Energy Transition)	-0.0009	-0.0307	-0.0152	0.0006	-0.0179
	(0.0398)	(0.0366)	(0.0347)	(0.0414)	(0.0351)
Panel E: Yakuza HHI					
Predicted Mining Employment (Energy Transition)	-0.1914***	-0.1986***	-0.1957***	-0.1686**	-0.1724***
	(0.0528)	(0.0493)	(0.0502)	(0.0729)	(0.0491)
Panel F: # of Designated Yakuza Syndicates					
Predicted Mining Employment (Energy Transition)	-1.3787***	-1.3884***	-1.3706***	-1.3737***	-1.2975***
	(0.2156)	(0.2116)	(0.2184)	(0.3091)	(0.1712)

P Robustness to Selection on Unobservables for Bartik-Style Analysis

The panel-level analysis addresses endogeneity concerns through Difference-in-Differences (DiD), event-study, and Bartik designs. For the Bartik-style analysis, I attempt to mitigate these concerns by constructing a predicted treatment variable that leverages Bartik variation. This predicted treatment variable shows minimal correlation with observed covariates measured in the pre-transition period, enhancing the validity of the research design. However, some readers might still harbor concerns about unobserved confounders. To address this issue, I employ Oster's (2019) coefficient stability approach. This method estimates the relative selection on unobservables, denoted as δ, which is a function of: (i) the estimate from regressing the outcome on the treatment variable alone, (ii) the estimate from regressing the outcome on both the treatment variable and observables, and (iii) the estimate from regressing the treatment variable on observables (i.e., selection on observables) The method compares the potential explanatory power of a theoretical model that includes unobservable factors (R^2_{max}) to the explanatory power of the most comprehensive model using only observable variables ($\bar{R}^2$). Specifically, it considers the ratio of R^2_{max} (which represents the unknown model fit if we could include all unobservable factors) to $\bar{R}^2$ (the R-squared from a fully specified regression using all available observable variables). The resulting δ value indicates how strong the influence of unobservables would need to be to nullify the observed treatment effect. The results indicate that unobservable factors would need to be approximately 3 to 14 times larger than the observable factors to drive away the observed effects. This holds true for most outcomes, with two exceptions: incarceration rates for unknown members, which consistently show a null effect, and incarceration rates for top-level members, which indicate negative values.

Panel-level analysis deals with endogeneity concerns via DiD, event-study, and Bartik designs. For Bartik-style analysis, I attempt to deal with them by constructing a predicted treatment variable that exploits Bartik variation; this predicted treatment variable is hardly correlated with observed covariates measured in the pre-transition period. This increases the validity of this research design, yet some readers might still be concerned about unobserved confounders.

Table A18: Oster's Coefficient Stability

Dep.Var.:	Yakuza Incarceration				Yakuza Syndicate	
	Total	High-ranking	Regular	Unknown	# of Designated	HHI
δ with $R^2_{max} = 1.3 \times \bar{R}^2$	14.31619	-3.90401	2.75528	-0.22502	3.56810	2.73841

Q Robustness to an Excluded Region

This section examines the robustness of the main results to the exclusion of a specific region in Japan, where the country is divided into 7 region. I analyze the outcome variables used in the main results for each section using prefecture-level data. I run a variant of the leave-one-out analysis, where I perform the main DiD regression while excluding one region at a time. Table A19 indicates that the results for each outcome are robust to the exclusion of any specific region. This provides suggestive evidence that the results are not sensitive to outliers.

Table A19: Robustness to an Excluded Region

Excluded Region:	Hokkaido-Tohoku	Kanto	Tokai	Kinki	Chugoku	Shikoku	Kyushu
Dep.Var.:				Property Crime			
Coal Mining Availability × Post	2.3089**	3.4760***	3.4265***	3.4279***	3.3924***	3.4285***	3.7903***
	(0.9811)	(0.4114)	(0.4168)	(0.4165)	(0.4257)	(0.4144)	(0.1985)
Observations	546	490	560	560	574	588	546
Dep.Var.:				Violent Crime			
Coal Mining Availability × Post	-6.4635***	-0.3586	-0.5060	-0.5017	-0.5826	-0.5014	1.3722***
	(2.1320)	(1.6418)	(1.6570)	(1.6560)	(1.6872)	(1.6479)	(0.4240)
Observations	546	490	560	560	574	588	546
Dep.Var.:				Conflict			
Coal Mining Availability × Post	0.1382***	0.1043***	0.1041***	0.1041***	0.1045***	0.1040***	0.092***
	(0.0293)	(0.0155)	(0.0152)	(0.0152)	(0.0154)	(0.0152)	(0.0115)
Observations	390	350	400	400	410	420	390
Dep.Var.:				Yamaguchi-gumi Expansion			
Coal Mining Availability × Post	-0.0004	0.1309***	0.1285***	0.1286***	0.1352***	0.1287***	0.1599***
	(0.0848)	(0.0298)	(0.0301)	(0.0301)	(0.0277)	(0.0299)	(0.0174)
Observations	195	175	200	200	205	210	195
Dep.Var.:				Total Yakuza Incarceration			
Predicted Mining Employment (Energy Transition)	-0.4033***	-0.5305***	-0.5129***	-0.5725***	-0.5175***	-0.5154***	-0.9375***
	(0.1469)	(0.0745)	(0.0810)	(0.0746)	(0.0812)	(0.0762)	(0.2791)
Observations	546	490	560	560	574	588	546
Dep.Var.:				High-ranking Yakuza Incarceration			
Predicted Mining Employment (Energy Transition)	-0.2873***	-0.2615***	-0.2635***	-0.2818***	-0.2653***	-0.2664***	-0.3028***
	(0.0499)	(0.0347)	(0.0318)	(0.0344)	(0.0350)	(0.0331)	(0.0954)
Observations	546	490	560	560	574	588	546
Dep.Var.:				Regular Yakuza Member Incarceration			
Predicted Mining Employment (Energy Transition)	-0.1585*	-0.2550***	-0.2395***	-0.3034***	-0.2447***	-0.2429***	-0.4299**
	(0.0789)	(0.0401)	(0.0504)	(0.0457)	(0.0460)	(0.0440)	(0.1807)
Observations	546	490	560	560	574	588	546
Dep.Var.:				Unknown Rank Yakuza Incarceration			
Predicted Mining Employment (Energy Transition)	0.0425	-0.0140	-0.0098	0.0126	-0.0075	-0.0061	-0.2048*
	(0.0418)	(0.0353)	(0.0270)	(0.0189)	(0.0304)	(0.0287)	(0.1013)
Observations	546	490	560	560	574	588	546
Dep.Var.:				Yakuza HHI			
Predicted Mining Employment (Energy Transition)	-0.1967**	-0.1975***	-0.1837***	-0.1878***	-0.1880***	-0.1845***	-0.2401**
	(0.0746)	(0.0533)	(0.0404)	(0.0417)	(0.0470)	(0.0457)	(0.1023)
Observations	234	210	240	240	246	252	234
Dep.Var.:				# of Designated Yakuza Syndicates			
Predicted Mining Employment (Energy Transition)	-1.5847***	-1.5183***	-1.4682***	-1.5546***	-1.5458***	-1.5210***	-1.9296**
	(0.3233)	(0.2104)	(0.1691)	(0.2091)	(0.2080)	(0.2012)	(0.7404)
Observations	78	70	80	80	82	84	78

R Robustness to Alternative Sample

This section examines robustness to an alternative sample. I exclude prefectures without any coal mining availability; thus, it forces me to exploit purely the intensive margin of coal mining availability across prefectures. Table A20 presents the results, which are generally consistent except for total incarceration rates and those for regular members.

Table A20: Alternative Sample

	Property Crime	Violent Crime	Yakuza Conflict	Yamaguchi-gumi Expansion	Incarceration				Yakuza Syndicate	
					Total	High-ranking	Regular	Unknown	HHI	# of Designated
Coal Mining Availability × Post	3.4921***	0.5447	0.0887***	0.1315***						
	(0.2462)	(0.9706)	(0.0109)	(0.0361)						
Predicted Mining Employment (Energy Transition)					-0.4154	-0.2869***	-0.1703	0.0418	-0.1093**	-1.1868***
					(0.2781)	(0.0978)	(0.1343)	(0.0563)	(0.0445)	(0.3342)
Observations	406	406	290	145	406	406	406	406	174	58
R-squared	0.7787	0.7891	0.4900	0.7785	0.7377	0.7573	0.7179	0.4437	0.8337	0.8851

S Additional Results and Robustness Checks: Municipal-Level Analysis

This section presents additional empirical results for municipal-level analysis. While the main text focuses on business establishments near mining municipalities, Table A21 shows employment rates in these areas, indicating increases in construction, restaurants/bars, and real estate sectors. These findings provide further evidence of growth in industries commonly associated with yakuza involvement.

Table A21: Effect of Distance to Historical Coal Mining Establishments on Employment Rates in Other Industries

Dep.Var.:	(1)	(2)	(3)	(4)
	Employment Rates			
	Construction	Restaurants/Bars	Real Estate	Infrastructure
log of Distance to a Coal Mining Establishment × 1971	-2.3283	-2.5205	-0.0811	0.0554
	(1.4177)	(4.0216)	(0.2669)	(0.0938)
log of Distance to a Coal Mining Establishment × 1981	-2.4444*	-4.1889	-0.3887	0.0088
	(1.3364)	(4.0845)	(0.2559)	(0.0746)
log of Distance to a Coal Mining Establishment × 1991	-2.6585**	-16.7004**	-0.6970**	0.0113
	(1.3403)	(8.3146)	(0.3313)	(0.0738)
log of Distance to a Coal Mining Establishment × 2001	-2.5171**	-14.9805**	-0.4856	-0.0176
	(1.2598)	(7.4943)	(0.3110)	(0.0742)
log of Distance to a Coal Mining Establishment × 2012	-2.5473**	-4.2815	-1.3070**	-0.0581
	(1.2487)	(4.3734)	(0.5884)	(0.0875)
# of Coal Mining Establishments × 1971	0.0186	0.1342	-0.0159	0.0074
	(0.0685)	(0.1884)	(0.0292)	(0.0054)
# of Coal Mining Establishments × 1981	-0.0184	-0.0537	0.0013	-0.0020
	(0.0652)	(0.1909)	(0.0179)	(0.0075)
# of Coal Mining Establishments × 1991	-0.0663	-0.3519	0.0053	0.0013
	(0.0649)	(0.2970)	(0.0179)	(0.0060)
# of Coal Mining Establishments × 2001	-0.0777	-0.4104	0.0049	-0.0063
	(0.0719)	(0.2784)	(0.0173)	(0.0058)
# of Coal Mining Establishments × 2012	-0.0468	0.1477	-0.0320	-0.0016
	(0.0628)	(0.1943)	(0.0248)	(0.0056)
Observations	360	360	360	360
R-squared	0.0474	0.0616	0.0436	0.0074

Tables A22, A23, A24 examine the robustness of the municipal-level analysis results. For yakuza offices, I also examine the robustness using alternative measures from Yakuza Wiki. The robustness checks include:(1) Alternative Conley standard errors with a 15km cutoff, (2) Alternative Conley standard errors with a 50km cutoff, (3) Analysis without geographic covariates, (4) Weighted Least Squares (WLS) with contemporary population, (5) Ordinary Least Squares (OLS), (6) Clustered standard errors, (7) Poisson-pseudo maximum likelihood (PPML) estimator for count outcomes and logit for binary outcomes, and (8) A binary measure for the distance variable, equaling one if the distance is below the median.

For the clustered standard errors (6), each municipality was assigned the identifier of the nearest coal mining establishment, with clustering by that ID. However, this approach resulted in only

22 clusters, so these results should be interpreted cautiously. Generally, the results from these robustness checks are consistent with the main findings, although some effects did not survive across all specifications.

Table A22: Robustness Checks: Effect of Distance to Historical Coal Mining Establishments on Yakuza Offices

PANEL A	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Yakuza Office (Yakuza Office Street View Search)							
	Extensive Margin							
log of Distance to a Coal Mining Establishment	-0.5142***	-0.5142***	-0.5392***	-0.5648***	-0.2609**	-0.5142**	-3.7139**	
	(0.1527)	(0.1137)	(0.1728)	(0.1311)	(0.1160)	(0.2341)	(1.7886)	
# of Coal Mining Establishments	-0.0161	-0.0161**	-0.0298**	-0.0194*	0.0002	-0.0161	-0.1457	-0.0146
	(0.0112)	(0.0072)	(0.0146)	(0.0104)	(0.0060)	(0.0117)	(0.0903)	(0.0091)
Distance (Below Median)								0.5610***
								(0.1044)
Observations	72	72	72	72	72	1,224	62	72
R-squared	0.2485	0.2485	0.1885	0.2212	0.1034	0.3475		0.2966
PANEL B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Yakuza Office (Yakuza Office Street View Search)							
	Intensive Margin							
log of Distance to a Coal Mining Establishment	-1.5417***	-1.5417***	-1.2567*	-1.7028***	-0.7085**	-1.5417*	-1.2618***	
	(0.5262)	(0.3377)	(0.7628)	(0.4434)	(0.2847)	(0.8505)	(0.3945)	
# of Coal Mining Establishments	-0.0604*	-0.0604**	-0.0848*	-0.0890**	-0.0263*	-0.0604**	-0.2290***	-0.0539*
	(0.0358)	(0.0237)	(0.0488)	(0.0450)	(0.0152)	(0.0282)	(0.0715)	(0.0314)
Distance (Below Median)								1.0930***
								(0.2973)
Observations	72	72	72	72	72	1,224	62	72
R-squared	0.1672	0.1672	0.1088	0.1625	0.0778	0.3256		0.1287
PANEL C	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Yakuza Office (Yakuza Wiki)							
	Extensive Margin							
log of Distance to a Coal Mining Establishment	-0.3332**	-0.3332***	-0.2914**	-0.3563**	-0.1527	-0.3332**	-1.7314*	
	(0.1442)	(0.1182)	(0.1208)	(0.1421)	(0.1560)	(0.1516)	(0.9353)	
# of Coal Mining Establishments	-0.0035	-0.0035	-0.0033	0.0020	0.0036	-0.0035	-0.0165	-0.0023
	(0.0259)	(0.0129)	(0.0151)	(0.0147)	(0.0139)	(0.0187)	(0.1343)	(0.0149)
Distance (Below Median)								0.3045*
								(0.1650)
Observations	72	72	72	72	72	1,224	72	72
R-squared	0.0505	0.0505	0.0462	0.0634	0.0197	0.0924		0.0507
PANEL D	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Yakuza Office (Yakuza Wiki)							
	Intensive Margin							
log of Distance to a Coal Mining Establishment	-2.6999	-2.6999***	-1.5330	-3.3253***	-1.5490**	-2.6999	-0.7092*	
	(1.7334)	(0.9593)	(2.6510)	(1.2660)	(0.6319)	(2.7886)	(0.3749)	
# of Coal Mining Establishments	0.0121	0.0121	-0.0125	-0.0519	0.0609	0.0121	-0.0048	0.0228
	(0.2063)	(0.1161)	(0.1844)	(0.2065)	(0.1076)	(0.1025)	(0.0433)	(0.1537)
Distance (Below Median)								2.1583*
								(1.1086)
Observations	72	72	72	72	72	1,224	72	72
R-squared	0.0551	0.0551	0.0109	0.0589	0.0525	0.2359		0.0489
Robustness to:	Conley 15km	Conley 50km	No Covariate	WLS with pop 2005	OLS	Clustered at Mining	PPML/logit	Binary Distance

Table A23: Robustness Checks: Effect of Distance to Historical Coal Mining Establishments on Crime Measures

PANEL A	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep.Var.:					Violent Crime			
log of Distance to a Coal Mining Establishments	-28.5143***	-28.5143***	-25.2041**	-25.9271***	-7.4259	-28.5143**	-0.5465***	
	(10.5225)	(6.0485)	(12.6521)	(9.6821)	(6.2062)	(10.8250)	(0.1893)	
# of Coal Mining Establishments	0.0687	0.0687	0.4759	0.1469	0.4308	0.0687	-0.0128	0.1828
	(0.7820)	(0.4858)	(0.6050)	(0.7602)	(0.6000)	(0.4799)	(0.0205)	(0.6472)
Distance (Below Median)								22.3997***
								(6.3357)
Observations	1,224	1,224	1,224	1,224	1,224	1,224	1,224	1,224
R-squared	0.1211	0.1211	0.0865	0.1001	0.0336	0.3646		0.0991
PANEL B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep.Var.:					Property Crime			
log of Distance to a Coal Mining Establishment	-160.0154***	-160.0154	-160.3879	-152.1389	-62.3859	-160.0154	-0.3188*	
	(116.5486)	(61.1932)	(124.5631)	(100.1195)	(39.5189)	(107.5519)	(0.1787)	
# of Coal Mining Establishments	7.7168	7.7168	11.5681	10.9505	8.3739	7.7168	-0.0018	8.1599
	(11.0098)	(6.2351)	(7.7426)	(8.8901)	(8.0160)	(5.2125)	(0.0206)	(7.6496)
Distance (Below Median)								188.0513***
								(69.2191)
Observations	1,224	1,224	1,224	1,224	1,224	1,224	1,224	1,224
R-squared	0.0643	0.0643	0.0401	0.0549	0.0474	0.6622		0.0794
Robustness to:	Conley 15km	Conley 50km	No Covariate	WLS with pop 2005	OLS	Clustered at Mining	PPML	Binary Distance

Table A24: Robustness Checks: Effect of Distance to Historical Coal Mining Establishments on Business Establishments

PANEL A	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Construction Establishments							
log of Distance to a Coal Mining Establishment	-285.1649**	-285.1649***	-185.2608	-310.1470***	-113.4411*	-285.1649	-0.4625***	
	(131.9853)	(75.1601)	(199.9871)	(92.6697)	(63.4011)	(197.0631)	(0.1381)	
# of Coal Mining Establishments	1.6377	1.6377	13.3343	-3.0117	5.5755	1.6377	2.7141	-0.0093
	(10.3752)	(6.4912)	(9.3748)	(12.0660)	(5.0238)	(6.6817)	(8.8990)	(0.0114)
Distance (Below Median)								244.3777***
								(84.1213)
Observations	360	360	360	360	360	360	360	360
R-squared	0.2008	0.2008	0.0548	0.2058	0.2311	0.3407		0.1898
PANEL B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Restaurants/Bars Establishments							
log of Distance to a Coal Mining Establishment	-1,824.7558**	-1,824.7558***	-1,439.5166	-1,956.6691***	-748.8496**	-1,824.7558	-0.6236***	
	(798.0752)	(437.5793)	(1,117.5818)	(632.3339)	(374.3556)	(1,105.3176)	(0.2303)	
# of Coal Mining Establishments	6.6139	6.6139	35.1206	-18.2554	22.7543	6.6139	14.0872	-0.0158
	(55.1620)	(34.9803)	(45.9923)	(69.7098)	(27.9218)	(32.1802)	(46.3310)	(0.0191)
Distance (Below Median)								1,378.3494**
								(567.6399)
Observations	360	360	360	360	360	360	360	360
R-squared	0.0835	0.0835	0.0571	0.0949	0.0781	0.3909		0.0602
PANEL C	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Real Estate Establishments							
log of Distance to a Coal Mining Establishment	-213.4505**	-213.4505***	-206.3759*	-214.0221***	-94.6096*	-213.4505	-0.2795	
	(94.1191)	(55.5857)	(113.7577)	(62.3178)	(54.0980)	(134.5735)	(0.2287)	
# of Coal Mining Establishments	-2.8816	-2.8816	0.3805	-6.6329	-2.4030	-2.8816	-2.5789	-0.0216
	(7.3791)	(5.7998)	(3.9466)	(12.8788)	(4.0802)	(6.2725)	(7.1470)	(0.0332)
Distance (Below Median)								342.0712***
								(102.1267)
Observations	360	360	360	360	360	360	360	360
R-squared	0.0523	0.0523	0.0475	0.0596	0.0632	0.3735		0.1274
PANEL D	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Infrastructure Establishments							
log of Distance to a Coal Mining Establishment	-5.6646***	-5.6646***	-4.0535	-5.8580***	-0.7613	-5.6646*	-0.5415**	
	(2.1386)	(1.4881)	(2.8287)	(1.9585)	(1.7615)	(2.8114)	(0.2310)	
# of Coal Mining Establishments	0.3586**	0.3586***	0.4124**	0.2485	0.4184***	0.3586***	0.3857***	0.0059
	(0.1706)	(0.0980)	(0.1944)	(0.2100)	(0.1066)	(0.0759)	(0.1303)	(0.0172)
Distance (Below Median)								3.0523**
								(1.3933)
Observations	360	360	360	360	360	360	360	360
R-squared	0.1803	0.1803	0.0996	0.1498	0.0562	0.2658		0.1049
Robustness to:	Conley 15km	Conley 50km	No Covariate	WLS with pop 2005	OLS	Clustered at Mining	PPML	Binary Distance

T Measurements and Variable Construction

This section provides the description of variable construction as well as data acquisition.

Contemporary Yakuza Members: Data on the number of yakuza members from 2008 to 2014 was obtained by requesting information from prefectural police departments. The police use various ways to verify whether a yakuza member has left their organization, according to the Organized Crime Division of the National Police Agency (NPA). These include examining expulsion letters, interviewing relevant members and arrested individuals, and conducting investigations at yakuza offices. This thorough process helps the police track the actual number of yakuza members and reduces the likelihood of miscounting members who may be hiding their identities (for a more detailed description, see Hoshino and Kamada (2020)).

Number of Designated Yakuza Syndicates: I obtain data on the number of designated yakuza syndicates, as of 2008, from (National Police Agency, 2009). To capture the number of yakuza syndicates in the 1990s, I also obtain data from National Police Agency (1996), which allows me to examine the medium-run effects as of 1996.

Yakuza Hirschman-Herfindahl Index: I use a prefecture-level yakuza Hirschman-Herfindahl index from 2008 to 2014 (also see Hoshino and Kamada, 2020, 2026). To calculate this index, I estimate the number of members of each yakuza organization in each prefecture, as such data is not directly available. The estimation assumes that members of a yakuza syndicate are distributed across all prefectures where the organization operates, proportionally to the population of these prefectures. Using these estimates, I calculate the share of each yakuza organization in each prefecture and then compute the yakuza HHI for each prefecture. The index of prefecture i is defined as $yakuza\,HHI_p = 1 - \sum_g s_{i,g}^2$, where $s_{i,g} = N_{gi} / \sum_{g'} N_{g'i}$ if g operates in i and $s_{i,g} = 0$ otherwise, where $\sum_{g'}$ runs over all yakuza syndicates operating in p. The number of g's members in p is estimated to be $N_{gp} = (g\text{'s total number of members}) \times (q_p / \sum_{p'} q_{p'})$. The index ranges from 0 to 1, with 0 indicating a monopoly (only one yakuza syndicate in the prefecture) and higher values suggesting a greater number of yakuza syndicates operating in the prefecture.

Description of the Yakuza Office Street View Search (Yakuza Jimusho Street View Kensaku): The website on the Yakuza Office Street View Search (Yakuza Jimusho Street View Kensaku) provides the location and address of each yakuza group—both designated and affiliated ones—based on Google Street View, as well as the date when a yakuza office was added to the website in each prefecture (access the website by clicking here). I extracted information on the yakuza offices as of August 3rd, 2023. Since yakuza groups are not illegal in Japan, the addresses are least likely subject to measurement error. However, it is important to note that the website does not specify how the sample is selected, so it might not be representative.

Enactment Dates of the Yakuza Exclusion Ordinances: The yakuza exclusion ordinances were enacted across different prefectures in Japan between 2010 and 2012.

Table A25: YEOs Enactment dates

Group	Enactment	#Prefecture	Prefecture
1	Apr. 2010	3	Fukuoka, Nagasaki, Kagoshima
2	Aug. 2011	1	Ehime
3	Apr. 2011	24	All the other prefectures
4	Jul. 2011	6	Aomori, Iwate, Akita, Fukushima, Nara, Wakayama
5	Aug. 2011	8	Yamagata, Saitama, Niigata, Shizuoka, Toyama, Ishikawa, Shiga, Miyazaki
6	Sep. 2011	2	Chiba, Nagano
7	Oct. 2011	2	Tokyo, Okinawa
8	Jan. 2012	1	Saga