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Vertical Integration in a World without Social Capital: The Example of Coal Mining in Turn-of-the-Century Japan

By J. Mark Ramseyer*

Formal judicial procedures and informal community sanctions function as substitutes, and so too do vertical integration and contracts. Sometimes, firms enforce contracts through the courts -- but not all parties have the assets that would make them susceptible to judicial enforcement. Sometimes, firms enforce them through informal mechanisms -- but not all parties live within worlds bound together by dense networks of social ties. When firms find both formal and informal mechanisms too limited, sometimes they integrate vertically instead. Integration can substitute, in other words, for cross-firm contracting where the possibilities of judicial and reputational enforcement are weak.

I illustrate this dynamic with an example from the turn-of-the (last) century Japanese coal industry. Given that entrepreneurs lacked actual mining experience, they hired seasoned miners to supervise their teams of miners. Given that they lacked the experience necessary to supervise these supervisors, they placed the supervisors in independent firms and generated the information they needed by sponsoring tournaments among them.

The structure did not work. The miners had no property amenable to judicial enforcement, and worked in mountain communities notoriously devoid of the tight social networks typical of cohesive agricultural communities. Facing multiple disasters caused by out-of-control miners, the mining firms brought their monitoring in-house.

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Ronald Coase famously observed that vertical integration and cross-market contracts function as substitutes. Suppose an entrepreneur wants to make a product that relies on a variety of inputs. He can either (a) locate the production of those inputs within a single firm, or (b) purchase those inputs by contract from independent firms. If he locates the production within a single firm, he will coordinate the effort through internal administration. If he allocates the production among separate firms, he will coordinate the effort through contract.

The choice between vertical integration and contracting -- between making or buying -- thus turns on the relative cost of each. Drafting and enforcing contracts is not free, but neither is trying to tell employees what to do informally. Outsiders who contract with a given firm can act opportunistically, but so can people who work within it. Contractual enforcement entails cost, but so does internal administration.

Enforcing contracts also presents a choice. Classically, parties can sue in court. But over the course of the last several decades, several scholars -- most prominently Janet Landa, Lisa Bernstein, and Avner Greif (collectively, LBG) -- have explored the way people can enforce cross-market contracts informally instead. Formal enforcement requires lawyers, literate parties, and judicial enforcement mechanisms. Sometimes, people can economize on these costs through informal arrangements. Those informal LBG enforcement mechanisms, however, turn on dense, inter-connected networks of local social ties that some scholars call "social capital" (Burt 2000; Coleman 1988, 1990; Putnam 2000). Sometimes, the parties can use the ties both to communicate information about each other, and to punish contractual breach.

Vertical integration can substitute for contract, and informal contracts can substitute for formal mechanisms. At stake, writes Barak Richman (2004, 2333), are the paired tensions of "firm versus market" on the one hand, and "private versus public ordering on the other." The two pairs function as "part of a single equation." The relational penalties LBG identified can substitute for formal judicial enforcement, and sometimes vertical integration can substitute for both. As Richman observed, the choice is not two-fold but three.

In the article that follows, I illustrate this dynamic with an example drawn from the organization of coal mining in late 19th century Japan. Given that the urban entrepreneurs who funded the largest of these mines lacked mining experience, they hired seasoned miners to supervise their mining teams. Given that they also lacked the experience necessary to supervise these supervisors, they placed the supervisors in independent firms. They then sponsored (what were in effect) tournaments among independently owned firms.

Over the decades that followed, the entrepreneurs realized that the structure did not work. Their independent supervisors did not stop the miners from acting in ways that jeopardized their reputational capital. To control the supervisors at these independent firms, the mining firms could not rely on formal judicial enforcement. The supervisors lacked both the education necessary to understand complex contracts, and the stability and wealth necessary to be amenable to formal enforcement.

To control their supervisors, the mining entrepreneurs needed to rely on informal enforcement mechanisms. As LGB detail, however, informal contract enforcement depends on reputational investments and an overarching network of social capital. Unfortunately for the mining firms, the mines were located within areas of Japan notoriously devoid of that social capital. Absent a dense network of social ties, the informal enforcement devices simply did not work. Consistent with Richman (2004), the entrepreneurs responded by vertically integrating.

I begin by reviewing the literature on vertical integration and informal enforcement (Section I). After a brief statement of the thesis, I turn to the turn-of-the century Japanese coal industry (Section II). I describe why the firms first contracted for their labor management through independent firms, and why they then reconsidered (Section III). I conclude with a fuller statement of the hypothesis and logic, and tie the implications of social capital for vertical integration (Section IV).

I. The Law & Economics of Cross-Firm Contracting

A. Introduction:

Vertical integration and cross-market contracts serve as substitutes. To produce a good, a firm can make all component parts itself, or it can buy those components from independent firms. Neither is free. Make the components in-house, and the firm executives will not need to detail their instructions in an enforceable contract, but they will need to supervise the men and women who work for the firm. Buy the components on the market, and those executives will not need to supervise production, but will need to insure that their contracting parties actually supply the goods they want.

To date, scholars working in this tradition have explored some of the factors that can push firms toward either integration or contract. They variously tend to discuss the risks of opportunism, or the benefits of residual control (Section B). In a parallel tradition, other scholars analyze the costs and benefits of informal contract enforcement (Section C).

B. Contracting and Vertical Integration:

In 1937, Ronald Coase observed that neither administering operations within a firm (to "make") nor contracting across the market (to "buy") is free.[1] If a firm must decide whether to "make or buy," it will find that both (i) coordinating production within the firm itself, and (ii) arranging to buy the designated good from other firms entail costs.

From that observation, modern scholars have explored the potential determinants of whether firms make or buy. Most scholars take one of two -- closely related -- inquiries. First, Oliver Williamson (1975, 1981) pioneered an approach that focuses on the risk of post-contractual opportunism. More specifically, he explored the extent to which relationship-specific investments can induce opportunism. Within the firm, he (Williamson 2009) studied the extent to which a firm can mitigate the associated agency costs through internal structure (he attributed the insight to Chandler). Second, Oliver Hart (1995), John Moore (with Hart, 1990), and Sanford Grossman (with Hart 1986) asked when the "property right" over an asset (i.e., whether owned outside the firm or vertically integrated into the firm) might prevent its moving to its highest valued use.

[1] A separate set of scholars focused on whether (or when) vertical integration might enhance market power. Obviously crucial to antitrust, the approach has little to do with any decision by Chikuho mines to hire workers directly. Accordingly, I ignore it here.

In some contexts, these transaction costs and property rights approaches can resemble each other closely. On the one hand, as Paul Joskow (2010, at 568) put it, the transaction-cost approach describes the "tradeoff between the costs of alternative governance arrangements. Governance arrangements are selected that represent the best that can be accomplished from a set of imperfect governance alternatives." On the other (Joskow 2010, at 569), the "property rights approach focuses on ownership and control of physical and intangible assets ... where ownership carries with it the authority to determine how these assets will be used." As Daron Acemoglu, et al. (2004, at 1) explained, scholars in the Williamson tradition treat "vertical integration as a way of circumventing the potential holdup problems" and predict "that vertical integration should be more common when there is greater specificity, increasing the costs of holdup." Those in the Hart tradition instead focus "on the role of ownership of assets as a way of allocating residual rights of control ...."

Crucially, for understanding the choices that firms made in the example described below, these distinctions largely do not matter. As Joskow (2010, at 575), again, put it, "both literatures have emphasized incomplete contracts, specific investments, and opportunism." The differences are subtle, and for the structure of labor organization in turn-of-the-century Japanese coal mines largely irrelevant. The firms with which the mining companies contracted for labor services were largely transient and judgment-proof. The mining companies could not have enforced their contracts with them through the courts. Instead, to adopt a cross-market contracting approach they needed to employ the informal mechanisms discussed immediately below.

C. Informal Contract Enforcement:

Detailed, closely specified contracts are always costly and incomplete, of course. As Benjamin Klein, Robert Crawford and Armen Alchian (1978, at 303) remind us, "every contingency cannot be cheaply specified in a contract or even known and ... legal redress is expensive ...." Indeed, in Joskow's (2010, at 563) words, "the recognition that contracts are incomplete and that contractual incompleteness potentially leads to contractual hazards that adversely affect ex ante investment incentives and the efficiency of ex post performance" lies at the very "foundation of transaction cost economics theories."

Given these problems with formal contracts, a separate set of scholars have explored how transacting parties sometimes opt to avoid legally enforceable contracts altogether. They detail the way that these parties can instead rely on their "reputations." Consider a person's reputation as a summary of information about the way that he has performed in the past, and (consequently) a prediction about the way he will perform in the future. Necessarily, a transacting party's reputation will capture the profits he can expect to earn from a stream of future transactions. Should he fail to perform, he will not just face a potential legal suit for contract damages. Instead, he will face his trading community's "ostracism" -- and find himself barred from profitable future opportunities altogether.

This literature builds on the work of Janet Landa, Lisa Bernstein, and Avner Greif (collectively, LBG; see generally Ramseyer 2023). Landa (1981, 2013) began the modern discussion with a series of articles in which she discussed the way that ethnic Chinese traders traded and extended credit over long distances in southeast Asia. Largely, she found, they traded within kinship groups. The family ties, she suggested, provided information about a potential partner's probity and resources. They further insured that any attempt to cheat on a contract would travel across the family information networks and magnify the punishment on the party attempting to breach. Ultimately, the penalty for breach was ostracism -- a collective refusal to deal by all

members of the community. In effect, she (2013, at 42) wrote, the traders used "religion and symbols of identity" to "economiz[e] on [the] costs of identifying club members" and to "set[] up barriers to entry to 'outsiders' ...."

Bernstein (1992) explored trades among the orthodox Jewish diamond traders in New York. Fundamentally, the fact that a potential trading partner was part of a closed religious community insured that news of any breach would travel far. Were a trader to renege on a contract, the community could then collectively sanction him by withholding all trade. He posted his reputation as a "bond," in other words, and community ostracism constituted the resulting punishment. As in Landa's work, the collective refusal to deal served to discourage breach by any trader planning potentially to engage in future transactions within the community. Together, the Jewish diamond traders had created a network of "repeat transactions among members of [a] small geographically concentrated and ethnically homogeneous group[]" (1992, at 116). Such networks, then, "expand[ed] the types of behavior that [could] be sanctioned through reputational harm or rewarded through reputational or other nonlegal benefits ...." (2015, at 563).

In turn, Greif (1993) modeled the way that 11th century Maghribi traders organized themselves into "coalitions" through which they used a "reputation mechanism" to enforce agreements with their overseas agents. Their close ties with each other served to ensure that news of any breach travelled. As with Landa and Bernstein, the denial of future trades helped to insure against breach in the present.

II. Vertical Integration and LBG Enforcement in Japan

A. The Argument:

In the article that follows, I explore some of the implications of the LBG analysis for a firm's decision about whether to integrate vertically. I do so with an example from the Japanese coal industry in Chikuho -- an area in Fukuoka prefecture at the north end of the island of Kyushu. Let me begin with a brief summary of the argument.

In late 19th century Japan, large national conglomerates like Mitsubishi and Mitsui invested heavily in Chikuho coal mines. Given their educational backgrounds, the executives at these firms could exploit modern technology and write sophisticated contracts. They could not recruit and monitor the men and women who actually dug the coal. For this, they hired experienced former miners (as naya gashira). Given that they could not intelligently monitor these monitors either, they contracted with them across the market.

In the scheme as eventually developed, each naya gashira controlled his own independent firm (naya). He hired the miners for his naya, and contracted with the mine for the right to dig for coal. In turn, the mine generated the information it needed to run the operation by placing these naya gashira in positions through which they competed against each other for favorable contractual terms.

In 1887 several journalists accused the naya at one mine of abusing miners so badly that a recruitment crisis ensued. In 1918, miners across Chikuho rioted en masse and burned and looted offices, stores, and the homes of wealthy neighbors. These twin crises made clear to mining executives the problems inherent in trying to contract across their labor market. The major mining firms were part of major national conglomerates with reputational investments that extended beyond industry lines. The naya gashira, by contrast, maintained more local and constrained reputations. And the mines, in turn, were located in an area notoriously devoid of the dense networks of social connections so common in agricultural communities. The mining firms faced employees and naya gashira willing to jeopardize their massive investment in reputational capital,

but could not constrain them through the courts (inadequate assets) or through informal networks (too shallow and sparse).

Given these disasters associated with their attempt to contract with naya across the market, the mines vertically integrated: they brought their naya gashira and miners in-house. Internal administration generates its own agency slack, of course. But when dealing with transient parties in a world without literacy, substantial assets, reputational capital, or an encompassing social network, the utter simplicity of monitoring and controlling the productive process apparently trumped any complex contractual alternatives.

B. Turn-of-the-Century Coal Mining in Japan

1. The issues. -- From its modest surface mines in mid-19th century Japan, the coal mining industry grew rapidly. By the end of the century, the firms were using western techniques. They were paying well. And in recruiting their miners, they were demanding general (as opposed to firm-specific) skills consistent with a highly transient labor force, and that transience was generating the low levels of reputational and social networks that drive the analysis below.

2. The industry. -- The earliest accounts of Kyushu coal date from the 17th century. Some farmers used it to cook, while some of their more entrepreneurial neighbors used it to boil salt from sea water. To obtain the coal, sometimes men dug small open-air surface mines, while sometimes they dug modest underground tunnels. But through the mid-19th century, they mostly collected coal in small amounts.

When the 19th Japanese government opened the country to international trade, things changed. Adventuresome merchants and investors now turned to a wide variety of western technology. Much of it relied on carbon fuel, and more than anything else it relied on coal. Investors and merchants demanded coal to fuel their factories, to run their locomotives, and to power their ships (see Table 1).

[Insert Table 1 about here.]

In 1875, Japanese mines produced 567,000 tons of coal (see Table 1). By 1900 they would produce 8.64 million tons, and by 1930, 31.3 million. In the early years, the mines exported some of this coal. In fact, in 1890 they sold abroad nearly half of their 2.7 million tons. As the economy grew, however, so did the national demand for the coal. By the 1920s, coal was less an export than an import (Niikura 2000, at 95).

Japanese miners found coal primarily in three areas: the northern-most island of Hokkaido, the northern-eastern sea-coast called Joban (encompassing Fukushima prefecture), and the northern mountains on the southern island of Kyushu (especially the prefecture of Fukuoka). The Hokkaido mines were large and productive, but the area was remote and blanketed with deep snow during the winter. Joban was accessible to the rapidly growing Tokyo, but yielded only low-quality coal.

This left northern Kyushu. The mines contained large amounts of high-quality coal, could be mined year-round, and lay a short distance (by railroad or coastal shipping) from metropolitan Osaka. The Chikuho area in Fukuoka prefecture contained the largest amount of the coal, scattered over several 100 mines (Tanaka 1974, at 45; Ushijima 1969, at 69). The single enormous mine of Miike lay 100 km away on the Kumamoto border. The large island mine of Takashima was 15 km

off the coast of Nagasaki and next to a twin mine on the island on Hashima And smaller mines also lay just south of Fukuoka in Saga prefecture.

The coal in northern Kyushu quickly became big business. Several local entrepreneurs invested heavily, and created large family enterprises: the Aso, Kaijima, and Yasukawa firms. Two national enterprises used the northern Kyushu mines to fuel what would become the massive conglomerates of Mitsubishi and Mitsui. In 1881, Yataro Iwasaki bought the Takashima mine, a mine first sold to the private sector during the previous decade (Tanaka 1984, at 51, 234; Nakamura 2016, at 52-53). Soon, he would make it a crucial part of what would become the Mitsubishi empire.

In 1888, the Mitsui family (it had sold textiles since the 17th century) bought the Miike mine from the government for an extraordinarily large amount. To handle the mine, Mitsui hired the young engineer Takuma Dan. Dan had studied at MIT in the 1870s, and now served on the faculty of Tokyo Imperial University. At Miike, he oversaw the installation of modern drainage and transport technology. Obviously talented, by 1914 he would become CEO of the entire Mitsui conglomerate.

3. The technology. -- As the 20th century opened, each miner in northern Kyushu worked a specific underground wall assigned to him by his supervisor. He used a hammer and a pick, and dug with his hands. As he cleared his wall, he left the adjacent area unmined as a pillar to support the ceiling. Mines in the U.S. often used the same "room-and-pillar" method. As William Boal (2018, 133) put it, in this technique "[m]iners worked alone, or sometimes with an assistant, each in his own 'place' or room, separated from other miners by hundreds of feet."

Typically, each Chikuho miner (called "saki-yama") worked with an assistant (called "ato-yama") who carted his coal to the surface. Until the law banned women from working the mines in 1928, the two were often a husband-wife pair (e.g., Osaka 1926, at 42; Noyori 2010, at 40-41). The firm paid them according to the quality and quantity of coal they together mined. The use of piece rates was international: according again to Boal (2018, 132), they "were essentially universal in early coal mining" in the U.S.

The Kyushu miners worked deep underground in obviously hard-to-observe circumstances. Had they worked in large teams (as they later would, see below), they would have created serious metering problems. The individualized work area used in room-and-pillar mining, however, coupled with piece-rate pay, let each miner largely internalize the cost and reward of what he did, and gave him appropriate incentives to produce.

4. The dangers. -- Miners faced two distinct types of dangers. The first and most common was a ceiling collapse. Crucially, this was a risk that the miner himself controlled. He decided the pace at which he worked, the space he attacked, and the size and location of the pillars he left. Should his ceiling collapse, he alone -- rather than his fellow miners -- suffered. As Price Fishback (1992, 106) put it in the U.S. context, a miner "explicitly saw the trade-off between income and safety while he made nearly all of the accident prevention decisions within his own workplace."

The second set of dangers involved explosions. These happened more rarely, caused far greater harm, but turned on decisions that individual miners did not control. The explosions resulted from gas and coal dust. The quantity of that gas and dust rarely turned on anything an individual miner did. Instead, it was a function of the ventilation system the firm had installed. In Boal's (2018, 134) words, efforts to improve the ventilation or sprinkle water on coal dust were "measures that reduced the risk of explosions," but were measures that the firm controlled and

which benefited all miners. They "were workplace *public* goods [ital. orig.], creating benefits for all workers in the mine simultaneously."

Table 2 illustrates the scale of the dangers. In most years, 2 to 4 men died for every 1000 workers. Fishback (1992, 102) writes that "in the United States before 1930 ... roughly three to four fatal accidents [occurred] for every thousand workers each year." In Japan in most years, a few hundred miners died from ceiling collapses. The number fluctuated, but not as massively as total deaths. The variation in the number of total deaths instead turned heavily on the presence or absence of a small number of catastrophic explosions. In 1900, 7 people died from explosions, and in 1910 and 1922 8 people died. In 1914, however, explosions killed 1,125 people. In 1912, they killed 513 people, and in 1917 415 people. Miners controlled the risk of ceiling collapses. They had almost no control over the risk of the rare but catastrophic explosions.[2]

[Insert Table 2 about here.]

5. Hours and days. -- For the most part, Chikuho miners chose whether and when to work, and generally chose only modest numbers of hours (other mining workers like those transporting the coal worked a more regular schedule). Recall that a miner worked with an assistant (often his wife) alone on a specified wall. Whether he chose to work or stay home, and whether he chose to work 8 hours or 10 affected few employees other than this assistant. Given that the firm paid him by his product, he paid for his days or hours off with lower earnings. Usually, firms let miners make that choice themselves.

Like their peers in the U.S.,[3] Japanese miners did not work very many days. Mayo Morimoto (nee Sakai; Sakai 2015a, at 136) surveys work data for 555 workers (400 male, 155 female) in Chikuho in July 1905. She (Sakai 2015a, at 137) finds that the average worker worked 22.5 days per month. Mitsuo Tanaka (1974, at 83) wrote that miners at some Kyushu mines lived by a work-a-day, rest-a-day norm. In 1906, he found that Kyushu miners averaged 17 to 22 days per month.[4] In the giant Miike mines, the free miners (Miike also used prisoners, see Subsection D., below) worked 18 days per month.

As of 1928, the law imposed a 10-hour-per-day maximum (Kozan 1932, 725), but in mining it did not matter. The Osaka labor office surveyed Chikuho mines in 1926 (Osaka 1926). It observed that even when miners worked a nominal 10- or 12-hour shift, they took long breaks and quit early. Typically, it found, they worked about 7 or 8 hours a day (Osaka 1926, at 37).

Still, the legislation also banned work by women -- and this provision did levy a substantial cost. In 1916, 1926 and 1928, the government imposed progressively stricter restrictions on work by women and children. In 1928 it finally banned all work in mines by women and children. Recall that many husbands and wives worked together as a team. In 1926, 44,500 workers in the mines were still women: typically, their husbands mined, and they transported the coal to the surface. As of 1928, the government banned this practice.[5]

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[2] Consistent with data from Ogino (1988), at 249.

[3] See Boal, Fishback & Kantor (1994), at 125: "most mines operated only 220 to 240 days per year."

[4] No shomu sho (1908), at 39, reports 21 day work month.

[5] The Kojo ho [Factories Act], Law of 1911, took effect by a Seko rei of Sept. 1916. The act applied to factories, but not to the mines. The mines were instead governed by the roughly comparable Kofu roeki fujo kisoku [Rules Regarding the Compensation of Miners], Sept. 1916. For general discussions of protective legislation, see Kozan (1932), at 716-25; Tanaka (1984), at 414.

6. Compensation levels. -- Mining rewarded skill and experience. Room-and-pillar mining did not require skill and experience specific to a mine. Instead, it required what Gary Becker (1964) called "general" skills. A miner needed to be able to identify coal layers. He needed to be able to gauge their depth and quality. He needed to know how to loosen coal, and when his work might turn the ceiling precarious. If he used dynamite to crack the rock, he needed to know where to place the explosives and how much to use.

The mines typically paid the miners every 3 days. They often withheld 20-30 percent to cover charges like room and board, and settled up once or twice a month. The larger firms tended to pay in cash. Smaller firms paid in scrip and exchanged the scrip for cash twice a month (Ogino 1991, at 177-78; No shomu sho 1908, at 63).

Room-and-pillar mining did not reward formal education, and the Chikuho miners did not bring much. As of 1933, 10.4 percent of the miners had not attended any school. Another 15.7 percent had not finished elementary school. Of all miners, 44.4 percent had finished elementary school and 23 percent had graduated from middle school. Almost non had gone farther (Takahashi & Wakabayashi N.D., at 49).

For manual work, coal mining generally paid well. Fishback (1992, at 84) writes that in the U.S. South, "coal mining offered an opportunity to earn substantially greater income than [the miner] could earn as hired labor on the farm." It also paid more per hour than manufacturing jobs, though the "high hourly earnings in coal were offset by more limited working time."

The same held true in Japan. Absent a consistent time series of wages in the coal mining industry (but see Table 3 Pans. A, B), consider some episodic estimates. In 1897, miners in 22 Chikuho coal mines generally earned 50-65 sen per day; in the same year, metal workers earned 39.2 sen per day, shipbuilders 45.7 sen per day, and men in manufacturing more generally 25 sen per day.[6] In 1905, male Chikuho miners earned 64 sen per day (and paid 22 sen per day for food and lodging); metal workers earned 58 sen per day, shipbuilders 54.3 sen per day, and men in manufacturing more generally 22 sen per day.[7] In 1908, the free (non-prisoner; more on this below) miners at the giant Miike mine earned about 78 sen per day in northern Kyushu, metal workers earned 68 sen per day, shipbuilders 59.6 sen per day, and men in manufacturing more generally 25 sen per day.[8]

[Insert Table 3 about here.]

[6] Table 3 Pans. C, D. Ryohei Ichihara and Mitsuo Tanaka (1964, 99) give the average daily wages for 1897 at 22 Chikuho coal mines. There, miners earned daily wages ranging from 44 sen to 70 sen. Of the 22 mines, the daily average fell below 50 sen at only 1 mine, and exceeded 65 at only 3. The rest of the averages ranged from 50 to 65 sen per day.

[7] Table 3 Pans. C, D. Mayo Morimoto (nee Sakai) reports that Chikuho miners in 1905 earned an average of 64 sen if male, and 54 sen if female. These are probably wages at a specific Aso mine see Sakai (2015a), at 137; Morimoto (2023).[7] These charges for meals and lodging would have totaled about 6.6 yen per month, which in turn suggests that a miner could cover his room and board by working 10.31 days per month. Ichihara and Tanaka (1964, 99) also report a survey of 24 coal mines (across the country) in 1906. Five Hokkaido mines reported daily wages ranging from 97.1 sen to 1 yen 34.2 sen (100 sen equaled 1 yen). In turn, they charged monthly room and board that ranged from 6 yen 80 sen to 8 yen. The other mines paid daily wages ranging from 56.6 sen to 87 sen, and charged room and board ranging from 13.5 sen per day to 30 sen.

[8] Table 3 Pans. C, D. Tanaka (1974, at 100).

From 1910 to 1920, the consumer price index soared from 62.6 to 177.1 (Miwa & Hara 2010, at 2). With this rise, miners fell behind their peers in manufacturing. In 1926, one source reports average daily wages among Chikuho miners of 184.1 sen (Osaka 1926, at 41, 44. A second source reports 181.9 sen for 1926, and 183.0 to 196.0 for the years 1927-1929 (Table 3 Pan. B). In 1925, men in manufacturing jobs earned 207 sen per day (Table 3 Pan. D).

C. Mobility:

Given that room-and-pillar mining rewarded only general skills, a good miner could work anywhere. A good miner was a skilled miner, and a skilled miner could exercise his skills at any of the hundreds of separately owned Chikuho coal mines. Recall Becker's analysis of "general" (as opposed to firm-specific) skills. The good miner could move.

And skilled Chikuho miners did move. Coal miners moved in the U.S. (Fishback, 1995, at 433), and they moved in Japan. They moved regularly, searching relentlessly for higher wages. Fishback (1996, at 3) explained the dynamic in the U.S.:

> [Exit (and the threat of exit)] was a powerful force in improving the economic welfare of the miners. There were thousands of mines hiring coal workers. [These workers] were willing and able to move on to the next mine or switch to other industries. Thus coal operators who tried to pay wages below the prevailing wage for labor often lost workers or could hire only the least productive miners.

As Table 4 shows, about 15 percent of the Chikuho workforce turned over every month.[9] Of those who quit, a third to a half just unilaterally walked off the job (No shomu sho 1908, at 16; Osaka 1926, at 91). The workforce in Hokkaido and Miike was more stable. Hokkaido offered many mines, but they were scattered over a wide area. Miike was a single massive mine. It lay in northern Kyushu, but roughly 100 km from the many mines in Chikuho.

[Insert Table 4 about here.]

Consistent with this high turnover rate, Chikuho miners typically had short job tenures. As Table 5 details, in 1906 half had worked at their current job less than a year.[10] Tenure was longer at larger mines like Mitsui Tagawa and Onoura, where three-quarters of the work force had worked over a year (Panel B). But the hundreds of smaller mines swamped the few larger ones, and in the district as a whole the majority had less than one-year tenure (Panel A).[11]

[Insert Table 5 about here.]

Given the turnover, mine owners faced constant pressure to recruit. And given the nontrivial recruitment expenses, they did what they could to keep their workers. To prevent abrupt departures, some firms paid in scrip rather than cash. Already in the late 19th century, the government tried to discourage the practice (Ogino 1993, at 47). Yet some firms resisted. They paid their workers in scrip and only settled in cash at distinct intervals.

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[9] Consistent with data from No shomu sho (1908), at 15-16.

[10] Consistent with data from No shomu sho (1908), at 16.

[11] Consistent with data from No shomu sho (1908), at 22, and the excellent analysis in Kim (2023), at 12-13.

Similarly to prevent turnover, some firms required miners to maintain savings deposits with the firm.[12] Typically, they withheld about 10 percent of a worker's wages.[13] The firms sometimes paid interest on these mandatory savings, and sometimes not (No shomu sho 1908, at 135). Should a worker leave on good terms, the firm paid him in full. Should he walk off the job with unpaid debts, the firm could at least offset the deposit (Morimoto 2013, at 235-36).

D. Social Capital:

1. Introduction. -- In many prominent ways, Japan is a country tied together by the networks of what some scholars call social capital. But not all areas within Japan are equally tightly bound. Chikuho is notoriously not bound. Today, it is the land of shuttered coal mines. At the close of the 19th century it was a land of thriving coal mines, but even then, it was a place of high crime, low levels of stability, and only the most tenuous networks of social ties.

Japanese villages at mid-19th century included primarily rice farmers. The dense network of social capital followed from the nature of the agriculture itself. Each family owned or rented (or both) one or more small paddies. Each individually supplied the seeds and fertilizer and the labor necessary to care for the land and crop. Each individually owned the harvest. Yet each shared in elaborate community-wide irrigation facilities, and at several crucial steps each family relied on collective community effort: most prominently in transplanting seedlings and in gathering the harvest.

The mining towns in Chikuho showed none of this communal coherence. Some of the miners were local to be sure. But the booming mines recruited broadly from across western Japan. The men they hired often brought no ties to Chikuho. They depended on the mine for work and wages, but needed nothing from Chikuho beyond the mine.

2. Criminal involvement. -- The workers hired by the mines were not just poor and transient. Many were also criminal. Of the U.S. coal mines, Price Fishback (1995, at 433) notes that because "coal mines were isolated, some of the workers were criminals hiding from the law ...."

In Chikuho, some of the criminals were not even hiding. Mitsui used prison labor (in conjunction with free labor) in its Miike mine until 1930 (Tanaka 1974, at 44, 53; Ogino 1993, at 29). In 1888, Miike had used only 959 free men, but used 2,144 prisoners (Tanaka 1974, at 64; Takahashi & Wakabayashi N.D., at 46). After serving their term, some of the prisoners would have settled in the area. They and their children would have become Chikuho residents.

Other miners arrived in Chikuho with unknown pasts. Some firms did try not to hire men whose background they did not know. But many miners at Chikuho brought at-least-dubious backgrounds. As Takahashi & Wakabayashi (N.D., at 46) explained, the mines needed workers, and men from other distant areas wanted work. Some of these men had uncertain pasts, and some had straightforwardly criminal pasts. Some of the firms hired them anyway.

To supervise these men, many firms hired naya gashira with similar backgrounds. Recall that the naya gashira had themselves worked for years as miners. Like the men they supervised, they had minimal education (Ogino 1991, at 211; Ichihara & Tanaka 1964b, pt. 1 at 116). And like the men they supervised, they sometimes brought criminal histories (Ushijima 1960, at 70; see Ichihara & Tanaka 1964b, pt. 1 at 117):

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[12] E.g., No shomu sho (1908), at 135; Ogino (1993), at 120-21; Ogino (1991), at 178.

[13] Morimoto (2013), at 235-36; Ogino (1991), at 178 (noting wide variety).

> Among the men flowing into the mine areas are lots of people with criminal histories, and whom one really can't know. [The mines] use these men without bothering to check their individual backgrounds. But to get people like that to work, you need to borrow the strength of a local boss.

To control men with criminal pasts, in other words, firms needed men with criminal pasts. Already at the turn of the century, the mines had been scenes of violent fights. Some of these battles grew out of fights between rival naya gashira (Ogino 1988, at 263). Symptomatic of this background, in 1900 a fight broke out between two naya gashira at the Mitsui Tagawa mine (Ayukawa 1997, at 18). One of the two died.

The naya gashira, wrote one observer, were simply "yakuza" -- i.e., part of the organized crime network (Ushijima 1960, at 69):

> Naya gashira (labor suppliers) who've been dealing with the major firms have a small mountain transferred to them. These men are mostly yakuza, and take a certain pride in calling themselves yakuza. ... When times are good, small and medium-sized coal mines appear like bamboo shoots after a rain. They build houses like castles, buy private cars, support several mistresses. When depression hits, they don't pay wages, fire their workers, and avoid creditors by putting property in other people's names.

To control their quasi-criminal employees, the mines used quasi-criminal supervisors. By 1918, the costs to this strategy would become obvious to everyone (Section III.D., below).

3. Resulting dysfunction. -- The social dysfunction in turn-of-the-century Chikuho followed from the way that the firms had staffed their mines. Some firms had staffed their mines with prisoners -- and when they had served their time, some convicts stayed behind. Other firms staffed their mines with outsiders. What histories these outsiders brought could be unclear, but some came to escape their past -- and when they had worked for a period, some stayed behind. The world beyond the mines in Chikuho reflected (and still reflects) this history.

Ooto is a small town in the heart of Chikuho. The coal is gone today, but the dysfunction remains. People from elsewhere in Japan call it "gang town." On Internet sites, they warn people to stay away. In 1986, someone shot the mayor in his office. In 2002, someone shot the chairman of the city council. In 2003, the police arrested the chairman on weapons charges. Later the same year they arrested his replacement for his part in a car-theft ring. In 2005, the mayor found his office firebombed.[14]

Nearby lies the town of Nishitahara. As the coal industry faded, its residents turned to theft. Indeed, for fifty years, its residents survived on theft. Periodically, they sent teams of 12 to 15 on shoplifting trips to Tokyo and Osaka. By one account, in the town of 180 households 123 people had criminal records for theft. Perhaps the statistic is not precise: by another account, in a population of 200, 88 people had criminal records. Whatever their records, the residents maintained only fluid family ties. If a husband left for prison, his wife took up with another man. When her husband came back, perhaps she returned to him. Perhaps she stayed with her new man (e.g., Kato 1972, at 26, 37, 54).

Ooto and Nishitahara both lie in Fukuoka. Fukuoka is a high-crime prefecture today, but it was a high-crime prefecture a century ago. Back in 1927, the rate of battery in Fukuoka was lower only than Osaka, Kanagawa (the location of the port city of Yokohama), and Hokkaido

[14] See, e.g., Fukuoka no oogun (n.d.); Boryokudan no machi (2011); Nottorareta machi (2015).

(Naikaku tokei kyoku 1928). By the early 21st century, the rate for major crimes (murder, battery, and a few others) in Fukuoka was lower only than Osaka (Kubo 2024).

III. Vertical Integration in Chikuho

A. The Hypothesis:

Return to the empirical phenomenon at issue:

> In the late 19th century, most of the larger mining firms in Chikuho contracted with independent firms (the naya) to recruit, monitor, discipline, and pay the men who would mine their coal. By the 1930s, most of the firms had abandoned these naya and integrated their services into the firm itself.

In turn, the corresponding question of why the firms did this goes to Coase:

> Should the mining firms integrate vertically, or contract across the market? Should they "make" or should they "buy."

And it goes to Landa, Bernstein, Greif and Richman:

> If they contract, should they rely on the courts or on informal reputational constraints?

Initially, the mining firms out-sourced their "human relations" by contract enforced through reputational capital; after several decades, they decided to hire their monitoring staff directly instead. Initially, they "bought" their HR; in time, they decided to "make" it instead.

In the rest of this article, I explore why this happened. The logic, I suggest, turns on the difficulty in contracting across the market in a world without literacy, wealth, reputational investments, or social capital. The mining firms had originally hired the naya gashira to obtain monitoring services that their university-educated entrepreneurs could not themselves provide. They hired these naya gashira across the market to generate the information that they needed to monitor them. Given that the naya gashira had too little capital to justify judicial enforcement, they relied on the networks of local social capital.

Over the course of the next several decades, the firms realized the cost this strategy entailed. The naya gashira did not live and work within LBG's world of deep and interlaced networks of social capital. Sometimes, they themselves were transient men with dubious (at best) reputations who supervised other transient men of dubious pasts. By contrast, the large mining firms were embedded within worlds where reputations mattered critically. Where the naya gashira cared only about the money they made in the mining industry year to year, the largest mining firms brought reputations that spanned national borders and crossed industry lines. Within a few decades, scandals and riots brought home to the mining executives the costs generated by this absence of social capital and the reputational mismatch between the naya gashira and the large firms. Once they did, the firms responded by moving the monitoring services in-house.

B. The Initial Reasons for the Independent Naya:

1. The need. -- Recall the historical backdrop. As mining firms developed and expanded the coal industry during the final decades of the 19th century, the larger firms often out-sourced their labor procurement. The smaller mines did not necessarily do so. Their owners were sometimes former miners themselves, and in some cases seem to have handled most managerial tasks themselves.

The larger firms, however, were often component firms within large diversified conglomerates. The Mitsui had been dry goods merchants in Tokyo since the 17th century. The Mitsubishi (the Iwasaki family) would soon make its fortune in ocean shipping. Both would become major financial firms. The Sumitomo and Furukawa combines similarly operated Chikuho

mines, and would similarly build internationally prominent conglomerates. These massive firms needed men who could spot expertise, who knew what they could realistically expect from a miner, who understood the tradeoffs between productivity and safety, who could induce a reluctant worker to invest more effort. To supervise them, they needed men who had themselves worked as miners for many years.

The Coasian question went to the location of these supervisors: whether (i) to hire them directly as recruiters, foremen, and dormitory managers, or (ii) to let them form firms and then contract with them across the market. The question was not specific to Japan. British coal companies often placed their own miners in independent "buttys" as well (Clark 1967). Whether in Japan or in Great Britain, mining firms apparently contracted for their labor services with independent firms in order to generate information. Precisely because they could not monitor the miners themselves, the executives who ran the largest firms could not monitor the naya gashira either. By locating those naya gashira in independent naya that competed against each other, the executives generated the information they needed to gauge relative performance.

2. The naya contract. -- I hypothesize that the understandings (often oral and informal) between a mining firm and a naya had several components. First, the naya gashira would procure the necessary workers and obtain personal guarantors for their performance. In some areas, he maintained a permanent recruiting post; elsewhere, he sent agents periodically to recruit the workers the firm needed. For their miners, the naya gashira searched for men (the miners were generally men) with skill and experience. All else equal, they avoided potential trouble makers -- namely, men with criminal or unionizing histories (Osaka 1926, at 99). And having found the workers, they either guaranteed the recruit's expertise themselves, or located a guarantor who would vouch for that expertise (Sakai 2015a, 2015b).

Second, the naya gashira would supervise the miners. He spent time down in the mine monitoring the workers he had hired. He allocated the mining surfaces among them to reward industry and expertise. He distributed their pay. And he disciplined workers as necessary (e.g., Morimoto 2023).

Third, the naya gashira would house and feed his miners. Typically, he offered married couples a small townhouse. It might measure 15 square meters, include one electric lightbulb, and provide access to a communal spigot and toilet. The naya gashira also ran a company store, and sold the couple food. For single men, he provided a place to lay bedding within a large room, and served meals.[15]

C. The Eventual Demise of the Independent Naya:

1. Introduction. -- This logic was not the end of the matter, for -- despite the logic -- the largest mining firms soon opted to abandon the independent naya. Recall that some of the smaller mines had gone without a naya from the start. As the 20th century opened, the largest firms increasingly shifted from an out-sourced personnel agent (the naya gashira) to a vertically integrated and internalized personnel department. The timing of the shift varied widely across the firms, but seems to have begun around 1900. It was largely complete by the 1930s.

[15] See generally Ogino (1991), at 179-80; Honda & Yamashita (1987).

2. The technological constraints. -- Mayo Morimoto[16] observes that in the 1920s coal mines adopted more modern, mechanized (i.e., longwall) mining technology, and that -- as they did so -- the nature of their informational problem changed. The naya gashira had not been engineers. They were retired pillar-and-room men who had mined by hand. They could gauge and supervise other men who mined by hand. They could not coordinate the use of the new mechanized equipment.

As the mines adopted the new Western mining machines, the entire character of the project changed. Miners no longer worked alone (or with their wives) to dig "rooms" and leave "pillars." Instead, they worked in larger teams, used complex mining machinery, and cleared massive "longwalls." On these lengthy panels, they together operated mechanized drilling equipment that would remove the successive layers of coal (Michalski 2011).

To supervise longwall mining, the firms needed trained -- educated -- engineers. They needed men with technical knowledge -- some with university engineering degrees. They needed men who understood the new equipment, knew what skills the new machinery required, and could select and supervise the men who operated it.

3. The choice to integrate vertically. -- Morimoto's observation is right as far as it goes, but does not itself explain the shift from contract to vertical integration in Chikuho. The modern western technology was expensive, and (as Morimoto observes) required trained engineers. Disproportionately, the large international conglomerates (like the Mitsui and Mitsubishi) owned the largest mines, and specialized in those projects that brought returns to that modern technology.

Yet the larger firms were not the firms that drove the shift to in-house HR. The smaller firms had largely avoided naya from the start. Table 6 Pan. B gives the number of naya-hired and direct-hired miners in 1923. The table covers all mines with over 100 workers. Of the 82 mines in Fukuoka (covering Chikuho), 50 mines used naya, and 32 did not. Of the 102,000 miners in Fukuoka, 46,000 workers worked at a naya.

[Insert Table 6 about here.]

Initially, the smallest firms -- the firms with the least sophisticated technology -- had been the most likely to run vertically integrated operations (see Table 6 Pan. D). Among firms with 500 or more workers, 43 used naya in 1923, but 15 did not. Among firms with 100 to 500 workers, only 7 used naya, while 17 did not. The smallest (and least sophisticated) firms, in other words, were most likely to hire directly.

More importantly, perhaps, even many of the larger firms abandoned their naya before they adopted the new technology. Although the mining firms would not adopt modern, technically advanced, mechanical drilling equipment until the 1920s, they had already begun to abandon the use of independent naya.[17] By 1908 a majority of the Chikuho mines had abandoned the use of

[16] Morimoto (nee Sakai) lays out her argument in a several thoughtful articles. See generally Sakai (2015a, 2015b); Morimoto (2013, 2023).

[17] See, e.g., Tanaka (1974), at 50: Sakai (2015a), at 127; Noyori (2010), at 38. Ventilation, pumping, and transportation technology was introduced to Miike rapidly, but the actual mining was not mechanized until about 1910. Murakushi (1976), at 14, 39. Similarly, Takashima introduced steam powered elevators and water pumps immediately, but the actual mining remained room-and-pillar. This generalization glosses over the variation among naya arrangements. For example, Ayukawa (1997), at 17 suggests that some of the shifts simply mirrored terminological

naya in whole or in part. Only 26 percent of the firms still hired miners exclusively through naya. Thirty-two percent hired miners only directly, and 42 percent hired some miners directly and some through the naya (Morimoto 2013, at 275; Morimoto ND, at 81). Within a decade, many of the remaining firms would abandon the naya as well.

D. The Tragedies:

1. Introduction. -- The large Chikuho firms integrated vertically -- I hypothesize -- because they found that they could not adequately monitor and constrain their naya gashira and workers by contract. A series of dramatic events made clear to them both (a) the difficulty that the naya gashira had in committing credibly to humane treatment, and (a) the mismatch in the scope of the reputational capital between the naya gashira and the mining firms more generally. The best-known of these events involved the 1887 Takashima scandal and the 1918 rice riots.

2. The Takashima disaster. -- (a) The claims. -- In 1887, a journalist published an article about a Kyushu coal mine in an obscure magazine.[18] It was a sensational account, and several more widely read newspapers quickly picked up the story.

The mine was Takashima. Located on an island about 15 km off the coast of Nagasaki, the mine had lain largely (albeit not entirely) unexploited during the Tokugawa period. Once the Meiji government removed the barriers to international trade and investment, the Nagasaki prefectural government claimed title. It then sold the mine to a Japanese developer, who turned to Scottish investor Thomas Blake Glover. Glover brought Jardine Matheson connections, and made extensive investments in steam-powered elevators and water pumps.

But Glover also gambled in the Osaka silk market. He soon lost those bets, and with them his fortune. In due course, he had no choice but to liquidate his stake in Takashima, and by 1881 title passed to what would soon become the Mitsubishi conglomerate (Murakoshi 1976, at 22-23, 61).

In the most notorious of the magazine articles, the author claimed to have worked in the Takashima mine for several months. Takashima's recruiters routinely exaggerated the pay workers would earn, he reported. They even lied about how often the firm would pay them. In fact, the naya gashira paid their workers only twice a year, but even that was fictitious, he said. The local store charged 30-50 percent over market, and room and board fees effectively exhausted a worker's pay. "Pay day" was simply an interview at which a worker's naya gashira told him how much his debt had increased since the previous pay day.

The workers worked 12 hours a day, the journalist continued. They slept together in a giant room on a wooden floor. For food they received fresh vegetables once a day, but only pickles otherwise.

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change. See generally Tanaka (1984), at 397; Morimoto (2013), at 222, 225, Morimoto (2020); Noyori (2010), at 38-39; Ogino (1993), at 19.

[18] For a general account of the Takashima dispute, see Oyama (1964), at 134-45. Contemporary newspaper accounts of the Takashima dispute appear at Yamamoto (1960), at 194-08; Tanaka (1984).

The Nihonjin magazine published the first essay about Takashima in June. "Takashima tanko no sanjo" (the misery of Takashima coal mine. But they published multiple stories in the issues that followed, and devoted the ninth issue (August) to the subject. Yoshimoto's article later appeared in many places, including outlets in Tokyo, the Kansai, and in Kyushu. See Tanaka (1984), at 205.

Think Pinocchio's Pleasure Island. Should a worker at Takashima complain or try to escape, journalists explained, his naya gashira responded brutally. He might beat the unhappy worker. Alternatively, he might string him from a tree. Sometimes, he sewed a worker's mouth shut so he could not scream, and lit a fire of smoking leaves under him. Sometimes, he publicly sodomized the worker with a stick.

So hellish were the conditions, wrote journalists, that some miners committed crimes precisely because they hoped the police would arrest them and take them off the island. If they did, the strategy did not work. Instead, the firm just handled the cases itself. Other miners despaired and killed themselves. In 1886, 875 people died on the island. According to the journalistic accounts, some of them had killed themselves simply to escape the living hell.

Once a worker arrived on the island, one journalist reported, "he will never set foot in the human world again."[19] The firm stationed several dozen watchmen around the island. It further contracted with the village across the bay: it paid the villagers a fee, and they agreed to capture and return to the firm any anyone they caught trying to escape.

"In Nagasaki city," one writer declared, "if a child starts to cry, all a mother or father need do is to threaten, 'We'll send you to Takashima.'" The child will promptly stop. In August of 1888, recruiters hired 35 people in Hiroshima to work the Takashima mines. By the time their boat landed at Hakata harbor, the scandal had hit the national news. They refused to go farther.[20]

Mitsubishi owned the mine, but it had not itself hired any of the workers. Instead, the naya had. When anyone complained to the firm -- reported the journalists -- Mitsubishi claimed non-involvement. Some 2,500 men and women (mostly men) worked the Takashima coal mines, but they did not work for Mitsubishi. It did not pay them, supervise them, or punish them. Instead, the miners worked for a naya. Each naya gashira had hired some 50 to 150 workers. These naya gashira had employed the workers, and they now supervised them. If the miners objected to their treatment, their complaints did not go to Mitsubishi. Instead, they went to the naya for whom they worked.[21]

(b) Doubts. One hundred forty years on, it is hard to know how bad the situation at Takashima might have been. At least one report claimed that a rival firm had invented the rumors deliberately to harm Mitsubishi (Tanaka 1984, at 217-18). To fight those rumors, Mitsubishi hired outside consultants. They investigated the claims,[22] and so did the police.[23] The consultants and police all backed Mitsubishi. A miner's room and board expenses did not begin to approach the amount he could earn, they found. A miner received food of reasonable quality. He received medical care and vaccines. Most miners were healthy, lived in sanitary conditions, and worked 23-25 days per month.

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[19] Takashima tanko, reprinted at Tanaka (1984) at 194-97.

[20] See Tanaka (1984), at 207; compare Murakushi (1976), at 84 (80-90 workers per naya).

[21] See Tanaka (1984), at 210; Mutsukoshi (1976), at 77 (2100 workers).

[22] Reproduced at Tanaka (1984), at 210-213. See also C. Arthur Arnold, "Report on the Sanitary, Hygienic, and Physical Condition of the Miners at Takasima and Nakanosima," June 23, 1888, at request of Mitsubishi Sha, as reproduced in Tanaka (1984), 215-17.

[23] Takashima tanko torishirabe ni kansuru Kiyoura keiho kyokucho no danwa [Conversation with Kiyoura Police Chief Regarding Inquiry into Takashima Coal Mine], Yubin hochi shimbun Sept. 15-16, 1888, as reproduced at Tanaka (1984), at 218-222.

Tsuyoshi Inukai also intervened (see Tanaka 1984, at 223-27). In time, he would become prime minister, but in the 1880s he still worked as a journalist. He investigated too. The Takashima workers were paid well, he wrote. Many did indeed die in 1886, but primarily because of an epidemic that had swept through the island, and the firm had improved sanitation in response. If a worker without debt wanted to quit, he could leave. Sometimes, even a worker who did owe the company money could freely leave.

Inukai accused the journalist behind the original rumors - Koichi Matsuoka -- of fraud. Matsuoka responded as if he had read Eugene Onegin: he challenged Inukai to a duel. Inukai dismissed the custom as barbaric, and the government responded by banning duels (Tanaka 2023).

(c) The Mitsubishi response. Fraud or no, the damage to Takashima was done. In part, the harm went to Mitsubishi's national standing. The conglomerate had its roots in Yataro Iwasaki's investments in ocean shipping. Its investment in Takashima reflected its trans-industrial ambitions, but that breadth also expanded the range of investments exposed to reputational damage from the Takashima disaster.

Given the horrific claims, Mitsubishi found it increasingly hard to recruit (see Murakushi 1976, at 90-91; Ogino 1993, at 32). Perhaps because of morale, or perhaps because it could now recruit successfully only second-rate workers, productivity fell (see Murakushi 1976, at 104, 112). And in 1897, Mitsubishi decided to end the use of naya in Takashima (Murakushi 1976, at 106). Rather than rely on independent firms to hire, monitor, and pay its miners, it brought these functions in-house. It vertically integrated into what we now call "H.R."

Production on Takashima had plummeted. From Mitsubishi's acquisition to 1888, production had increased. By 1888, it stood at approximately 300 thousand tons. By 1897, it had fallen to 155 thousand tons (the firm had not reduced the number of workers; Murakushi 1974, 6-7, 13).

Simultaneously, labor relations on the island had collapsed. Workers rioted over pay. They struck. They complained that their mistreatment had increased after the scandal (Murakushi 1974, 8-12). In 1897, strikes on the neighboring Hashima island coal mine left two naya gashira dead (Kim 2020, 50).

And so it is that Mitsubishi in 1897 abolished its naya system on Takashima. Sure enough, production rebounded. By 1900, miners on the island produced 191 thousand tons, and by 1904, 231 thousand tons (Murakushi 1974, 13).

To protect its multi-industry reputation and to be able cost-effectively to recruit skilled miners, Mitsubishi needed to insure that its naya would not abuse recruits. Yet the naya were legally independent of Mitsubishi and not subject to its direct control. Although, Mitsubishi could try to control their behavior by contract, Mitsubishi and the Takashima naya had fundamentally different interests. Mitsubishi curated an enormously valuable reputation. It cared about its recruiting costs. It cared about its productivity. And it cared about the effect of any scandal on its other firms in a wide range of industries.

By contrast, a naya gashira cared only about the margin he earned on the men under his control. Given the far more constrained nature of his stakes, Mitsubishi could control him only through a comprehensively detailed and sharply enforced contract. Never mind the difficulty in enforcing a court judgment against the naya or the absence of dense networks of social capital in Chikuho The more straightforward solution to the non-aligned stakes was simple: take over the naya's functions directly.

Not only did Mitsubishi need to stop any abuse by its naya (if in fact any of the rumors were true), in order to recruit effectively it needed credibly to convince potential recruits that they would be treated well. Because Mitsubishi curated such a valuable reputation, it commanded a credibility no naya could match. Granted, it could -- hypothetically -- promise by contract to make good any abuse by its naya. It could warrant to new hires that the naya would not abuse them, and agree to pay damages if any naya did. It could introduce itself as a direct party to the contracts between the naya and the recruits.

Yet this contract-across-the-market approach presented a credibility problem. The mine recruited heavily among entirely illiterate workers. Some could not even write their names. These were not men familiar with complicated legal mechanisms. Were Mitsubishi to promise to indemnify them against any naya abuse, they would not know how to read the promise, how to understand the promise, and whether to trust the promise.

A vertical integration offered a no-abuse warranty in an intuitively far-more-tractable form. Coase observed that lawyers could replicate by contract the incentives that came with vertical integration -- but the Chikuho miners were not lawyers. They did not understand contracts.

The potential Chikuho recruits did understand the intuition that Mitsubishi was liable for the cruelty of its employees. With the naya gone, they would now sign contracts directly with Mitsubishi representatives. They knew Mitsubishi carried a national reputation. They would live in dormitories owned by Mitsubishi and work under the supervision of Mitsubishi employees. Even to the illiterate, Mitsubishi had put its reputation on the line. If abuse occurred, they understood that Mitsubishi was legally responsible.

3. Rice Riots. -- (a) The violence.[24] A second catastrophe hit the industry in 1918 -- a catastrophe that brought into harsh light the extent of the reputational mismatch between the local naya gashira and the national conglomerates. In turn, the mismatch would apparently convince those firms that had not yet abandoned their naya to shift to vertical integration.

In 1918, disaffected poor across the country rioted en masse. Rice prices had trebled in a year, and the poor decided to act. The stimulus was not poverty itself. For farmers, the higher rice prices obviously translated directly into higher profits. Urban residents were enjoying higher income as well, and for poorer Japanese rice had only recently become a staple anyway. Traditionally, the poor had eaten barley and millet, and sold their rice as a luxury good. With their newfound prosperity, however, famers and urban workers had shifted a larger and larger share of their diet from barley to rice (Harada 1989, at 87). In response to this new demand (boosted further by army procurement), the price of the luxury-turned-widespread-staple climbed. But supply was fixed, at least in the short-run. Boost demand and cap supply, and prices will rise. And so they did.

At root, the riots were not merely about protest; they were also about arson and looting and extortion. The protests themselves began in a Toyama fishing village in July; the riots themselves started in Kyoto and Nagoya on August 10. In Kyoto, those riots lasted 23 days, in Hyogo 12 days, and in Nara 14 days. In Fukuoka they would last over a month.[25] Through the course of several weeks, rioters across the country pillaged and burned stores, warehouses, and wealthy homes. Most often, the mobs targeted rice dealers, merchant houses, and wealthy homes. There, they used the threat of arson to extract cash or price cuts. If their targets hesitated or refused, they looted the

[24] Adapted from Ramseyer (2019).

[25] See generally Shakai (1938), at 2-5, 91-95, 102-04, 416-27, 430-35.

building, drenched it with "oil" (probably kerosene), and burned it down. If a mob torched a home during the night, women and children appeared early the next morning to take any valuables that remained (see Shakai 1938, at 97, 178, 216, 230, 260).

Mobs took their violence, arson, and extortion far across the country. When firemen arrived, they sometimes attacked the firemen themselves. In Fukui, they destroyed the homes of the mayor and police chief, and burned down the police station. In Kobe, they torched 27 of the Suzuki shoten trading firm's buildings. In Osaka prefecture, mobs sometimes 20,000-strong extorted money, looted merchant safes, and torched buildings (see Shakai 1938, at 98-101,128, 137, 182-84).

Some historians identify the beginning of the riots not in the Toyama fishing village of 1918, but at the Chikuho mines in 1917. Rice prices were already rising in 1917, and Chikuho miners had begun to protest (Nihonshi 2017). From 1917 through early 1918, they struck and rioted multiple times. One dispute involved 1,200 workers. Another involved 2,190 workers, and a third involved over 3,000 (Ogino 1988, at 266; Hayashi 2001, at 12). When an explosion at the Taisho kogyo mine killed 72 in 1917, they rioted over this as well (Hayashi 2001, at 12).

Several weeks after the women in the Toyama fishing village demonstrated in July 1918, violence appeared again in northern Kyushu. Among the coal industry longshoremen in the coastal city of Moji, the riots began on August 15 (Hayashi 2001, at 6). As the crowds grew to 1,000 on the 16th, demonstrators burned down storehouses. They destroyed stores. Over the course of the next four days, they attacked 173 homes, 46 rice merchants, 34 sake outlets, and 83 other stores.[26]

By August 17, the riots had moved southwest to the mines themselves. They also moved across the straits to coal mines in Yamaguchi prefecture as well. There at the Okinoyama mines, over 3,000 coal miners rioted over wages. They burned buildings, pillaged stores, and 13 people died (Chikuho 1973, at 288). In Chikuho, over 2,000 miners at the Mineji coal mine rioted over wages and rice prices. They attacked company stores and offices, looted stores, and dynamited buildings. The government called in the army, and on the 18th it shot and killed one of the workers. A demonstrator may or may not have thrown dynamite at the soldiers. Several days later, the army bayoneted another to death.[27]

And from there, the Chikuho riots only grew. On the 19th of August, 200 workers rioted at the Kameyama coal mine and another 20 at the Mitsubishi Hojo mine. On the 20th, 400 workers rioted at the Kanada and Itoda mines. On the 22d, workers rioted at two other mines, and 500 struck at the Mitsubishi Namazuta mine on the 23d. And on the 26th, over 200 workers at two Shinhara mines burned down the house of the company officer in charge.[28]

On August 27th, 1,000 workers assembled at the Nihon (Yahata) seitetsu coal mine and 300 at the Urono mine. On the 28th, over 400 workers at the Sato coal mine demanded wage increases. At the Meinohama coal mine 450 people demanded lower rice prices on the 29th, while over 300 people did the same at the Umi mine (Chikuho 1973, at 289; Ogino 1988, at 274-76).

Through the first half of September, the miners rioted on. Workers rioted at the Akasaka coal mine (Sept. 1), threw dynamite at another mine (also on Sept. 1), and struck for higher wages at the Meiji Toyokuni mine (Sept. 10). At the Meiji coal mine, 380 workers struck over September 16-17 (Chikuho 1973, at 289; Ogino 1988, at 274-76).

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[26] See generally Chikuho (1973), at 288-289; Hayashi (2001), at 11.

[27] See generally Chikuho (1973), at 288-289; Hayashi (2001), at 13.

[28] Chikuho (1973), at 289; Ogino (1988), at 274-76; note that the two lists differ on some details.

All told, the government mobilized the army to suppress the riots at 27 locations within Fukuoka prefecture. Several of these mobilizations lasted multiple days, and some involved over 100 troops each (Matsuo 1988, at 174, 181). Prosecutors filed cases against 7,776 people nationwide. Of these, 740 people were from Fukuoka -- the largest number of any prefecture (Hashimoto 1986, at 157).

The violence subsided, but tension remained. Activists now shifted to unionization. During their time in prison for their role in the Chikuho riots, some of the men had made plans to organize unions. Once the riots ended, they accelerated these unionization efforts (Hayashi 1986, at 203, 264). Labor disputes followed, and the firms responded with black lists (Ogino II, 192).

All of this coincided -- as the industrialists knew too well -- with the emergence of Bolshevik and anarchist cells. The Russian revolution had begun in 1917. The ambitious left organized the cells around the industrialized world in the years that followed, and they organized them in Japan as well.

(b) The mining firm responses. Within this world, conglomerates like the Mitsui, Mitsubishi, Sumitomo and Furukawa found themselves trying to build international business empires. Toward these empires, the coal mines had provided a regular stream of cash. When the riots hit Chikuho in the fall of 1918, the executives realized that they ran their mines within a very bad neighborhood indeed: bad in a way that reflected the nearly total absence of social capital in Chikuho. People do not burn and pillage in neighborhoods tied together by dense networks of social relations. They burn and pillage where no one much cares about his reputation.

The large mining firms were determined never to let this happen again. Toward that end, the industry trade association agreed to circulate the name and address of everyone prosecuted for taking part in the riots. Mitsubishi declared that it would rid the firm of everyone who participated in the riots. It decided even to bar anyone from a family where someone had been convicted of participating in the riots.

And increasingly, the mining executives decided to replace the naya. Post-Coase we may tell ourselves that firms can accomplish the same thing across the market by contract that they can do within the firm by fiat. But they can contract only with parties that are either amenable to judicial enforcement or vulnerable to informal social sanctions. The naya gashira were neither. The mining executives had tried to contract with the naya, and faced unprecedented disaster. Among their employees, they needed basic public order, and their arrangements with the naya were not providing it.

Facing informal social mechanisms that did not work (and consistent with Richman, 2004), the large mining firms fired the naya and integrated vertically. Given the obvious risk of violence, the mines needed near instantaneous information about their workers and an ability quickly and forcefully to intervene. With only contractual relations to the naya gashira who controlled their miners, they had had no such ability. Mitsubishi had already abandoned the naya on Takashima. In the fall of 1918, senior Mitsubishi executives decided to abandon it at their other mines as well (Ayukawa 1997, at 13-14). They dropped the naya and hired and supervised their workers directly (Ogino 1991, at 203; Tanaka 1984, at 415). Increasingly, firms across Chikuho restructured their operations from contract to vertical integration.

IV. Recapitulation

Return then to the two questions at the heart of this article. Put in theoretical form: (a) when do firms choose whether to integrate vertically or to contract across the market, and (b) if

they do choose to contract, when do firms rely on formal mechanisms and when on the informal? Applied to the example at issue: (a) by what economic logic did late 19th century coal mining firms choose to out-source their H.R. (the recruitment, supervision, and reward and punishment of their miners) to independent firms called naya, and by what logic did they later bring those functions in-house; and (b) when they did originally contract for these functions across the market, by what logic did they choose between formal judicial enforcement and informal reputational mechanisms?

When the major conglomerates like Mitsubishi and Mitsui decided to invest in the coal industry, they lacked skilled miners. More specifically, they lacked people with the expertise necessary to identify skilled miners and effectively to monitor and supervise them in their work. Toward that end, they entered into arrangements with experienced miners who agreed to supply these services, and to provide the miners with room and board beside.

Although the mining firms could have hired these experienced miners as senior blue-collar employees, they chose not to do so. Instead, they contracted with men who would supervise the miners across the market through independent firms called naya. Doing so gave these men (the naya gashira) hard-edged incentives to perform. The income that an experienced miner now earned did not turn on what the firm's white collar executives thought of his work. It turned on the quality and quantity of the coal his employees dug, and the efficiency with which they dug it.

What is more, by contracting with multiple experienced miners as independent naya, a mining firm generated crucial information for itself. Had it hired the experienced miners as its own employees, it would have faced the classic who-monitors-the-monitor problem. By simultaneously working with multiple independent naya gashira, it generated hard information about their relative performance.

To enforce its agreements with its naya, a mining firm could not realistically rely on the courts. Having little education, many naya gashira would not have understood (and sometimes could not even have read) some of the contracts proffered. Having no assets other than a few primitive buildings, they were largely judgment proof. Being retired miners themselves, they were almost as mobile (if they had to be) as the men they hired. If they could avoid liability by disappearing, they could disappear.

To enforce a contract with its naya without relying on the courts, a mining firm needed to be able to rely on the informal arrangements that LBG explore so elegantly. Unfortunately for the firms, those arrangements turn crucially on social capital: on communal enforcement and reputational bonds. In a world where LBG logic controlled, a party who breached his contract could expect the community within which he operates to ostracize him -- and to forfeit his gains from expected future trades. Against a trader who operated within a world lacking a dense network of communal ties, a contracting partner would have little recourse.

The largest of the mining firms were part of massive international conglomerates. They employed trade names (e.g., Mitsui, Mitsubishi, Sumitomo) that triggered reputations extending across a broad range of products and services and far into the future. By contrast, the naya brought reputations with neither that product scope nor that temporal depth. Should a large mining firm adopt an opportunistic strategy, it risked reputational damage not just to itself but to its affiliated bank, trading company, insurance firm, steel manufacturer, and a host of other firms. It jeopardized streams of income that extended indefinitely into the future. By contrast, an opportunistic naya gashira jeopardized only his position as an out-sourced H.R. manager and dormitory supervisor. He conducted no other business that might rely on his reputation. And should he renege on his

reputation at one mine, he could disappear almost as quickly and as readily as the miners he had hired.

Many of the miners (and naya gashira) were men who had deliberately chosen not to invest in a reputation for probity at all. Some of the miners were simply criminals. The naya gashira may or may not have been criminals themselves, but they were men who could control criminals and induce them to perform the tasks they assigned them. Think of the contract-enforcement service offered by Meyer Lansky and Lucky Luciano. They induced criminals to honor their contracts -- and violence was part of their lives.

The Takashima crisis of 1887 and the rice riots of 1918 demonstrated dramatically the way that Chikuho lacked any but the most tenuous networks of social capital. The BLG models do not simply posit parties who post their own reputational bonds. They posit parties who live and transact within a community bound together by a complex network of social bonds.

Yet the Chikuho workers were so transient that the area itself lacked much of that network. Some of the miners were local, but many had come from distant areas and brought no ties to the community. They also brought no known history. When they quit, they routinely faded into the local community or (if they were leaving with unpaid debts) to a community one or two villages away.

Many of the larger mining firms needed to protect a reputational asset that extended across industry lines. They needed continually to recruit new miners. Per Takashima, they needed to be able credibly to assure potential miners that their supervisors would not torture and sodomize them. Per the rice riots, they needed to keep order. They needed to ensure that their workers did not burn, pillage and loot their offices, their rich neighbors' homes, their local sake brewers, or their local rice merchants. If the workers did not join Bolshevik and anarchist cells or organize a labor union, so much the better.

The mining firms had hoped to monitor and control their workers through contract, but failed. In the early 20th century, they turned to vertical integration instead.

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Table 1: Coal Output, by Useage

	Export	Ocean transport	Rail	Indus-Road	Salt trial	Total prod.
1875						567
1880						882
1885						1,239
1890	1,224	464	69	428	481	2,666
1895	1,860	747	223	1,198	522	4,549
1900	3,376	1,464	507	2,653	639	8,639
1905	2,528	1,997	842	3,776	499	9,641
1910	4,198	2,358	1,335	4,776	742	13,409
1915		5,385	1,916	8,133	826	20,491
1920		6,972	3,220	14,695	778	29,245
1925		7,200	3,706	18,000	780	31,459

Notes: in 1000 tons.

Sources: Yoshihiro Ogino, Chikuho tanko roshi kankei shi [A History of the Relation between Capital and Labor in the Chikuho Coal Mines] (Fukuoka: Kyushu daigaku shuppan kai, 1993), at 15; Kozan konwa kai, Nihon kogyo hattatsu shi [History of Japanese Mining] (1932), reprinted Meiji hyakunen shi sosho [Meiji 100 Year History] (Tokyo: Hara shobo) (Vol. Chu-1), at 172-74, 187-89; Nisaburo Murakushi, Nihon sekitan gyo no gijutsu to rodo [The Technique and Labor in Japanese Coal Industry] (Kogyo kenkyu bukai, Kokuren daigaku HSDRJE-17J/UNUP-37, 1979), at 171; Takuo Niikura, 2000.Senkanki Nihon sekitan shijo no jukyu kozo no henka ni tsuite [Regarding the Change in the Structure of Demand and Supply in the Coal Market in Interwar Japan, (Kyushu Daigaku) Keizaigaku kenkyu, 66: 95-157 (2000), at 98; Ryoichi Miwa, & Akira Hara, eds. Kingendai Nihon keizai shi yoran [Survey of Early Modern and Modern Japanese Economic History] (Rev. ed.) (Tokyo: Tokyo daigaku shuppan kai, 2010), at 14.

Table 2: Deaths per Year in Coal Mining, 1899-1927.

Year	A. Total Deaths	B. Total Miners	A/B *1000	C. Prod'n (1000 t)	A/C *1000	Deaths fr Explosions
1899	265	60,964	4.35	6,775	39.22	230
1900	43	70,508	0.61	7,489	3.74	7
1901	180	75,230	2.39	9,018	19.96	24
1902	135	78,894	1.71	9,702	13.92	29
1903	215	84,941	2.53	10,089	21.31	125
1904	189	88,330	2.14	10,724	17.62	93
1905	256	79,505	3.21	11,542	22.18	38
1906	560	106,589	5.25	12,982	43.14	330
1907	468	118,772	3.63	13,804	33.90	355
1908	245	126,999	2.93	14,824	16.53	114
1909	535	152,515	3.51	13,048	35.55	280
1910`	307	137,467	2.23	13,681	19.58	8
1911	497	145,412	3.42	17,632	28.19	119
1912	860	152,429	5.64	19,639	43.79	513
1913	507	172,446	2.94	21,315	23.78	108
1914	1572	182,637	8.61	22,293	70.51.	1,125
1915	634	193,142	3.39	20,490	31.93	18
1916	449	197,907	2.25	22,901	19.61	21
1917	1008	250,144	4.03	26,361	38.24	415
1918	682	287,159	2.37	28,029	24.33	67
1919	765	348,240	2.20	31,271	24.46	32
1920	992	352,873	2.89	29,245	33.92	347
1921	643	267,614	2.40	26,220	24.52	54
1922	547	249,022	2.20	27,702	19.75	8
1923	663	278,771	2.38	28,949	22.90	32
1924	839	251,069	3.34	30,111	27.86	165
1925	721	252,898	2.85	32,459	22.92	33
1926	712	235,044	3.03	31,426	22.66	44
1927	909	239,167	3.80	33,531	27.11	96

Source: Kozan konwa kai, Nihon kogyo hattatsu shi [History of Japanese Mining] (1932), reprinted Meiji hyakunen shi sosho [Meiji 100 Year History] (Tokyo: Hara shobo) (Vol. Chu-1), at 217, 370.

Table 3: Comparative Wage Levels

A. Average daily wages for Chikuho miners in early Meiji:

1879	22.5 sen
1880	23.0
1881	24.4
1883	24.0
1884	30.0

B. Average daily wages for male Fukuoka miners in inter-war period:

1926	181.9 sen
1927	186.4
1928	183.0
1929	196.0

C. Selected jobs, 1897-1909 -- sen/day

	Silk reeling F	Cotton Spinning F	Metal working M	Nagasaki shipbuilding M
1897	18.3	13.6	39.2	45.7
1898	19.8	14.9	41.1	51.6
1899	21.6	16.4	45.3	54.2
1900	20.0	19.3	48	56.1
1901	20.0	20.6	49	54.4
1902	20.3	20.6	52	55.7
1903	19.5	20.6	52	56.0
1904	21	21.2	55	57.1
1905	22	22	55	54.3
1906	23	24	57	53.9
1907	27	25	65	56.3
1908	25	27	68	59.6
1909	27	26	67	63.3

Continued on next page --

Table 3 (Continued):

D. Selected jobs for men, 1882-1939 -- sen/day

	Manufacturing	Agricultural daily work	Construction
1882	27	22	34
1885	22	15	23
1890	19		
1895	25	19	33
1900	41	31	55
1905	46	31	61
1910	60	41	84
1915	64	46	88
1920	193	139	274
1925	207	165	312
1930	194	112	261
1935	190	91	207
1939	240	171	282

Sources: Panel A: Ichihara Ryohei & Mitsuo Tanaka. 1964. Naya seido ron, II [The Theory of the Naya System, II]. Keizai ronshu, x: 83-116, at 98; Panel B: Kozan konwa kai, Nihon kogyo hattatsu shi [History of Japanese Mining] (1932), reprinted Meiji hyakunen shi sosho [Meiji 100 Year History] (Tokyo: Hara shobo) (Vol. Chu-1), at 214; Panel C: Yoshihiro Ogino, Chikuho tanko roshi kankei shi [A History of the Relation between Capital and Labor in the Chikuho Coal Mines] (Fukuoka: Kyushu daigaku shuppan kai, 1993), at p. 80; Panel D: Ryoichi Miwa, & Akira Hara, eds. Kingendai Nihon keizai shi yoran [Survey of Early Modern and Modern Japanese Economic History] (Rev. ed.) (Tokyo: Tokyo daigaku shuppan kai, 2010), at 14, as given in Okawa.

Table 4: Monthly Miner Turnover, 1906

	Total miners	Number of miners who Leave	Join	Turn-over %	% local	% married
Hokkaido	11158	763	819	7.1	20.2	59.9
Joban*	3405	368	359	10.7	57.5	67.7
Chikuho	47,865	7101	7132	14.9	42.9	65.3
Miike	8951	435	481	5.1	61.7	60.4
Karatsu	12479	1048	1182	8.9	59.5	58.2
Nishi-sonogi	2503	201	230	8.6	31.4	38.3
Total	86361	9916	10203	11.6	45.0	62.3

Notes: Joban coal fields are in Fukushima and surrounding areas; the Miike mines straddle the Fukuoka and Kumamoto border; the Karatsu mines are in Saga; and Nishi-sonogi is in Nagasaki and includes the Takashima coal mine.

"Turnover %" defined as (Leaving+Joining) x 100/(Miners x 2)

"% local" gives percent of miners from the prefecture in which the mine is located.

*Joban total is inconsistent in source; alternative is 6488.

"% married" data is for 1910.

Source: Yoshihiro Ogino, Chikuho tanko roshi kankei shi [A History of the Relation between Capital and Labor in the Chikuho Coal Mines] (Fukuoka: Kyushu daigaku shuppan kai, 1993), at 21, 25

Table 5: Job Tenure in Coal Mines

A. National data, 1906:

% Years	x<1	1<x<2	2<x<3	3<x<5	5<x	Total
Hokkaido	36.2	21.0	19.0	9.3	14.6	11,158
Joban	52.9	14.7	14.6	10.2	7.6	6,476
Chikuho	50.4	21.5	11.6	8.1	8.4	47,881
Miike	33.0	21.0	12.3	11.5	22.2	8,951
Karatsu	41.7	28.0	14.8	8.8	6.6	12,479
Nishi-sonogi	46.0	21.5	9.0	8.9	14.5	2,502
Total	45.7	21.8	13.2	8.8	10.4	89,447

B. Major Chikuho Mines, 1925-30:

% Years	x<1	1<x<3	3<x<5	5<x<10	10<x	Total
Mitsui Tagawa (1925 Nov)	27.3	29.8	12.1	19.7	11.2	9,154
Shin'nyu (1925 Dec)	53.9	26.2	7.7	8.2	4.0	4,967
Kami-yamada	56.2	25.3	8.6	7.2	2.7	2,383
Shin'nyu (1928 July)	51.6	29.3	9.4	6.7	34.0	2,821
Onoura (1930 Nov)	25.7	21.4	15.3	26.1	11.5	8,011
Namazuta goko (1933 June)	28.4	4.8	37.7	22.5	6.5	626

Source: Yoshihiro Ogino, Chikuho tanko roshi kankei shi [A History of the Relation between Capital and Labor in the Chikuho Coal Mines] (Fukuoka: Kyushu daigaku shuppan kai, 1993), at 26 (Panel A), 313 (Panel B).

Table 6: Use of Naya at Kyushu Mines, 1923

A. Number of Mines:

	Number of mines		Total	Total	Number naya/mine		
	With naya	No Naya	Mines	naya	High	Low	Mean
Fukuoka	50	32	82	554	70	1	11
Saga	5	8	13	94	52	8	19
Nagasaki	17	13	30	167	66	1	9
Total	72	53	125	815	70	1	12

B. Number of Miners:

	Miners	Direct hires at mines		
	at naya	with naya	w/o naya	Total
Fukuoka	46,044	20,816	34,718	101,578
Saga	8,924	2,274	4,450	15,648
Nagasaki	7,579	2,284	4,783	14,646
Total	62,547	25,374	43,951	131,872

C. Miners per Naya

	High	Low	Average
Fukuoka	559	7	91
Saga	496	10	101
Nagasaki	145	5	54

D: Use of Naya, by number of workers at Coal Mine, 1923

No. workers:	100-500		500-1000		1000-3000		3000-		Total	
Use of naya:	Y	N	Y	N	Y	N	Y	N	Y	N
Fukuoka	7	17	16	5	19	6	8	4	50	32
Saga	0	6	0	1	3	0	2	1	5	8
Nagasaki	12	10	2	2	1	0	2	1	17	13
Yamaguchi	1	3	2	0	4	0	0	0	7	3

Table 6 (Continued):

Notes: For Panels A through C: survey of naya at Fukuoka, Saga, Nagasaki, and Yamaguchi ken coal mines with over 100 miners. By number of miners, this covers 96 percent of all.

Sources: Fukuoka komu kyoku, Taisho 12 nen 1gatsu, Fukuoka, Saga, Nagasaki, Yamaguchi, 4 kenka ni okeru naya gashira ni kansuru chosa [Survey of Naya Bosses in Four Prefectures of Fukuoka, Saga, Nagasaki and Yamaguchi in January of 1923], pub. 1924, reprinted at Naoki Tanaka, Kindai Nihon tanko rodo shi kenkyu [A Study of the History of Early Modern Japanese Coal Mining Labor] (Tokyo: Sofukan, 1984), at at 416-17; also available at Ryohei Ichihara & Mitsuo Tanaka. 1964. Naya seido ron, I [The Theory of the Naya System, I]. Keizai ronshu, 14: 97-134, at 131-32; Ryohei Ichihara & Mitsuo Tanaka. xx. Naya seido ron, I [The Theory of the Naya System, I]. Keizai ronshu, 14: 97-134, at 132.