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## Conformism and Innovation: Evidence from R&D and Patents\*

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### Abstract

Innovation is central to productivity growth, yet firms facing similar technological and policy environments differ in their R&D investment behavior. We examine whether persistent regional social norms help explain this variation. Using prefecture-level data from Japan, we measure regional conformism based on a 1941 military conscription examination and contemporary school education surveys, demonstrating that regional differences have persisted over time. Linking them to data on all Japanese manufacturing firms from 1995 to 2022, we find that firms in more conformist regions exhibit significantly lower R&D intensity even after controlling for cognitive ability, firm characteristics, and fixed effects. The relationship with patenting is weaker and less robust. To isolate the historical component of conformity, we instrument pre-war conformism using differences in domain-level educational curricula during the Edo-period (1603–1868). The IV results similarly indicate a significant negative effect on firms' R&D intensity. Overall, the findings suggest that persistent regional social norms are most strongly related to firms' innovation investment rather than realized innovation output.

Keywords: conformism, social norms, R&D, patents, innovation investment, cultural persistence, regional culture.

JEL classification: G23, G32, L25, O31, M14

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# 1 Introduction

Innovation is a key engine of economic growth. Seminal contributions have shown how technological progress drives productivity and long-run prosperity, notably through firm incentives, competition, and policy choices (Mokyr, 1990; Romer, 1990; Aghion and Howitt, 1992; Jones and Williams, 1998; Bloom et al., 2013; Akcigit and Kerr, 2018). Yet even in similar institutional settings, firms differ markedly in their willingness to invest in innovation. We ask whether such differences stem from deeper social and psychological characteristics of the population surrounding firms. Specifically, we examine whether *conformism*—a non-cognitive attitude reflecting the tendency to follow social norms and avoid deviating from collective behavior—helps explain persistent differences in innovation investment across otherwise similar regions.

We construct prefecture-level measures of conformism and cognitive skills across Japan’s 47 prefectures and relate these traits to firms’ innovation outcomes. Our design therefore links regional culture to the average innovation performance of firms located in that region. Our empirical analysis uses a large panel of Japanese manufacturing firms, both listed and unlisted, covering the years 1995 to 2022. Our baseline analysis aggregates firm-level outcomes and controls to the prefecture–year level and estimates panel regressions of regional innovation on historical regional traits. Because conformism varies at the prefecture level and changes only slowly over time, identification comes primarily from cross-prefecture differences. Aggregation aligns the unit of observation with the level of cultural variation and

reduces idiosyncratic firm-level noise. The setting offers two key advantages. First, Japan's prefecture borders have remained stable for over 130 years, allowing us to merge modern firm-level data with rich historical measures of regional attitudes. Second, while Japan may appear culturally homogeneous from the outside, there exists substantial and persistent heterogeneity across prefectures in both cognitive and non-cognitive traits.

To examine whether conformism reduces innovation while accounting for other known determinants of innovative activities, we first use a proxy of conformism derived from present-day surveys of school students, namely, the extent to which students say they follow the rules of their school. We find that prefectures with higher conformism exhibit lower average R&D intensity and, in several specifications, lower patenting activity among firms headquartered there, even after controlling for cognitive skills, firm characteristics, and industry fixed effects. The effects are consistently stronger and more robust for R&D than for patents, and the patent relationship attenuates once conditioning on R&D, indicating that conformist norms are more closely related to firms' innovation investment than to realized innovation output.

The main analysis then uses unique pre-World War II survey data to measure regional attitudes before modern industrial development and mass migration took root. Specifically, we use a 1941 nationwide conscription survey that included both cognitive tests and value-based questions, allowing us to construct a prefecture-level index of conformism based on the percentage of respondents correctly identifying socially expected virtues. Despite internal migration over the postwar period, regional culture appears to persist over time, consistent

with findings by Davis and Weinstein (2002), Montgomery (1993), and Ito et al. (2017).

Not only do these attitudes persist, but they still affect economic outcomes today. In our prefecture-level panel estimates, a one standard deviation increase in historical (pre-WWII) conformism is associated with roughly a 2 to 3 percent lower average R&D intensity among firms located in that prefecture. The corresponding estimates for patent output are smaller, less precisely estimated, and in some specifications statistically insignificant. This contrast suggests that conformism primarily affects firms' willingness to invest in innovation rather than the translation of these investments into patent output, which depends more strongly on firm size, industry composition, and long-run regional development. The findings hold when we control for a wide range of firm-level variables and other cultural dimensions. We also find that prefectures with a higher share of firms with foreign ownership and greater use of stock-based compensation exhibit higher innovation intensity, consistent with findings by Bena et al. (2017) and Luong et al. (2017).

Although pre-WWII conformism attitudes clearly precede present-day corporate decisions, there is still the question of why conformism varies across Japan. Our interpretation is that these 1940s attitudes capture a genuinely deep, regional cultural component, but they could also be correlated with other long-run features of prefectures, such as earlier modernization, industrial development, or regional scale, that are not themselves "conformism" but do matter for innovation. Following the logic in Nunn (2009) and related work on the long-run persistence of local cultural traits (e.g. Nunn and Wantchekon, 2011), we trace this

variation back to the Edo period (1603–1868), when education was organized at the level of autonomous *han*. Domains differed substantially in the content of instruction: some han schools (*hankō*, *shijuku*, *terakoya*) focused mainly on traditional subjects such as *wagaku*, *kangaku*, *shintō*-oriented studies, calligraphy, and etiquette, while others allocated a larger share of teaching to more outward-looking or practical fields such as Dutch/Western learning (*rangaku*), mathematics, astronomy, or medical science. We capture this variation with a prefecture-level “traditional-subject share.” When aggregated to the modern prefecture level and used as an instrument, this Edo-period measure strongly predicts pre-WWII conformism. In the second stage, instrumented conformism continues to reduce prefecture-level R&D intensity, with magnitudes comparable to the baseline estimates. This result remains robust when controlling for historical population and early industrialization, suggesting that the Edo measure captures more than long-run differences in regional scale or development. By contrast, the initially positive relationship between the Edo measure and patenting becomes statistically insignificant once these historical controls are included, indicating that patent outcomes are more sensitive to industrial structure and firm scale than to conformist norms.

Taken together, the evidence points to a long causal chain: Edo-period educational choices shaped local attitudes by the 1940s, and these attitudes continue to influence regional R&D investment today. Across specifications, the relationship is consistently stronger for R&D than for patenting, suggesting that persistent social norms operate mainly at the

innovation investment stage rather than uniformly affecting realized innovation output.

This mechanism fits naturally into a broader literature showing that non-cognitive traits and preferences matter for economic behavior. Much of that work has focused on individuals and on outcomes such as on labor income (Heckman et al., 2006; Lindqvist and Vestman, 2011), educational attainment (Cunha et al., 2010), health (Heckman et al., 2018), and financial decision-making (Xu et al., 2015; Parise and Peijnenburg, 2017). Only a smaller set of papers has linked such traits to firm policies. For example, Gow et al. (2016) show that firms led by CEOs with higher “openness” scores invest more in R&D, and Adams et al. (2011); Adams (2018) document that directors’ and board members’ values correlate with shareholder-oriented policies. Related work on CEO ideology, narcissism, or long-term orientation likewise suggests that psychological and social characteristics at the top of the firm can tilt investment and innovation choices (Licht and Adams, 2016; Fiordelisi et al., 2018). Our contribution is to push this logic one step further down the ladder of formality: even when we do not observe CEO traits, region-level social norms, formed long before present managers were hired, still show up in firms’ innovation investment behavior.

A complementary strand of research studies deeper cultural or psychological dispositions, such as grit, persistence, or ideational priming, that shape behavior over long horizons (Bryan et al., 2018; Laudenbach et al., 2018). Our results are consistent with this view: prefectures that were socialized into more rule-following and traditionally oriented educational environments continue to exhibit lower regional innovation intensity decades later.

Seen from the perspective of the innovation-and-growth literature, our findings supply a micro-historical channel for why otherwise similar regions or firms may innovate at different rates. Classic Schumpeterian models and their empirical counterparts stress the roles of incentives, competition, and policy (Romer, 1990; Klette and Kortum, 2004; Aghion et al., 2005; Aghion and Jaravel, 2015; Akcigit et al., 2022), and economic history has underlined the importance of an innovative culture for sustained growth (Mokyr, 2016). We add that such cultures can be locally produced, through Edo-period schooling choices about subject matter (*wagaku* versus *rangaku*) and that they can persist strongly enough to matter for firms operating in Japan’s late-20th- and early-21st-century manufacturing sector. In this sense, the paper links the modern, policy-focused innovation literature to the longer-run, history-and-culture narrative, and shows that social norms are an important determinant of cross-regional differences in innovation investment, even in a modern, innovation-driven economy.

The remainder of the paper is organized as follows. Section 2 describes how we measure regional conformism and cognitive skills using pre-WWII and current-day data. Section 3 presents the firm-level data, the construction of prefecture-year aggregates, and the key variables used in the analysis. Section 4 presents the main findings. Section 5 describes education policy in the Edo period and develops instrumental variables estimates. Section 6 concludes.

## 2 Conformism and Cognitive Skills

We construct prefecture-level measures of conformism using both contemporary and historical data sources, and we also account for cognitive ability using standardized academic assessments. The dual focus allows us to explore the role of long-standing cultural attitudes, rooted in Japan’s decentralized educational traditions, as well as more recent variations in student discipline and academic proficiency across regions.

Section 2.1 describes the contemporary data drawn from nationwide school testing in the early 2000s. Section 2.2 outlines our primary data source: a uniquely rich survey of young men in 1941 administered as part of the military conscription system. These historical data provide standardized, prefecture-level indicators of both cognitive and non-cognitive traits, allowing us to trace the persistence of regional cultural characteristics and their relationship to modern economic behavior.

### 2.1 Current-Day Data

Although central government (the Ministry of Education, MEXT) has maintained standardized curriculum guidelines since World War II, the implementation of education remains locally decentralized. Specifically, municipal education committees retain considerable autonomy in shaping how core subjects and moral education are taught.<sup>1</sup> This decentralized

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<sup>1</sup>See Ito, Kubota, and Ohtake (2015) for evidence that public school curricula vary substantially across municipalities and influence preference formation.

structure contributes to persistent heterogeneity in both cognitive abilities and non-cognitive attitudes across regions.

We utilize the nationwide standardized achievement tests administered by MEXT since 2007 (National Assessment of Academic Performance, Zenkoku Gakuryoku Gakushu Jokyo Chosa), which target two cohorts: sixth-year elementary students and third-year junior high school students. These data provide two types of metrics:

- **Cognitive Skills:** Measured by the average performance in academic subjects—specifically mathematics and Japanese language. We standardize these scores at the prefecture level.
- **Conformism:** Measured by the proportion of students responding “yes” to the question: “*Do you follow the rules of your school?*” A higher affirmative response rate is interpreted as indicating a stronger regional norm of conformist behavior.

## 2.2 Pre-World War II data

Our pre-WWII data come from the 1941 *Educational Survey on Soldiers in the Conscription System* (*Sōtei Kyōiku Chōsa Gaikyō*) conducted by the Ministry of Education. As part of the conscription process, all twenty-year-old men were required to take standardized examinations across several subjects. These data, aggregated at the prefecture level, provide a rare and valuable snapshot of regional skills and attitudes immediately prior to World

War II. Notably, Japan's 47 prefectures have maintained stable boundaries since the late 19th century, facilitating the direct matching of these historical measures to modern firm headquarters.

The survey includes three primary academic areas: Language (literacy and writing in Japanese), Science (basic knowledge of the natural sciences), Social Studies (geography, history, political systems, and moral education). Moral education in the section of Social Studies is based on *Shūshin*. Shūshin education was a form of moral education in pre-WWII Japan, strongly influenced by Confucian values such as filial piety, loyalty, harmony, and respect for hierarchy. Unlike Western moral education, which often focused on universal ethics or individual rights, shūshin emphasized duty, social order, and collective responsibility. It was closely tied to the Imperial Rescript on Education (1890), which provided the official foundation for teaching loyalty to the Emperor, respect for parents, and devotion to the nation. Through this system, schools aimed to shape students not only as individuals but as dutiful members of family, society, and the state. Crucially for our purposes, the social studies section includes a question designed to assess moral values: “Which of the following is a virtue (*kōtoku*)?” The multiple-choice answers were

1. Giving your seat to an elderly person on a train
2. Working hard
3. Saving money and making a profit
4. Punctuality

The official “correct” answers were options (1) and (4). We interpret selection of these responses as an indicator of adherence to socially sanctioned behavioral norms, i.e., conformity. Our central assumption is that these answers were highly salient to examinees, and deviation from them reflects a willingness to go “against the grain.” While not a validated psychological scale, this measure provides a historically grounded and consistent proxy for regional conformist attitudes.

We aggregate responses to this question at the prefecture level to construct our historical (pre-WWII era’s) conformism index.<sup>2</sup> One might reasonably ask whether failure to select the expected answers reflects misunderstanding rather than nonconformity. To address this, we include orthogonalized controls for the same individuals’ performance in language and science sections, thereby distinguishing cognitive ability from attitudinal disposition.

In summary, our historical measure captures a region-level non-cognitive trait that is conceptually close to willingness to follow socially sanctioned behavior. Because the survey also recorded cognitive test scores, we can separate this attitudinal component from differences in academic skills. In Section 5 we show that this prefecture-level variation in conformism is plausibly rooted in earlier, Edo-period differences in educational content.

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<sup>2</sup>We primarily use scores for individuals with less than junior high school degree (Kou) because they account for 85.7% of examinees, while individuals with higher than junior high school degree (Otsu) account for 14.3%. Around 660,000 male (all male aged 20) took the exam (as of 1941).

## 2.3 Descriptive Variation and Persistence

The constructed indices for conformism and cognitive skills exhibit substantial regional variation across Japan, both pre-WWII era and today. These prefecture-level differences form the basis of our empirical analysis, which relates regional variation in innovation outcomes to historical cultural traits. Figure 1 maps the standardized scores for today’s conformism across the 47 prefectures. The Appendix also shows pre-WWII era scores (and also maps the corresponding measures for cognitive skills). Darker shading indicates higher scores.

These maps reveal notable patterns. Mie prefecture ranks among the top for both current cognitive and non-cognitive skills (4th in non-conformism, 3rd in language, and 1st in science). Tokyo ranks 45th in conformism—indicating low adherence to uniform behavioral norms—but 2nd in language and 1st in science, suggesting strong cognitive capacity despite relatively independent attitudes. Osaka similarly combines moderate cognitive scores (10th in language, 16th in science) with low conformism (38th place). These examples illustrate that cognitive and non-cognitive traits do not perfectly correlate

*[Figure 1 about here]*

*[Figure 2 about here]*

Figure 2 plots pre-WWII era and current-day conformism and cognitive skill scores against each other. Panel A demonstrates a strong positive association between past and present conformism, suggesting cultural persistence. In Panel C, higher conformism in pre-

WWII era is negatively associated with current cognitive skills. While there is some correlation between cognitive and non-cognitive indicators (Panels B and C), the relationships are far from perfect. This supports our interpretation that conformism is not merely a proxy for test-taking ability.

Regional persistence of culture and educational attitudes is supported by several strands of literature. Despite labor migration—especially into Tokyo and Osaka since the 1920s—Japan has seen relatively low long-distance mobility overall (Montgomery, 1993; Kondo and Okubo, 2015). Population densities across prefectures are highly correlated from the 1600s to the 1990s, and even wartime shocks such as the Tokyo bombings or the 1923 earthquake did not permanently disrupt the urban hierarchy (Davis and Weinstein, 2002; Imaizumi et al., 2016).<sup>3</sup>

## 3 Firm-Level Data and Prefecture-Level Aggregation

### 3.1 Sample and Data Sources

We use panel data covering Japanese manufacturing companies from 1995 to 2023, constructed by merging three data sets from the Ministry of Economy, Trade and Industry (METI): the *Basic Survey of Japanese Business Structure and Activities*, the *Census of Manufacture*, and the *Survey on Overseas Business Activities*. Our main data source is the

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<sup>3</sup>Cultural traits such as social capital and even surname clusters also show long-term regional persistence (Ito et al., 2017; Cheshire et al., 2014)

Basic Survey of Japanese Business Structure and Activities, which includes accounting and governance information for both listed and unlisted firms with over 50 employees and at least 30 million yen in capital assets.<sup>4</sup>

We use the firm-level data to construct prefecture–year aggregates of innovation outcomes and firm characteristics. Specifically, for each prefecture and year, we compute the average value of innovation measures and control variables across all firms headquartered in that prefecture. The empirical analysis is therefore conducted at the prefecture–year level, which aligns naturally with the prefecture-level measurement of conformism and cognitive skills.

Our analysis is restricted to manufacturing firms, consistent with our focus on R&D behavior and patenting. We restrict our analysis to independent firms that do not have parent companies. If a firm is owned by another company (a parent company), its managerial decision-making, including innovation decisions, is likely to be shaped primarily by the parent. Therefore, the impact of local attitudes and culture may be attenuated for such firms. We exclude these firms before constructing prefecture–year aggregates.

### **3.2 Dependent Variables: Innovation**

We measure innovation using two complementary outcomes. First, *R&D Intensity* is calculated as research and development (R&D) expenditures divided by the number of employees, scaled by 100. R&D expenditure includes all costs incurred to generate new knowledge

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<sup>4</sup>The survey achieves a response rate of approximately 85%.

and/or develop new products and production processes, including materials and labor costs for research personnel. Second, *Patents* is the number of patents owned by the firm under the Japanese Patent Law. For the prefecture–year analysis, we compute the average number of patents per firm within each prefecture and year. We acknowledge limitations in the patent measure: patents vary in economic significance, and we lack citation data or semantic content analysis (cf. Kelly et al. (2018)). However, the count of patents remains a widely used proxy in empirical innovation studies. In sum, our two proxies reflect, respectively, innovation inputs and observable outputs, following standard approaches in the literature (Acharya and Xu, 2017; Chemmanur et al., 2014).

### **3.3 Control Variables**

We include a set of lagged firm-level controls to capture key characteristics of firms and their economic environment that may also drive innovation differences among firms. Specifically, we account for firm size (measured by the number of regular employees), average wage per worker, firm age (natural logarithm of the years from the founding years). To proxy for firm performance, we include a dummy variable for the listed firms and return on assets (ROA), defined as net income divided by total assets. We also add prefecture level GDP to control regional differences. We also control for whether a firm is publicly listed, via a binary indicator equal to one for listed firms. Corporate governance practices are captured by a dummy variable for the use of stock option plans and the percent foreign ownership. All

firm-level controls are averaged at the prefecture–year level before inclusion in the regressions.

Finally, to account for regional economic and non-economic conditions, we include the logarithm of prefecture-level GDP per capita (Cabinet Office data). In additional results, we control as well for prefecture-level measures of individual perceptions and attitudes (Big Five traits and social capital indicators such as trust, reciprocity, and cooperation), constructed from the Okubo-NIRA survey (Okubo and Nippon Institute for Research Advancement (NIRA), 2022).<sup>5</sup> Finally, in some regressions we use the (log) number of factories (from the Census of Manufacture, Ministry of Agriculture and Commerce) and (log) population (from the Population Census, Cabinet Office) before World War II.

All firm-level controls are lagged by one year before aggregation to reduce simultaneity concerns. Definitions of all variables are summarized in Table 1.

*[Table 1 about here]*

### 3.4 Descriptive Statistics

Table 2 reports summary statistics for the prefecture–year aggregates that constitute the unit of observation in our baseline regressions, while Table A1 presents summary statistics for the underlying firm-level variables prior to aggregation.

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<sup>5</sup>NIRA and Toshihiro Okubo conducted the panel survey on more than 10,000 Japanese workers (Okubo-NIRA Survey). The survey started from April 2020, taking a stratified random sampling strategy. The number of samples for 60 region–age groups was determined by workforce ratio. The Labor Force Survey (Ministry of Internal Affairs and Telecommunication) was employed as the sampling unit. Using the survey, we aggregate micro-level to prefecture-level. See Okubo (2022) for more details on the survey. Link to the data: <https://nira.or.jp/paper/data/2022/26.html>.

At the prefecture–year level (Table 2), the average R&D intensity is 36.35, with a standard deviation of 21.56. Because R&D intensity is defined as R&D expenditures divided by the number of employees, scaled by 100, this variable captures the average intensity of innovative input per employee among firms located in a given prefecture and year. The interquartile range (20.91 to 48.76) indicates substantial dispersion across prefectures and over time.

The average number of patents per firm (within prefecture–year) is 46.70, with a standard deviation of 42.19 and a median of 33.79. The wide spread between the 25th and 75th percentiles (14.51 to 63.74) suggests pronounced heterogeneity in innovative output across regions.

Turning to the explanatory variables, the standardized conformism and cognitive skill measures exhibit considerable cross-prefecture variation. For example, pre-WWII conformism has a mean of 0.66 and a standard deviation of 0.95, while the Edo-period traditional education share has a standard deviation of 1.15. These magnitudes indicate meaningful dispersion in the cultural variables that form the basis of our identification strategy.

Table A1 shows that, at the firm level, innovation activity is highly skewed. Many firms report low or zero patenting, while a subset of firms accounts for a disproportionately large share of innovative output. Similarly, R&D expenditures per employee vary widely across firms. Aggregation to the prefecture–year level smooths idiosyncratic firm-level noise, but substantial regional heterogeneity remains, which we exploit in the empirical analysis.

Governance variables also display marked heterogeneity. While the share of listed firms

and average foreign ownership vary systematically across prefectures, stock option usage remains relatively rare. These patterns motivate the inclusion of governance controls in our regressions to ensure that estimated cultural effects are not proxying for systematic differences in corporate structure or ownership across regions.

*[Table 2 about here]*

## 4 Results

### 4.1 Empirical strategy

Our key regressors—historical and contemporary measures of prefecture-level *conformism* and *cognitive skills*—vary at the prefecture level and are time invariant (or very slow moving). Identification therefore comes from *between-prefecture* differences, while exploiting the panel dimension of the data to improve precision and control for common time shocks.

Our baseline unit of observation is the prefecture–year. For each prefecture and year, we compute the average innovation outcomes and firm characteristics across all manufacturing firms headquartered in that prefecture. This aggregation aligns the level of variation in the explanatory variables (prefecture-level culture) with the level of the dependent variables and mitigates idiosyncratic firm-level noise, especially in patent counts.

Let  $Y_{jt}$  denote the average innovation outcome in prefecture  $j$  and year  $t$ , and let  $\mathbf{X}_{jt}$  be the corresponding vector of prefecture–year averages of firm characteristics. Our baseline

specification is

$$Y_{jt} = \alpha + \gamma_t + \beta_1 \text{Conformism}_j + \beta_2 \text{CognitiveSkills}_j + \mathbf{X}'_{jt}\Gamma + \varepsilon_{jt}, \quad (1)$$

where  $\gamma_t$  are year fixed effects and the cultural indices are standardized to mean zero and unit variance. Standard errors are clustered at the prefecture level to allow for arbitrary serial correlation within prefectures over time.

We consider two innovation outcomes  $Y_{jt}$ : (i) *R&D intensity*, defined as R&D expenditures divided by the number of employees and expressed in percentage terms, and (ii) the average number of patents per firm in the prefecture–year. Equation (1) therefore measures how differences in regional conformism are associated with systematic differences in average innovation inputs and outputs across prefectures, controlling for time-varying economic conditions and average firm characteristics.

## 4.2 Main results

We begin with regressions of prefecture–year average innovation outcomes on prefecture–level indices of *Conformism* and *Cognitive skills*, controlling for year fixed effects and prefecture–year averages of firm covariates.

*[Tables 3 and 4 about here]*

Table 3 shows that prefectures with higher contemporary conformism exhibit significantly

lower average innovation intensity. Using the sample mean of R&D intensity in Table 2 (36.35), the point estimates imply that a one-standard-deviation increase in present-day conformism is associated with a reduction in R&D intensity of approximately 1.5 to 2 units, corresponding to roughly 4–6% of the mean.

For patents, where the prefecture-year mean is 46.70, the estimated effects imply reductions on the order of 2 to 3 patents per firm, or roughly 5–7% of the mean. Contemporary cognitive skills enter with the opposite sign: prefectures with higher academic performance exhibit significantly higher R&D intensity and patenting.

The coefficients on standard firm-level controls, reported in Appendix Table A2, are generally in line with expectations: larger firms and those with higher capital intensity exhibit higher R&D intensity and patenting, while the inclusion of these controls does not materially affect the estimated relationship between conformism and innovation.

Column (3) of Table 3 additionally controls for R&D intensity in the patent regressions. The coefficient on conformism declines meaningfully in magnitude once R&D intensity is included, indicating that the relationship between conformism and patenting partly operates through firms' innovation investment. This pattern is consistent with a channel in which conformist environments reduce R&D spending, which in turn contributes to lower patent output.

Including additional prefecture-level cultural controls (Table 4) leaves the core patterns intact. Intergenerational occupational persistence (“same occupation as parents”) enters

with a positive coefficient, suggesting that regions with stronger occupational continuity may also be characterized by more stable industrial structures or established firm bases that support innovation activity. At the same time, this variable does not attenuate the conformism coefficient, which remains negative and statistically meaningful across specifications.

The inclusion of personality-trait aggregates (Big Five) yields mixed and generally less robust patterns. In particular, openness is positively associated with innovation outcomes, consistent with its interpretation as a trait linked to creativity and receptiveness to new ideas. By contrast, other traits such as extraversion do not display stable relationships across specifications, with coefficients varying in sign and significance. Overall, the inclusion of these controls does not materially affect the estimated impact of conformism. The R&D results remain stable, whereas patent coefficients become less precisely estimated, reinforcing the view that innovation inputs are more tightly linked to regional cultural traits than innovation outputs.

Turning to the historical measures, Table 5, columns (1)–(2), shows that the 1941 pre-WWII conformism index is even more strongly associated with innovation inputs. A one-standard-deviation increase in historical conformism is associated with a reduction in R&D intensity of approximately 2 to 2.5 units, corresponding to roughly 6–7% of the sample mean.

For patents, the coefficients are negative but less precisely estimated and sensitive to specification. In several specifications they fall short of conventional significance levels. This

pattern suggests that conformism operates most robustly on firms' innovation investments (inputs), while translation into measurable patent output likely depends more strongly on firm-specific technological opportunities, industry composition, and regional scale.

Historical cognitive skills (language and science performance in 1941) are positively related to both R&D intensity and patenting, with economically meaningful magnitudes comparable to those of the contemporary measures.

In specifications that include governance covariates—foreign ownership and stock-option usage—the conformism coefficients remain negative and of similar magnitude. Prefectures with a higher share of foreign-owned firms and greater use of stock-based compensation exhibit higher R&D intensity and patenting. However, these governance variables do not attenuate the conformism effects, indicating that regional cultural norms are not merely proxies for differences in ownership structure or incentive schemes.

Figure 3 illustrates the cross-prefecture relationships graphically. The negative association between conformism and R&D intensity is visually apparent and not driven by extreme outliers.

*[Figure 3 about here]*

Taken together, the evidence indicates that regional conformism is systematically and economically associated with lower innovation inputs and, to a lesser extent, innovation outputs. The stronger and more robust effects for R&D intensity are consistent with a channel

in which conformist environments discourage experimentation and risk-taking at the investment stage. The attenuation of patent effects once conditioning on R&D further supports this interpretation. The fact that historical measures exhibit larger coefficients reinforces the interpretation of a persistent cultural mechanism rather than short-run sentiment.

## 5 Historical Background and Instrumental Variables

### 5.1 Why did prefectures differ in conformism in 1941?

The results so far show that attitudes measured before World War II explain systematic differences in innovation across prefectures several decades later. This raises a natural follow-up question: why did prefectures already differ in conformism in the 1940s? An econometric concern is that our 1941 conformism index may capture broader, slow-moving prefecture characteristics that also affect innovation today. For example, prefectures that modernized earlier, invested more heavily in Meiji-era schooling, or were more exposed to foreign influence may both exhibit lower conformism in 1941 and host more innovative firms in the postwar period. In that case, OLS estimates would confound conformism with these deeper historical factors. This is a standard concern in work on long-run persistence, where historical variables often bundle together several slow-moving regional characteristics (Nunn, 2009).

To address this concern, we exploit regional variation originating in the Edo period (1603–1868), when education was organized at the level of autonomous domains (*han*). Be-

cause this institutional structure predates industrialization, centralization, and modern economic development, it provides plausibly exogenous variation in the educational environment that shaped later attitudes.

## 5.2 Edo-period educational heterogeneity

During the Edo period, Japan consisted of roughly 250 semi-autonomous domains governed under the Tokugawa Shogunate. Education was not centrally administered but organized locally by domain authorities, private academies, and temples. This decentralization generated substantial heterogeneity across regions (see Oishi (2006, 2007)).

Several types of schools coexisted. *Hankō* were domain-sponsored schools, typically serving the samurai class and emphasizing classical Chinese learning and ethics. *Shijuku* were private academies, while *terakoya* provided literacy and numeracy training to commoners. Beyond these institutional forms, domains differed in the *content* of instruction. Some schools focused primarily on traditional subjects such as *wagaku* (Japanese studies), *kan-gaku* (Chinese classics), *shinto* studies, and calligraphy. Others devoted greater attention to more outward-looking or practical subjects, including Dutch or Western learning (*rangaku*), mathematics, astronomy, and medical science. By the end of the Edo period, literacy rates were high by international standards. However, the intellectual orientation of education varied markedly across domains. Some regions maintained a curriculum centered on classical and moral instruction, while others incorporated more scientific and technical subjects.

The Meiji Restoration abolished the han system (*Haihan Chiken*) and introduced a centralized education system. Nevertheless, many existing schools were incorporated into the new structure, and local intellectual traditions persisted. It is therefore plausible that Edo-period educational emphases shaped the social norms that later manifested in the 1941 conformism measure.

### 5.3 Edo-period measure: traditional subject share

We construct a prefecture-level measure of Edo-period educational emphasis using the han-school dictionary compiled by Oishi (2006). There are no hans in Tokyo, Yamanashi, and Okinawa prefectures; this part of the analysis therefore covers 44 prefectures.<sup>6</sup> For each han, we classify schools according to whether they primarily taught traditional subjects (e.g., *wagaku*, *kangaku*, *shinto* studies, calligraphy) or more outward-looking and scientific subjects (e.g., *rangaku*, mathematics, astronomy, medical science).

For each prefecture, we compute the *Traditional education share* as the share of Edo-period schools teaching traditional subjects. When aggregating to the prefecture level, we weight han-level measures by domain economic size, proxied by rice production (*roku daka*) in the late Edo period. This weighting accounts for differences in demographic and economic importance across domains.

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<sup>6</sup> Tokyo (the capital city, Edo) was directly governed by the Tokugawa Shogunate; Yamanashi prefecture had no hans after the abolition of Kofu han in 1724; Okinawa was an independent kingdom (Ryukyu) during the Edo period.

The Appendix provides illustrative historical examples showing that these differences in curricular emphasis were systematic and reflected deliberate local policy choices rather than random variation.

## 5.4 Reduced-form and instrumental-variable results

We use the Edo-period measure in two ways. First, we estimate reduced-form regressions of prefecture-year innovation outcomes on the Traditional education share. As shown in Table 6, columns (1) and (2), which control for pre-war population to account for historical differences in regional scale, prefectures with a higher historical emphasis on traditional subjects exhibit significantly lower R&D intensity in the late twentieth and early twenty-first centuries. In quantitative terms, a one-standard-deviation increase in the Traditional education share is associated with a reduction in R&D intensity comparable in magnitude to the effect of pre-WWII conformism itself.

In contrast, the reduced-form relationship with patenting is initially positive. This pattern suggests that the historical education measure primarily operates through firms' R&D investment behavior rather than consistently translating into observable patent output, which is more sensitive to firm size and industrial structure. The coefficient on historical population is negative for R&D intensity but positive for patenting, consistent with differences between intensive and extensive margins of innovation. More populous regions host more firms and patenting activity overall, but tend to exhibit lower R&D spending per

employee due to industry composition and firm scale.

*[Table 6 about here]*

Second, we use the Traditional education share as an instrument for pre-WWII conformism in the prefecture–year specification. The first-stage regression shows that prefectures with a stronger historical emphasis on traditional subjects are also the prefectures in which young men in 1941 were more likely to select the socially expected “virtue” answers, and this relationship remains robust when controlling for pre-war population. The Kleibergen–Paap statistics indicate that the instrument is informative under prefecture-level clustering, although inference remains naturally limited by the number of prefectures.

*[Figure 4 about here]*

In the second stage, instrumented conformism retains a negative and economically meaningful effect on average R&D intensity. The magnitude is comparable to the OLS estimates, reinforcing the interpretation of a persistent cultural channel. Table 7 shows that this result is robust to additionally controlling for pre-war industrialization, proxied by the number of manufacturing factories in 1919 alongside population. Including these historical controls attenuates the reduced-form relationship, as expected if the Edo education measure partly captures long-run differences in regional development, but the IV coefficient on conformism remains negative.

In contrast, the previously positive relationship between the Edo measure and patenting becomes statistically insignificant once these controls are included. This suggests that the earlier positive patent coefficients were driven by differences in historical industrial structure rather than by conformist norms per se. Taken together, these findings indicate that the historical channel operates primarily through innovation inputs, while patent outcomes are more sensitive to long-run industrial composition and firm scale.

The identifying assumption is that, conditional on year fixed effects and time-varying prefecture characteristics, and controls for historical population and early industrialization, Edo-period curricular emphasis affects modern innovation only through its impact on local social norms captured by the 1941 conformism measure. This follows the identification logic used in studies of the historical origins of culture, where early institutional variation is used to isolate persistent cultural components of later economic outcomes (e.g. Nunn and Wantchekon, 2011). Because Edo educational policies predate industrialization, corporate governance structures, and modern economic institutions, reverse causality is implausible. While alternative long-run channels cannot be completely ruled out, the stability of the IV estimates after controlling for historical population and industrialization strengthens the interpretation that conformism—shaped by historical educational environments—plays a persistent role in firms’ R&D investment decisions.

Overall, the historical analysis supports a long causal chain: Edo-period curricular choices influenced the development of local social norms; those norms were observable in 1941; and

they continue to shape firms’ innovation inputs today, even after accounting for persistent differences in regional scale and industrial development.

## 6 Conclusion

This paper shows that regional social norms, in particular conformism, help explain why otherwise comparable firms differ in their innovation investment. Using pre-WWII prefecture-level information on values and cognitive skills, merged with prefecture-year aggregates of Japanese manufacturing firms from 1995 to 2022, we find that firms located in more conformist regions exhibit lower average R&D intensity. The relationship for patenting is weaker, less precisely estimated, and not robust across specifications. The R&D results are robust to controlling for cognitive skills, firm characteristics, governance variables, and rich fixed effects.

To probe the historical roots of these differences, we trace regional variation in conformism back to the Edo period. During that time, domains differed substantially in the content of their educational systems. Some emphasized traditional subjects such as *wagaku* and *kan-gaku*, while others incorporated more outward-looking and scientific fields, including *rangaku*, mathematics, and medical studies. We use this variation in Edo-period curricular emphasis, aggregated to modern prefectures, as an instrument for 1941 conformism. The first stage shows that prefectures with a stronger historical focus on traditional subjects display higher non-cognitive “virtue” scores in 1941. In the second stage, instrumented conformism contin-

ues to reduce R&D intensity, including when controlling for historical population and early industrialization. By contrast, the initially positive relationship between the Edo measure and patenting becomes statistically insignificant once these controls are included, indicating that patent outcomes are more sensitive to long-run differences in industrial structure and regional scale than to conformist norms.

The broader lesson is that durable local social norms can shape regional innovation investment even in a modern economic environment. Much of the innovation-and-growth literature emphasizes incentives, competition, and knowledge spillovers as the primary drivers of innovation. Our evidence suggests that these levers operate within a regional cultural environment that affects firms' willingness to undertake R&D. Across specifications, the relationship with R&D is consistently strong, while the relationship with patenting is weaker and less robust. This pattern indicates that conformist norms are most closely linked to firms' innovation investment decisions, whereas realized innovation output is more strongly shaped by industrial composition and firm scale. Taking this distinction into account helps explain why firms in some regions exhibit persistently lower R&D investment despite facing broadly similar contemporary technologies, markets, and policies.

## References

- Acharya, V. V. and Xu, Z. (2017). Financial dependence and innovation: The case of public versus private firms. *Journal of Financial Economics*, 124(2):223–243.
- Adams, R. (2018). Are CEOs born leaders? Lessons from traits of a million individuals. *Journal of Financial Economics*, 130(2):392–408.
- Adams, R. B., Licht, A. N., and Sagiv, L. (2011). Shareholders and stakeholders: How do directors decide? *Strategic Management Journal*, 32(1):116–132.
- Aghion, P., Bloom, N., Blundell, R., Griffith, R., and Howitt, P. (2005). Competition and innovation: An inverted-u relationship. *American Economic Review*, 95(4):701–728.
- Aghion, P. and Howitt, P. (1992). A model of growth through creative destruction. *Econometrica*, 60(2):323–351.
- Aghion, P. and Jaravel, X. (2015). Knowledge spillovers, innovation, and growth. *Economic Journal*, 125(583):533–573.
- Akcigit, U., Aghion, P., and Howitt, P. (2022). Innovation and growth: The schumpeterian perspective. *Annual Review of Economics*, 14:1–31.
- Akcigit, U. and Kerr, W. R. (2018). Growth through heterogeneous innovations. *Journal of Political Economy*, 126(4):1374–1443.
- Bena, J., Ferreira, M. A., Matos, P., and Pires, P. (2017). Are foreign investors locusts? The long-term effects of foreign institutional ownership. *Journal of Financial Economics*, 126(1):122–146.
- Bloom, N., Schankerman, M., and Van Reenen, J. (2013). Identifying technology spillovers and product market rivalry. *Econometrica*, 81(4):1347–1393.
- Bryan, G., Choi, J. J., and Karlan, D. (2018). Randomizing religion: The impact of protestant evangelism on economic outcomes. *Working paper*.
- Chemmanur, T. J., Loutskina, E., and Tian, X. (2014). Corporate venture capital, value creation, and innovation. *Review of Financial Studies*, 27(617):2434–2473.
- Cheshire, J. A., Longley, P. A., Yano, K., and Nakaya, T. (2014). Japanese surname regions. *Papers in Regional Science*, 93(3):539–555.
- Cunha, F., Heckman, J. J., and Schennach, S. M. (2010). Estimating the technology of cognitive and noncognitive skill formation. *Econometrica*, 78(3):883–931.
- Davis, D. R. and Weinstein, D. E. (2002). Bones, Bombs, and Break Points: The Geography of Economic Activity. *American Economic Review*, 92(5):1269–1289.

- Fiordelisi, F., Renneboog, L., Ricci, O., and Lopes, F. S. S. (2018). Creative corporate culture and innovation. *Working paper*.
- Gow, I. D., Kaplan, S. N., and Larcker, D. F. (2016). CEO personality and firm policies. *NBER Working Paper Series*, 22435.
- Heckman, J. J., Humphries, J. E., and Veramendi, G. (2018). Returns to education: The causal effects of education on earnings, health and smoking. *Journal of Political Economy*, 126(1):197–246.
- Heckman, J. J., Stixrud, J., and Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor Economics*, 24(3):411–482.
- Imaizumi, A., Ito, K., and Okazaki, T. (2016). Impact of natural disasters on industrial agglomeration: The case of the Great Kantō Earthquake in 1923. *Explorations in Economic History*, 60:52–68.
- Ito, T., Kubota, K., and Ohtake, F. (2017). Long Term Effects of Buddhist Temples, Jizo Bodhisattvas and Shrines on a School Rute: The Effects on Income, Happiness and Health Thorough Social Capital. *ISER Discussion Paper*.
- Jones, C. I. and Williams, J. C. (1998). Measuring the social return to r&d. *Quarterly Journal of Economics*, 113(4):1119–1135.
- Kelly, B., Papanikolaou, D., Seru, A., and Taddy, M. (2018). Measuring technological innovation over the long run. *Working paper*.
- Kimoto, T. (2019). The education under the tokugawa shogunate system: Schools of edo shogunate and schools established by local domains (historical verification of the education in edo and its role as the foundation for the modern public education started in meiji era). *Shin-ai Kiyo*, 60.
- Klette, T. J. and Kortum, S. (2004). Innovating firms and aggregate innovation. *Journal of Political Economy*, 112(5):986–1018.
- Kondo, K. and Okubo, T. (2015). Interregional labour migration and real wage disparities: Evidence from Japan. *Papers in Regional Science*, 94(1):67–87.
- Laudenbach, C., Malmendier, U., and Niessen-Ruenzi, A. (2018). The long-lasting effects of propaganda on financial risk-taking. *Working paper*.
- Licht, A. N. and Adams, R. B. (2016). Shareholders and stakeholders around the world : The role of values and culture in directors’ decisions.
- Lindqvist, E. and Vestman, R. (2011). The labor market returns to cognitive and noncognitive ability: Evidence from the Swedish enlistment. *American Economic Journal: Applied Economics*, 3(1):101–128.

- Luong, H., Moshirian, F., Nguyen, L., Tian, X., and Zhang, B. (2017). How do foreign institutional investors enhance firm innovation? *Journal of Financial and Quantitative Analysis*, 52(4):1449–1490.
- MEXT (Ministry of Education, Culture, Sports, Science and Technology) (1972). *Gakusei 100 nen-shi: A Centennial History of the 1872 Education System*. Ministry of Education, Culture, Sports, Science and Technology (Japan).
- Mokyr, J. (1990). *The Lever of Riches: Technological Creativity and Economic Progress*. Oxford University Press.
- Mokyr, J. (2016). *A Culture of Growth: The Origins of the Modern Economy*. Princeton University Press.
- Montgomery, E. B. (1993). Pattern in Regional Labor Market Adjustment: The United States vs. Japan.
- Nunn, N. (2009). The importance of history for economic development. *American Economic Review*, 99(2):49–53.
- Nunn, N. and Wantchekon, L. (2011). The slave trade and the origins of mistrust in africa. *American Economic Review*, 101(7):3221–3252.
- Oishi, M. (2006). *Kinsei Hansei Hankou Daijiten (Encyclopedia of Feudal Domain Administration and Clan Schools in Early Modern Japan)*. Hirokawa Kobunkan, Tokyo.
- Oishi, M. (2007). *Edo no Kyoiku ryoku (Educational Power of Edo Japan)*. Tokyo Gakugei University Press, Tokyo.
- Okubo, T. (2022). Telework in the spread of COVID-19. *Information Economics and Policy*, 60:100987.
- Okubo, T. and Nippon Institute for Research Advancement (NIRA) (2022). Report on the results of a questionnaire survey concerning the impact of the use of telework to respond to the spread of COVID-19 on working styles, lifestyles, and awareness. Technical report, Nippon Institute for Research Advancement, Tokyo.
- Parise, G. and Peijnenburg, K. (2017). Understanding the determinants of financial outcomes and choices: The role of noncognitive abilities.
- Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy*, 98(5, Part 2):S71–S102.
- Shiraishi, T. (2016). Development of moral education in Japanese school: Syushin, all school activities, moral education class and special subject. *Hiroshima Bunkyo Joshi Daigaku Kiyo*, 51:47–57.

Xu, Y., Beller, A. H., Roberts, B. W., and Brown, J. R. (2015). Personality and young adult financial distress. *Journal of Economic Psychology*, 51:90–100.

## **Appendix: Educational System in the Edo-era**

This Appendix provides historical background for the Edo-period educational heterogeneity that underlies our instrument based on the prefecture-level traditional-subject share. While our empirical measure focuses on variation in curricular content across domains, historical sources also document meaningful differences in philosophical orientation and moral emphasis. Together, these sources confirm that local educational environments differed systematically across regions in ways that plausibly shaped long-run attitudes.

### **Overview: Educational system from Edo to Meiji**

In the Edo period (1603-1868), Japan was a decentralized nation with a feudal political system governed by the Tokugawa Shogunate. There were around 250 hans (regions). Each han was governed by a feudal lord. The educational system was local. Terakoya educational system had spread throughout Japan, was run by temples and provided preliminary education to ordinary people. The main subjects were basic writing, reading, arithmetic, and abacus. In the decentralized educational system, some lords were very eager to promote educational and industrial development. They established han schools, which provided intermediate or high level of education to sons of upper-class families. Since hans had a high degree of independence in education, educational subjects and contents were highly diversified across domains. The basic philosophy of han schools was also heterogeneous. While our empirical measure focuses on variation in subject content, historical records show that domains dif-

ferred in their adherence to Neo-Confucian orthodoxy, which was endorsed by the Tokugawa Shogunate, versus more heterodox traditions such as Yangmingism. Thus academic subjects were also highly varied. Most han-schools, however, specialized in a few specific subjects out of many social science or natural science subjects, e.g. the Japanese studies (*wagaku*), studies of Chinese classics (*kangaku*), calligraphy, music, mathematics, foreign languages, European science, medical science, and astronomy. Therefore, we can say that Japan in the Edo period already saw a high level of basic education, but academic backgrounds were highly heterogeneous across regions. This variation in curricular emphasis across domains forms the basis of our prefecture-level measure of the traditional-subject share, which aggregates the relative importance of classical studies versus more outward-looking and scientific subjects.

The Meiji Restoration (1868-1889) reformed the political system and dramatically promoted modernization. In 1871, the *Haihan Chiken* (abolition of the han and establishment of prefectures as administrative regional units) closed Han schools. With the promulgation of the 1872 Education Order, the Meiji government rapidly centralized and modernized the school system under the newly established Ministry of Education. Educational administration, curricula, and teacher training were unified according to national policy, introducing modern sciences and Western pedagogical models (MEXT (Ministry of Education, Culture, Sports, Science and Technology), 1972). Yet, despite this institutional unification, local moral and ethical traditions persisted. Domain-based values—such as loyalty, diligence, and

communal responsibility—were reinterpreted within the framework of *shūshin* (moral education), captured in our pre-war conformism measure, a compulsory subject throughout the late Meiji, Taishō, and pre-war Showa eras (before 1945) (Kimoto, 2019; Shiraishi, 2016). This moral instruction, blending Confucian ethics with state ideology, allowed regional educational cultures to survive under a national system, shaping Japan’s distinctive balance between moral conformity and regional identity.

## Some examples of han-schools

The following examples illustrate the type of curricular heterogeneity that is captured by our traditional-subject share measure.

### (1) Heterogeneity in han-school education

There existed a Han-school in almost all hans. Each han was independent in its educational system. Some large hans had large scale schools. The followings are some representative cases based on Oishi (2006).

#### 1. Jishu-kan in Kumamoto prefecture

Jishu-kan was founded in 1754 by Kumamoto-han and accepted not only upper class families’ sons but also children from ordinary households. Its basic educational policy was strict rewards and punishments. The top level students were commended by the feudal lord (han-shu), while lazy students were strictly punished (page 904, Oishi, 2006). Neo-Confucianism was the central philosophy. Traditional subjects were taught, such as calligraphy/writing

and reading ancient Japanese ((*wagaku*) and Chinese philosophy ((*kangaku*). (pages 904-905, Oishi, 2006). This combination of Neo-Confucian moral instruction and emphasis on classical subjects corresponds closely to the high traditional-subject end of our empirical measure.

## 2. Zoushi-kan in Kagoshima prefecture

A contrasting example is Zoushi-kan in Kagoshima prefecture, which was founded in 1772 by Satsuma han. The feudal lord, Nariakira Shimazu, reformed the education of Zoushi-kan. The new school policy was to foster both academic and practical persons. “To realize the primary meaning of Japan and to enhance the glory of the nation toward foreign countries, Zoushi-kan taught students in learning ancient Japanese and Chinese philosophy as well as Western studies by translations of European academic books. This provided them with new practical knowledge and technology” (page 941, Oishi, 2006). Satsuma-han introduced a great deal of Western natural science and technology. For example, Satsuma-han built blast furnaces (*hansha-ro*) and tried to make gunpowder, glass and nitric acid. Furthermore, a Western-type school, *Kaiseijo*, was opened in 1864 to teach advanced military technology, geography, navigation, and medical science. Such an outward-looking curriculum with substantial Western scientific content corresponds to a lower traditional-subject share in our data.

## 3. Shinshu-kan in Oita prefecture

Nakatsu-han established Shinshu-kan in 1796. Masataka Okudaira, the feudal lord of

Nakatsu-han, liked Western culture and could speak Dutch fluently. He compiled Dutch-Japanese dictionaries. The Shinshu-kan introduced medical science studies and started to dissect human bodies for analysis. Then a medical school was opened. Han's medical doctor, Ryotaku Maeno, published *Kaitai Shinsho*, which was the first medical book on anatomy in Japan (page 922, Oishi, 2006). The explicit introduction of medical science and Dutch learning places this domain clearly toward the science-oriented side of the curricular spectrum.

#### 4. Nisshin-kan in Fukushima prefecture

The Aizu-han established its han-school, Nisshin-kan, in 1803 under the feudal Lord Matsudaira Katanobu. Rooted firmly in Neo-Confucian orthodoxy, the school's curriculum emphasized moral cultivation through the study of the Four Books and Five Classics, the *Great Learning*, and the *Elementary Learning*. Physical disciplines such as archery, swordsmanship, horsemanship, and swimming were also required, not for technical purposes but as exercises in discipline and virtue. The institutional ethos stressed loyalty, filial piety, and propriety, epitomized by the "Rules of the Jū," which governed students' daily conduct. This moral-didactic focus fostered a culture of ethical rigor and social order but left little room for scientific or practical studies such as Western learning or engineering. The heavy emphasis on moral cultivation and classical learning left relatively less room for scientific or technical subjects (page 283-284, Oishi, 2006), placing Aizu toward the high traditional-subject end of the distribution in our classification.

## 5. Kodo-kan in Ibaraki prefecture

The Mito-han established its han-school, Kōdō-kan, in 1841 under Lord Tokugawa Nariaki as part of his political and moral reform program. Unlike other han-schools grounded purely in orthodox Zhu Xi Confucianism, the Kōdōkan was guided by Mitogaku—a uniquely Mito form of Neo-Confucian thought that fused Confucian ethics with Shinto reverence and the principle of "sonno joi" (revering the Emperor and expelling the foreigners). The curriculum combined the Four Books and Five Classics, Japanese history (e.g. Dai Nihon-shi), and martial disciplines such as archery, swordsmanship, and gunnery, all taught within a rigorously moral framework emphasizing loyalty, filial piety, and self-discipline. This intellectual climate cultivated a spirit of high moral and patriotic activism which largely influenced late-Tokugawa political thought. Many proponents of "sonno joi" and later Meiji reformers emerged from Mito's scholarly circle, making the Kōdō-kan a key ideological bridge between Confucian ethics and the nationalist movements that preceded the Meiji Restoration (page 336-338, Oishi, 2006). Although our empirical instrument does not separately code philosophical stance, such examples underscore that educational environments combined both curricular and moral components that may have shaped local norms.

### (2) Regional persistency

The following two schools are well-known as representative schools in Edo period, and they long affected local education.

#### 1. Shizutani School (Okayama prefecture)

Shizutani School was established in Okayama han (currently Okayama prefecture). Strictly speaking, this school was not categorized as a han-school (school for sons in upper class families) but as a *gō*-school (school for ordinary people). The philosophy of the school was Neo-Confucianism and *kangaku* was its main subject. In 1870, the Shizutani school was closed down. However, the school reopened in 1873, called Shizutani Shousha, where only *kangaku* was taught and thus the number of students decreased. In 1877 the school was closed down. Then, the school reopened in 1884, called Shizutani-kou. The new school taught *kangaku* as well as British academics and mathematics, which attracted many students. The schooling period was three years. Importantly, the philosophy of the school was to learn both academics and morality/dignity (*hinkaku*), with dignity regarded as much more important than academics. The school was formally accepted as a private school in 1903 by the Japanese government. The private school kept its long tradition with its solid philosophy, arguably influencing local culture and non-cognitive attitudes of local people (page 758-759, Oishi, 2006). The private school kept its long tradition with its solid philosophy, arguably influencing local culture and the moral orientation later reflected in standardized *shūshin*-based measures of conformity, our pre-WWII scores.

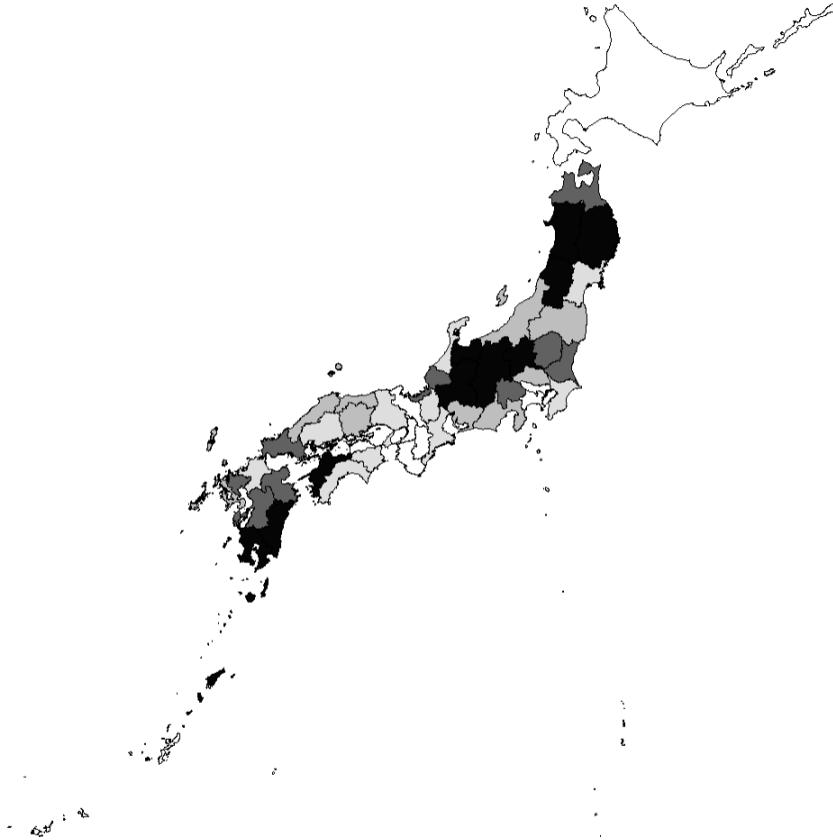
## 2.Meirin-kan (Yamaguchi prefecture)

Meirin-kan was established in Hagi han (currently, Yamaguchi prefecture). This was a han school only for sons of upper-class families. The school mainly taught *kangaku* and the philosophy of the school was Neo-Confucianism. In the late Edo period, the school was

reformed, and it accepted not only sons of upper-class families but also ordinary people. Due to the reform, many subjects including history and literature were added, which boosted the local educational level. Similar to Shizutani school, Meirin-kan has also long influenced local culture and people (page 795-796, Oishi, 2006). Taken together, these historical examples demonstrate that Edo-period Japan exhibited systematic and observable variation in curricular emphasis across domains. This variation provides the historical foundation for the traditional-subject share that we use as an instrument for pre-war conformism in the main analysis.

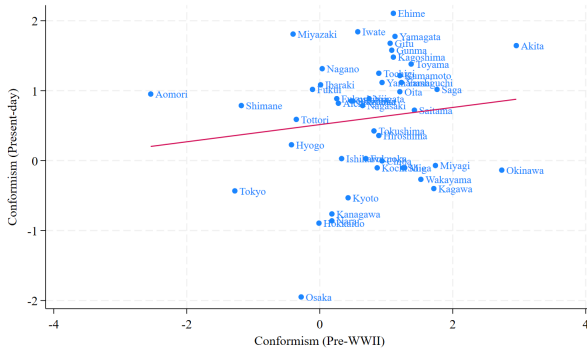
**Figure 1:** Conformism across Japan

This figure shows the prefecture-level standardized values of conformism score (*Conformism (Present-day, E)*) extracted from the 2007 MEXT school data. See Section 2.1 for details. Darker areas indicate higher values.

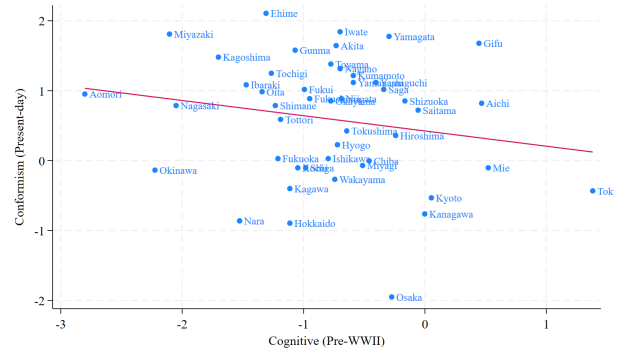


## Figure 2: The Association of Pre-WWII and Current Educational Skills

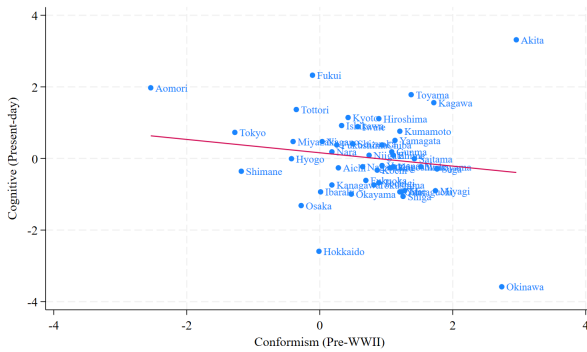
This figure shows scatter plots of prefecture-level educational scores in the present days (vertical axes) against educational skills in the pre-WWII era (horizontal axes). All values are standardized.



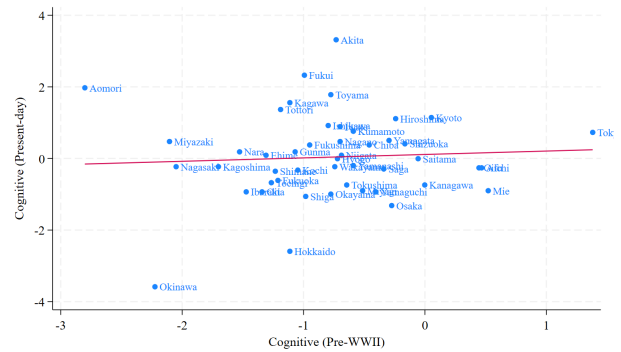
Panel A: Conformism (Pre-WWII) and Conformism (2007)



Panel B: Cognitive (Pre-WWII) and Conformism (2007)



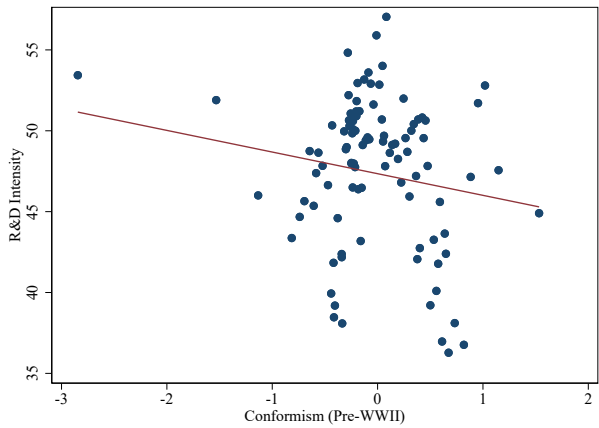
Panel C: Conformism (Pre-WWII) and Cognitive (2007)



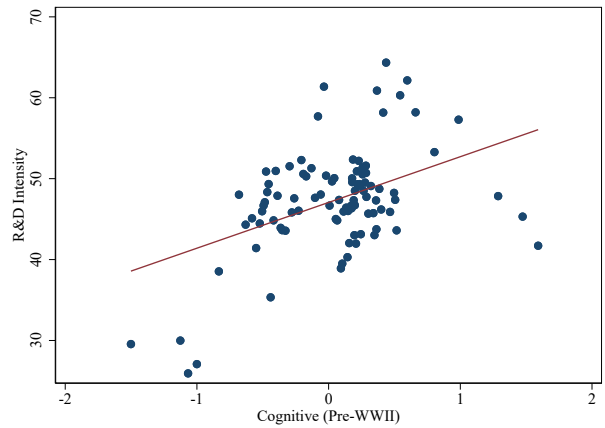
Panel D: Cognitive (Pre-WWII) and Cognitive (2007)

**Figure 3:** Graphical Summary of Main Results

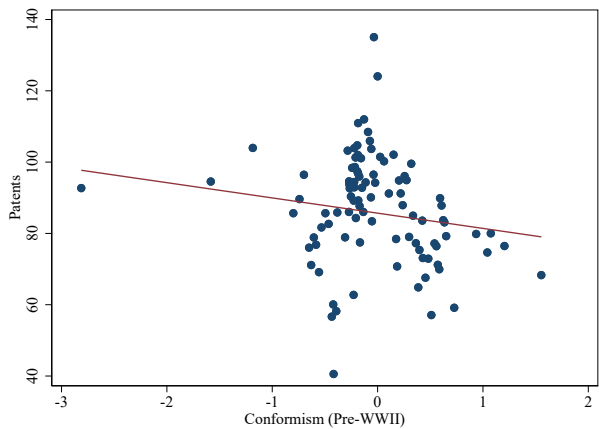
This figure shows binned scatter plots of prefecture-year average R&D intensity (Panels A and B) and average patent counts (Panels C and D) against pre-WWII educational scores. Panels A and C plot outcomes against historical conformism; Panels B and D plot outcomes against historical cognitive skills. All plots partial out the control variables and year fixed effects used in the baseline regressions reported in Tables 3.



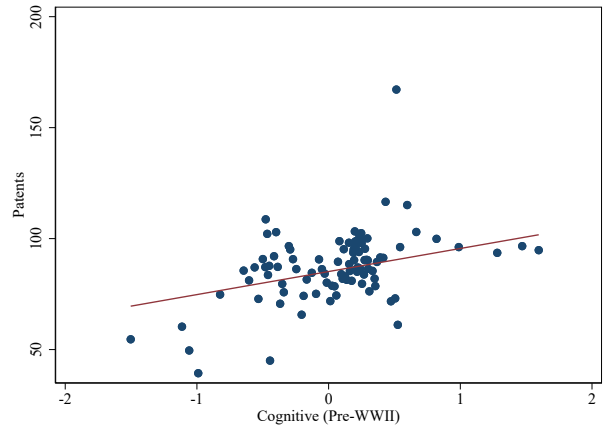
Panel A: R&D Intensity and Conformism



Panel B: R&D Intensity and Cognitive Skills



Panel C: Patents and Conformism



Panel D: Patents and Cognitive Skills



**Table 1: Variable Definitions**

This table describes the definitions of all variables used in the analysis. The column “Data Source” indicates the origin of each variable: “Census” refers to the Census of Manufacture; “MEXT” to the Ministry of Education, Culture, Sports, Science and Technology; “Educ.” to the Educational Survey on Soldiers in the Conscription System (1941); “CAO” to the Cabinet Office of Japan; “METI” to the Ministry of Economy, Trade and Industry; and “NIRA” to the Okubo–NIRA survey data. All dependent variables and firm-level control variables are constructed at the firm level and then averaged to the prefecture–year level for the baseline regressions.

Variable Name	Data Source	Definition of the variable
<i>Dependent variables</i>		
R&D Intensity	METI	R&D expenditures divided by number of employees and multiplied by 100.
Patents	METI	The number of patents the firm owns. Prefecture/year level average value is calculated with the observations without missing values.
<i>Explanatory variables: Cultural variables</i>		
Conformism (Current, E.)	MEXT	Average score on conformism questions for sixth grade of elementary schools in 2007, standardized.
Cognitive Skills (Current, E.)	MEXT	Average score on cognitive questions for sixth grade of elementary schools in 2007, standardized.
Conformism (Current, J.H.)	MEXT	Average score on conformism questions for third grade of junior high schools in 2007, standardized.
Cognitive Skills (Current, J.H.)	MEXT	Average score on cognitive questions for third grade of junior high schools in 2007, standardized.
Conformism (Pre-war)	Educ.	Average correct answer rate for conformism questions in 1941, standardized.
Cognitive Skills (Pre-war)	Educ.	Average correct answer rate for cognitive questions in 1941, standardized.
Traditional Education Share	Educ.	Edo-era share of schools teaching traditional subjects, standardized.
<i>Explanatory variables: Control variables</i>		
ln(Employees)	Census	Natural logarithm of the total number of full-time employees.
Factories (Pre-WWII)	Census	Natural logarithm of the number of manufacturing factories in 1919.
Wage	METI	Total wage divided by the number of employees.
ln(Firm Age)	METI	Natural logarithm of firm age.
Listed Dummy	METI	One for listed firms.
Profitability	METI	Net income divided by total assets and multiplied by 100.
Population (Pre-WWII)	CAO	Natural logarithm of prefecture level population in 1930
ln(Prefecture GDP)	CAO	Natural logarithm of GDP per capita of prefecture where the firm is located.
<i>Explanatory variables: Additional corporate governance and current cultural variables</i>		
Foreign Ownership	METI	Ratio of foreign ownership.
Stock Option Usage	METI	One for firms using stock options and zero otherwise.
%Same Occup.	NIRA	the percentage of the individuals with the same occupation as your parent’s one at prefectural level
Trust	NIRA	Prefectural average score of the survey question “Generally speaking, most people can be trusted” strongly agree = 5 to strongly disagree = 1.
Reciprocity	NIRA	Prefectural average score of the survey question “People must live by helping one another.” strongly agree = 5 to strongly disagree = 1.
Cooperation	NIRA	Prefectural average score of the survey question “Community resources (things shared and used by everyone in the area) should be protected through everyone’s cooperation.” strongly agree = 5 to strongly disagree = 1.
Extraversion	NIRA	Prefectural average score of extraversion.
Agreeableness	NIRA	Prefectural average score of agreeableness.
Conscientiousness	NIRA	Prefectural average score of conscientiousness.
Neuroticism	NIRA	Prefectural average score of neuroticism.
Openness	NIRA	Prefectural average score of openness.

**Table 2:** Summary Statistics: Prefecture–Year Aggregates

This table reports summary statistics for the prefecture–year level variables used in the baseline panel regressions. Each observation corresponds to a prefecture–year, constructed by averaging firm-level outcomes and control variables across all manufacturing firms headquartered in that prefecture and year. Variable definitions are in Table 1. Cultural variables are standardized to mean zero and unit variance.

	mean	sd	p50	p25	p75
R&D Intensity	36.35	21.56	33.60	20.91	48.76
Patents	46.70	42.19	33.79	14.51	63.74
Conformism (Pre-WWII)	0.66	0.95	0.82	0.18	1.20
Cognitive Skills (Pre-WWII)	-0.79	0.75	-0.74	-1.21	-0.34
Conformism (Present-day, E)	0.60	0.86	0.82	-0.10	1.22
Cognitive Skills (Present-day, E.)	0.04	1.17	-0.01	-0.74	0.73
Traditional Education Share	-0.20	1.15	-0.35	-0.84	0.33
Factories (Pre-WWII, ln)	6.36	0.94	6.28	5.70	6.89
Population (Pre-WWII, ln)	7.08	0.51	7.04	6.63	7.35
ln(Employees)	5.29	0.19	5.28	5.16	5.41
Wage	4.49	0.53	4.47	4.12	4.82
ln(Firm Age)	3.61	0.18	3.62	3.48	3.76
Listed Firm	0.19	0.11	0.19	0.13	0.27
Profitability	2.20	0.95	2.17	1.51	2.88
ln(Prefecture GDP)	15.80	0.83	15.60	15.17	16.23
Extraversion	3.74	0.11	3.74	3.65	3.81
Agreeableness	4.17	0.10	4.19	4.15	4.23
Conscientiousness	4.07	0.08	4.07	4.00	4.14
Neuroticism	3.97	0.10	3.99	3.89	4.04
Openness	3.83	0.08	3.84	3.78	3.87
Observations	1269				

**Table 3:** Present-day conformism and innovation

This table reports OLS estimates from prefecture–year panel regressions of average innovation outcomes on prefecture-level present-day indices of *Conformism* and *Cognitive skills*. The dependent variables are: (1) prefecture–year average R&D intensity and (2) prefecture–year average number of patents per firm. All specifications include prefecture–year averages of firm-level controls (see Table 1) and year fixed effects. Conformism and Cognitive skills are standardized to mean zero and unit variance. Standard errors are clustered at the prefecture level; *t*-statistics are reported in parentheses. \*\*\*, \*\*, \* denote significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)
	R&D Intensity	Patents	Patents
Conformism (Present-day, E)	-1.467*** (0.490)	-2.894*** (1.093)	-1.681* (0.923)
Cognitive Skills (Present-day, E.)	2.278*** (0.375)	3.596*** (0.759)	1.718** (0.691)
R&D Intensity			0.828*** (0.0643)
Constant	-91.89*** (20.44)	-533.3*** (36.64)	-442.5*** (31.74)
Controls	✓	✓	✓
Year FE	✓	✓	✓
Observations	1269	1175	1175
R-squared	0.669	0.619	0.681

**Table 4:** Present-day conformism and innovation with additional prefecture-level cultural covariates

This table reports OLS estimates from prefecture–year panel regressions of average innovation outcomes on prefecture-level present-day indices of *Conformism* and *Cognitive skills*, augmented with additional prefecture-level cultural covariates. Columns (1) and (3) use prefecture–year average R&D intensity as the dependent variable; columns (2) and (4) use prefecture–year average number of patents per firm. All specifications include prefecture–year averages of firm-level controls (see Table 1) and year fixed effects. Conformism and Cognitive skills are standardized to mean zero and unit variance. Standard errors are clustered at the prefecture level; *t*-statistics are reported in parentheses. \*\*\*, \*\*, \* denote significance at the 1%, 5%, and 10% levels, respectively.

	(1) R&D Intensity	(2) Patents	(3) R&D Intensity	(4) Patents
Conformism (Present-day, E)	-1.543*** (0.490)	-2.960*** (1.099)	-1.027** (0.478)	-1.081 (1.047)
Cognitive Skills (Present-day, E.)	2.516*** (0.387)	3.824*** (0.798)	3.371*** (0.352)	4.497*** (0.804)
%Same Occup.	38.42*** (11.45)	35.20 (26.80)		
Extraversion			10.57*** (3.899)	-26.42*** (9.359)
Agreeableness			2.432 (3.293)	14.82* (8.179)
Conscientiousness			-13.70*** (4.485)	4.718 (12.56)
Neuroticism			-38.88*** (3.681)	-55.97*** (7.898)
Openness			28.31*** (6.015)	24.46** (11.38)
Constant	-89.19*** (20.10)	-530.5*** (36.60)	-14.98 (39.82)	-331.3*** (84.82)
Controls	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Observations	1269	1175	1269	1175
R-squared	0.672	0.620	0.726	0.638

**Table 5:** Pre-WWII Conformism and Firm Innovation

This table reports OLS estimates from prefecture–year panel regressions of average innovation outcomes on historical (pre-WWII) prefecture-level indices of *Conformism* and *Cognitive skills*. The dependent variables are prefecture–year average R&D intensity and prefecture–year average number of patents per firm. All specifications include prefecture–year averages of firm-level controls (see Table 1) and year fixed effects. Historical indices are standardized to mean zero and unit variance. Standard errors are clustered at the prefecture level;  $t$ -statistics are reported in parentheses. \*\*\*, \*\*, \* denote significance at the 1%, 5%, and 10% levels, respectively.

	(1) R&D Intensity	(2) Patents
Conformism (Pre-WWII)	-1.338** (0.569)	-4.481** (1.961)
Cognitive Skills (Pre-WWII)	1.686** (0.839)	7.906*** (2.818)
Constant	-21.01 (24.24)	-667.3*** (77.55)
Controls	✓	✓
Year FE	✓	✓
Observations	1269	1175
R-squared	0.891	0.876

**Table 6:** Edo-Period Educational Legacies, Conformism, and Innovation

This table presents reduced-form and instrumental-variables estimates linking Edo-period educational characteristics to modern innovation outcomes. Columns (1)–(2) report reduced-form prefecture–year panel regressions of average innovation outcomes on the Edo-period *Traditional education share*. Columns (3)–(5) report IV estimates where the endogenous regressor is the pre-WWII prefecture-level *Conformism* index, instrumented with the Edo-period *Traditional education share*. Column (3) shows the first stage; columns (4) and (5) report the second stage for prefecture–year average R&D intensity and prefecture–year average number of patents per firm, respectively. All specifications include prefecture–year averages of firm-level controls (see Table 1), a control for pre-war population, and year fixed effects. Historical indices are standardized to mean zero and unit variance. Standard errors are clustered at the prefecture level; *t*-statistics are reported in parentheses. Kleibergen–Paap rk Wald *F*-statistics are shown for weak-instrument diagnostics. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively.

	Reduced Form		Instrumental Variables		
	(1) R&D	(2) Patents	(3) Conformism	(4) R&D	(5) Patents
Traditional Education Share	-1.436*** (0.356)	1.882** (0.856)	0.115*** (0.0158)		
Conformism ( $Pre - \hat{WWII}$ )				-12.94*** (3.162)	12.20* (7.320)
Cognitive Skills (Pre-WWII)			0.613*** (0.0506)	8.730*** (2.021)	0.0458 (5.005)
Factories (Pre-WWII, ln)	3.920*** (0.917)	16.88*** (2.424)	-0.225*** (0.0372)	0.709 (1.311)	17.01*** (3.012)
Population (Pre-WWII, ln)	-11.62*** (1.858)	-4.201 (5.108)	-0.235** (0.103)	-13.74*** (2.220)	7.136 (5.069)
Constant	-51.33* (27.03)	-413.4*** (59.88)	11.37*** (1.329)	99.39** (42.65)	-519.6*** (99.71)
Controls	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
Observations	1188	1100	1188	1188	1100
R-squared	0.838	0.801	0.506	0.800	0.774
Cragg–Donald Wald F				52.28	50.27
Kleibergen–Paap rk Wald F				52.61	49.52

**Table 7:** Edo-Period Educational Legacies, Conformism, and Innovation: Controlling for Historical Industrialization

This table presents reduced-form and instrumental-variables estimates linking Edo-period educational characteristics to modern innovation outcomes. Relative to Table 6, the difference is that these regressions additionally control for pre-war industrialization, proxied by the number of factories in 1919. Columns (1)–(2) report reduced-form prefecture–year panel regressions of average innovation outcomes on the Edo-period *Traditional education share*. Columns (3)–(5) report IV estimates where the endogenous regressor is the pre-WWII prefecture-level *Conformism* index, instrumented with the Edo-period *Traditional education share*. Column (3) shows the first stage; columns (4) and (5) report the second stage for prefecture–year average R&D intensity and prefecture–year average number of patents per firm, respectively. All specifications include prefecture–year averages of firm-level controls (see Table 1), a control for pre-war population, and year fixed effects. Historical indices are standardized to mean zero and unit variance. Standard errors are clustered at the prefecture level; *t*-statistics are reported in parentheses. Kleibergen–Paap rk Wald *F*-statistics are shown for weak-instrument diagnostics. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% levels, respectively.

	Reduced Form		Instrumental Variables		
	(1) R&D	(2) Patents	(3) Conformism	(4) R&D	(5) Patents
Traditional Education Share	-1.436*** (0.356)	1.882** (0.856)	0.115*** (0.0158)		
Conformism ( <i>Pre</i> – $\hat{W}WII$ )				-12.94*** (3.162)	12.20* (7.320)
Cognitive Skills (Pre-WWII)			0.613*** (0.0506)	8.730*** (2.021)	0.0458 (5.005)
Factories (Pre-WWII, ln)	3.920*** (0.917)	16.88*** (2.424)	-0.225*** (0.0372)	0.709 (1.311)	17.01*** (3.012)
Population (Pre-WWII, ln)	-11.62*** (1.858)	-4.201 (5.108)	-0.235** (0.103)	-13.74*** (2.220)	7.136 (5.069)
Constant	-51.33* (27.03)	-413.4*** (59.88)	11.37*** (1.329)	99.39** (42.65)	-519.6*** (99.71)
Controls	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓
Observations	1188	1100	1188	1188	1100
R-squared	0.838	0.801	0.506	0.800	0.774
Cragg–Donald Wald F				52.28	50.27
Kleibergen–Paap rk Wald F				52.61	49.52

**Figure A1:** Cognitive Skills across Japan: Then and Now

This figure shows the historical prefecture-level values of cognitive score. Panel A shows the pre-WWII and Panel B shows the current-day values, extracted from the 2007 MEXT school data. See Section 2.1 for details. Darker areas indicate higher values.



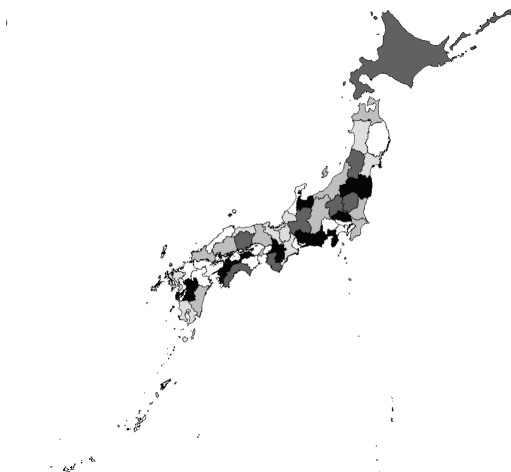
Panel A: Cognitive Skills (Pre-WWII)



Panel B: Cognitive Skills (Current)



Panel C: Conformism Skills (Pre-WWII)



Panel D: Traditional education share (Edo)

**Table A1:** Summary Statistics: Firm-Level Variables (Pre-Aggregation)

This table reports summary statistics for the underlying firm-level variables prior to aggregation. The sample includes independent manufacturing firms observed between 1995 and 2022. These firm-level observations are subsequently averaged within each prefecture and year to construct the prefecture-year dataset used in the main analysis. Variable definitions are in Table 1.

	N.	mean	sd	min	p1	p50	p25	p75	p99	max
R&D Emp	194577	38.00	63.99	0.00	0.00	6.94	0.00	42.97	237.44	237.44
Patents (ln)	127612	1.82	1.87	0.00	0.00	1.39	0.00	3.22	5.56	5.56
Conformism (Present-day, E)	194577	-0.08	1.03	-1.95	-1.95	-0.43	-0.43	0.82	1.84	2.11
Cognitive Skills (Present-day, E.)	194577	-0.01	0.96	-3.58	-2.59	0.09	-0.74	0.73	2.33	3.32
ln(Employees)	194577	5.38	1.09	3.91	3.97	5.13	4.55	5.93	8.88	11.36
Wage	194577	4.82	2.22	0.00	1.25	4.71	3.74	5.75	9.67	612.82
ln(Firm Age)	194577	3.77	0.48	0.00	2.08	3.87	3.58	4.06	4.57	7.40
Listed Firm	194577	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	1.00
Profitability	194577	1.81	3.75	-13.88	-11.99	1.44	0.33	3.33	13.38	17.99
ln(Prefecture GDP)	194577	17.01	1.08	14.35	14.82	17.29	16.06	18.21	18.55	18.56
R&D Intensity	194577	45.39	93.96	0.00	0.00	6.94	0.00	42.97	548.42	580.71

**Table A2:** Present-day conformism and innovation: Full results

This table presents the full estimation results of the prefecture–year panel regressions reported in Table 3, including coefficients on all control variables. The dependent variables are: (1) prefecture–year average R&D intensity and (2) prefecture–year average number of patents per firm. All specifications include prefecture–year averages of firm-level controls (see Table 1) and year fixed effects. Conformism and Cognitive skills are standardized to mean zero and unit variance. Standard errors are clustered at the prefecture level;  $t$ -statistics are reported in parentheses. \*\*\*, \*\*, \* denote significance at the 1%, 5%, and 10% levels, respectively.

	(1) R&D Intensity	(2) Patents	(3) Patents
Conformism (Present-day, E)	-1.467*** (0.490)	-2.894*** (1.093)	-1.681* (0.923)
Cognitive Skills (Present-day, E.)	2.278*** (0.375)	3.596*** (0.759)	1.718** (0.691)
ln(Employees)	17.28*** (4.487)	61.38*** (7.761)	47.00*** (6.576)
Wage	29.49*** (2.075)	37.44*** (3.272)	12.29*** (2.877)
ln(Firm Age)	-17.09*** (4.504)	-22.20** (8.812)	-8.023 (7.858)
Listed Firm	-16.10*** (6.127)	-53.40*** (13.04)	-39.45*** (11.63)
Profitability	1.153 (0.823)	0.188 (1.467)	-0.703 (1.340)
ln(Prefecture GDP)	-2.869*** (1.042)	8.731*** (1.774)	11.12*** (1.660)
R&D Intensity			0.828*** (0.0643)
Constant	-91.89*** (20.44)	-533.3*** (36.64)	-442.5*** (31.74)
Year FE	✓	✓	✓
Observations	1269	1175	1175
R-squared	0.669	0.619	0.681