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Working Paper

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GLO Discussion Paper, No. 932

Provided in Cooperation with:
Global Labor Organization (GLO)

Suggested Citation: Jin, Zhangfeng (2021) : The Legacies of the Soviet Influence in the 1950s: China's 156 Major Industrial Projects, GLO Discussion Paper, No. 932, Global Labor Organization (GLO), Essen

This Version is available at:
https://hdl.handle.net/10419/240911

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The Legacies of the Soviet Influence in the 1950s: China's 156 Major Industrial Projects

Zhangfeng Jin*

Abstract: This paper investigates whether and how China's adoption of Soviet-aided industrialization programs in the 1950s has affected its long-run innovation. Focusing on 156 major industrial projects aided by the Soviet Union, combined with an instrumental variable approach, I find that the adoption of these programs substantially discourages local firms to innovate in the long run. A causal mediation analysis of instrumental variable settings shows that the negative effect is entirely driven by local firms' lower intensity of incentive pay. This evidence suggests disadvantages of Soviet-aided industrialization programs for long-run innovation due to firms adopting incentive-incompatible management technology.

Keywords: Soviet Aid; Technology Transfers; Incentive Pay; Innovation; China

***JEL Code*:** O10; O30; L20; M52

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Shortly after the formal establishment of the People's Republic of China (PRC) on October 1, 1949, China launched several Soviet-aided industrialization programs to restore and develop its economy. The newly formed government aimed to modernize the war-torn country after decades of civil war against the Kuomintang (KMT)-led government of the Republic of China. With large-scale technology transfers from the Soviet Union, these economic development programs laid the foundation for China's industrialization (Zhang, Zhang, and Yao 2006; Brandt, Ma, and Rawski 2017). However, Soviet-style management practices were not compatible with employee incentives (e.g., higher pay, bonuses) and thus stifled production and innovation (Kornai 1992; Roemer 1994). Unlike the U.S.-aided European Recovery Program (i.e., the Marshall Plan) for Western Europe (DeLong and Eichengreen 1991; Eichengreen and Uzan 1992; Bianchi and Giorcelli 2019), much less is known about the consequences of Soviet-aided industrialization programs for China's long-run development outcomes (Giorcelli and Li 2021).[1] In this article, I empirically investigate China's adoption of 156 major Soviet-aided industrial projects (hereinafter, the "156 Projects") in the 1950s. Specifically, I answer two questions. Has China's adoption of the 156 Projects affected its long-run innovation, and if so, how and to what extent does this effect occur through the intensity of incentive pay?

As part of China's First Five-Year Plan (1953–1957) to rebuild its economy, the Soviet Union provided the most comprehensive technology transfers in modern industrial history. The 156 Projects concentrated in sectors of heavy industry, such as energy, metallurgy, machinery, chemistry, and national defense. These large-scale, capital-intensive projects totaled more than half of U.S. aid to Western Europe under the Marshall Plan (1948–1952).[2] However, they were unevenly adopted across Chinese cities (see **Figure A1** in Appendix A1), in part due to geological conditions (e.g., access to natural resources) but mostly to avoid military attacks from Taiwan (Bo 1991).[3] These distinctive features of the adoption of the 156 Projects provides a unique case to examine the long-run consequences of Soviet-aided industrialization programs, including effects of Soviet-style, incentive-incompatible management practices.

[1] To the best of my knowledge, Giorcelli and Li (2021) is the only study to explore the causal impact of China's adoption of the 156 Projects. This article differs from Giorcelli and Li (2021) in several ways. First, it focuses on innovation outcomes. Second, it investigates a different channel regarding the intensity of incentive pay, or more broadly, management technology (Bloom, Sadun, and Van Reenen 2016). Third, it uses a different identification strategy, comparing cities that adopted the 156 Projects with other cities that did not adopt the 156 Projects.

[2] Soviet aid to the 156 Projects totaled 2020 USD 80 billion (Giorcelli and Li 2021), compared to 142.8 billion in U.S. aid to Western Europe. Conversions into 2020 USD are based on https://www.saving.org/inflation/inflation.php?amount=13.

[3] In 1949, after losing control of mainland China, the Republic of China under the KMT withdrew to Taiwan.

To estimate the causal impact of adopting the Soviet-aided 156 Projects, I use an instrumental variable (IV) approach based on plausibly exogenous variations in early industrial investments made by China's central government in each locality. Specifically, I construct an IV using the geographical distance between each mainland Chinese city and Jinmen, which is two miles from the mainland Chinese city of Xiamen but controlled by Taiwan.[4] The rationale is that mainland Chinese cities closer to Jinmen were exposed to higher risks of armed conflict in the Taiwan Strait, owing to tensions between mainland China and Taiwan in the early 1950s.[5] These cities thus were less likely to adopt the 156 Projects under the centrally planned economy. An important assumption for the validity of the IV is that, conditional on observable characteristics, long-run innovation in each locality is independent of the geographical distance between the mainland Chinese cities where these firms are located and Jinmen. I provide some empirical validation of the IV assumption.

Incentives are important components of management technology (Bloom, Sadun, and Van Reenen 2016). Thus, I explore the extent to which the 156 Projects has affected China's long-run innovation based on the intensity of incentive pay adopted by local firms. I employ an identification framework for mediation analysis in IV settings, as developed by Dippel et al. (2019, 2020). This framework provides a simple set of three separate two-stage-least-squares estimations, enabling me to estimate the share of the total innovation effect of adopting the 156 Projects according to the intensity of local firms' incentive pay.

The main findings are as follows. First, I find that China's adoption of the Soviet-aided 156 Projects has significantly reduced its long-run innovation. The IV estimate shows that firms' average probability of innovation decreases by 0.36 in adopting localities. Second, using a causal mediation analysis, I find that the negative impact of adopting the 156 Projects is entirely driven by the lower intensity of incentive pay. Third, I find no obvious impact of adopting the 156 Projects on local firms' employment, capital, and capital-labor ratio in the long run. By contrast, adoption decreases local firms' total compensation, wage gap, and market size. This evidence suggests disadvantages of the Soviet-aided industrialization programs for long-term innovation due to firms adopting incentive-incompatible management technology.

[4] Several recent papers have employed geographical distance as instruments. For example, Becker and Woessmann (2009) use distance to Wittenberg, the hometown of Martin Luther, as an IV for Protestantism. Nunn and Wantchekon (2011) use the historical distance from the nearest coast of an individual's ethnic group location as an instrument for slave exports. T. Chen, Kung, and Ma (2020) construct an IV for *jinshi* (i.e., the highest and final degree in the imperial examination in Imperial China) density using a prefecture's shortest river distance to its nearest sites of pine and bamboo—the raw materials necessary for producing ink and paper for use in woodblock printing.

[5] Two separate crises occurred in the Taiwan Straits between 1954 and 1958.

This article contributes to the literature in several aspects. First, it closely relates to a broad literature examines why history matters for long-run development outcomes (Acemoglu, Johnson, and Robinson 2001; Banerjee and Iyer 2005; Nunn 2009; Jia 2014; Markevich and Zhuravskaya 2018; Lowes and Montero 2021). Following this line of literature, this article adds to studies linking China's 156 Projects to its long-run development outcomes (Zhang, Zhang, and Yao 2006; Giorcelli and Li 2021) and to studies comparing the 156 Projects to the U.S.-aided European Recovery Program in Western Europe (DeLong and Eichengreen 1991; Eichengreen and Uzan 1992; Bianchi and Giorcelli 2019). Second, this article demonstrates the persistence of incentive-incompatible management technology in China, complementing existing studies examining differences in management technology across countries and firms (Bloom and Van Reenen 2010; Bloom et al. 2019; Frederiksen and Manchester 2020; Bloom et al. 2020). Third, it sheds light on the ambiguous impact of incentive pay on innovation (Lerner and Wulf 2007; Ederer and Manso 2013).

I. Background

In 1927, China experienced a civil war between the KMT-led government of the Republic of China and the Communist Party of China (CPC). Though the U.S. government supported the KMT with military, economic, and political assistance, the CPC declared victory and established the PRC on October 1, 1949.[6] The new government aimed to build a modern industrial system, but the country lacked technical knowledge and expertise. On February 14, 1950, China and the Soviet Union signed the Sino-Soviet Treaty of Friendship, Alliance and Mutual Assistance, which marked the beginning of large-scale economic and military cooperation between the two nations and the official recognition of the PRC as a strategic partner of the Soviet Union (Zhang, Zhang, and Yao 2006). In response to the Alliance, the United States and its allies imposed economic sanctions against the PRC in the 1950s.

Between 1950 and 1957, China and the Soviet Union reached various agreements in support of large-scale, capital-intensive industrial development.[7] These 156 Projects were unevenly distributed across Chinese cities. Geological conditions (e.g., access to natural resources) played a role in this distribution, but Chinese leaders also prioritized the northeastern and inner regions to minimize the threat of military attacks from Taiwan (Bo 1991). Up to that point, few existing firms were located along the coasts. The total value of the Soviet Union's

[6] Regional armed conflicts between KMT and PRC continued in a number of cities after October 1, 1949.

[7] In fact, only 150 projects were actually constructed. They can be divided into five areas: energy (25 projects in coal, 25 in power), metallurgical and chemical industries (13 in nonferrous metals, 7 in iron and steel, 7 in chemicals, 2 in petroleum), machinery (24 in machine building, 12 in aviation, 10 in electronics), military (16 in weapons, 4 in shipbuilding, 2 in space), and 3 in light industry and pharmacy (Zhang, Zhang, and Yao 2006).

investments in China was equivalent to 45.7 percent of the Chinese GDP in 1949 and 144.3 percent of its industrial output. The adoption of the 156 Projects thus helped China establish its industrial foundation. The Sino-Soviet cooperation formally ended in 1963 after several years of political and ideological disagreement.

II. Data Sources and Model Specification

II.A. Data Sources

To measure each city's adoption of the 156 Projects, I manually sort a dataset containing information on each industrial project (e.g., name, industry, geographic location, and total investments) from the literature (Dong and Wu 2004; Chen 2020). I then match this information with firm-level data using city-level IDs. I construct a dummy variable to measure whether a city adopted any of the 156 Projects from 1953 to 1957.[8] For a robustness check, I use the total amount of investments toward that project in each locality as an alternative measure.

The firm-level dataset come from an Enterprise Survey for firm managers conducted by the World Bank in 2005. The survey covers 12,400 Chinese manufacturing firms in 120 cities across all provinces, autonomous regions, and directly administrated cities, with the exception of Tibet.[9] The survey covers a broad range of firm-level information, including firm age, employee wage components, labor conditions, and financial statements. I focus on two variables of interest: intensity of incentive pay and innovation behavior.

To measure each firm's intensity of incentive pay, I focus on a single dimension: the extent to which each firm adopts bonuses and piece-rate wages. Given the wage components of all employees for each firm, I calculate the percentage of bonuses and piece-rate wages in total compensation among permanent workers for each firm. Consequently, firms with a higher percentage of bonuses and piece-rate wages in total compensation among permanent workers are identified as having higher incentive pay. Conceptually, the minimum intensity of incentive pay is 0, and the maximum is 100. I use alternative measures of intensity of incentive pay for robustness checks.

To measure each firm's innovation behavior, I construct a dummy variable indicating whether a firm has positive research and development (R&D) expenditure based on annual total R&D expenditure. I construct an alternative measure using the percentage of R&D expenditure in total sales for a robustness check.

[8] This approach does not distinguish between cities that adopted different industrial projects, projects that were built as planned with Soviet machinery and technical assistance, or other projects realized by China only (Giorcelli and Li 2021).

[9] More information on the survey methodology can be found at http://www.enterprisesurveys.org/methodology.

To further measure each firm's innovation performance, I complement the main dataset above with the Chinese Annual Survey of Industrial Firms (1998–2015), constructed by the National Bureau of Statistics of China. This survey includes all industrial firms owned by the state or with sales above 5 million RMB. It covers all industrial sectors, including the mining sector, and accounts for roughly 88 percent of the national industrial output. The survey contains extensive information about firm production, including total output, employment, wages, assets, total sales, exports, and so on, but little information on management practices.[10] Importantly, the additional firm-level dataset can be matched with China's State Intellectual Property Office patents.[11] The matched firm-level dataset contains variables on innovation performance, such as total number of patents and number of patents by category (invention, utility model, design).

Finally, I resort to the China City Statistical Yearbook (1985–1986), also provided by the National Bureau of Statistics of China, to construct other city-level variables such as total registered population, local human capital stocks (e.g., number of scientists, number of social scientists), foreign direct investments, and exports.[12] **Appendix A1 (Table A1)** reports summary statistics for the main variables.

II.B. Model Specification

To examine the causal impact of China's adoption of the 156 Projects on its long-run innovation, I use the following Two-Stage Least Squares model:

$$T_c = \beta_T^Z \cdot Z_c + \beta_T^K \mathrm{K_{ic}} + \varepsilon_{ic} \quad (1)$$

$$Y_{ic} = \beta_Y^T \cdot T_c + \beta_Y^K \mathrm{K_{ic}} + \eta_{ic} \quad (2)$$

where Y_{ic} is a dummy variable indicating positive R&D expenditure for each firm i in city c. T_c is a dummy variable indicating adoption of a project in city c. Z_c is the instrument, defined as the geographical distance between the centroid of each mainland Chinese city c and the centroid of Jinmen. K_{ic} refers to firm characteristics such as the age, skill composition of workers and general managers, percentage of permanent workers, percentage of exports, logarithm of total employment, logarithm of total capital, ownership dummies, 2-digit industry dummies for firm i in city c, and logarithm of the geographical distance between county c

[10] Several studies, including Bloom et al. (2018) and Hau et al. (2020), have tried to match other survey data about management practices in 564 Chinese firms sampled in 2006, 2007, 2008, and 2010 by Bloom and Van Reenen (2010). The sample size of this dataset, however, is too small to conduct my analysis.

[11] He et al. (2018) provide details on the matching process.

[12] All variables are available for 1984, the earliest data available, except exports, which is available from 1985.

in which firm i is located and the coastline. ε_{ic} and η_{ic} are error terms. β_Y^T is the parameter of interest. Standard errors are clustered at the city level.

Estimating the causal impact of the 156 Projects on long-run innovation presents some empirical challenges. For example, innovative firms may self-select into localities that are closer to the technology frontier, resulting in reverse causality issues that render the OLS estimate biased and inconsistent. Additionally, firms may differ in production technology. If firms' access to production technology is relevant to the adoption of the 156 Projects in that locality, omitting this variable also makes the OLS estimate biased and inconsistent.

I thus resort to an IV approach to reduce the endogeneity problems. The IV approach takes advantage of plausible exogenous variations in early industrial investments made by the central government in each locality. Specifically, I use the geographical distance between the centroid of each mainland Chinese city and the centroid of Jinmen to capture the city-level exposure to risk of armed conflict between mainland China and Taiwan in the Taiwan Strait in the 1950s. The rationale is that mainland Chinese cities closer to Jinmen were exposed to higher risks of armed conflict and thus less likely to adopt the 156 Projects.

The validity of the IV depends on two important assumptions. First, the geographic distance between mainland Chinese cities and Jinmen is positively associated with the probability of adopting the 156 Projects. Second, conditional on observable characteristics, the geographic distance between mainland Chinese cities and Jinmen affects long-run innovation only through the adoption of the 156 Projects. The first assumption can be tested empirically, but the second assumption is more challenging.

I provide some empirical validation of the IV exclusion restriction assumption by controlling for other likely channels through which the IV affects long-run innovation: For population size, I control for city-level total population that is potentially correlated with both the IV and innovation. For market access, in addition to controlling for local firms' geographical distance to the coastline as in the benchmark model, I further control for foreign direct investments and exports at the city level. For human capital stocks, to allow for the possibility that the IV would affect human capital stocks and therefore long-run innovation, I further control for the numbers of scientists and social scientists at the city level. For additional channels, the rich firm-level information in the survey data allows me to control for several other firm-level characteristics that are potentially correlated with both the IV and innovation. These include firms' exposure to overall labor or skilled labor shortages, access to finance, financing cost such as interest rates, local protectionism factors, anti-competition behaviors by

other enterprises, percentage of employees who received job-relevant training, average monthly employee overtime days, number of manager demotions, decision making power among junior managers/staff, number of staff who regularly use computers, and sales revenue realized through internet and email. If the IV exclusion restriction assumption is valid, controlling for these channels should not significantly affect the parameter of interest.

As an additional test, I further regress a measure of past human capital stocks based on hand-collected archival data (i.e., the number of universities and colleges in each mainland city in 1949 accumulated prior to the establishment of the PRC) on the IV with included controls. If the instrument is valid, I should not find significant impact of the IV on past human capital stocks.

Finally, to formally test instrument validity, I propose a new IV based on hand-collected archival data on the date of KMT defeat by the CPC in each Chinese mainland city during the civil war. Unlike the main IV (i.e., geographical distance between each Chinese mainland city and Jinmen), the new IV takes advantage of a plausible exogenous variation in the date of ending the armed conflict in each mainland city (**Figure A2**). Cities that ended the armed conflict before October 1, 1949, the day of formally establishing the PRC, were more likely to adopt the 156 Projects because the central government made more early industrial investments in these cities.[13] The additional IV thus allows me to estimate and compare the parameter of interest using different IVs and to test the validity of instruments through the Hansen overidentification test.

III. Empirical Results

III.A. Impact of China's Adoption of the 156 Projects on Long-run Innovation

Table 1 reports the main results. Columns 1 and 2 show the OLS estimate of the impact of the adoption of the 156 Projects on local firms' propensity to innovate in the long run. Without controlling for additional variables, the coefficient of interest is −0.04, which is not statistically significant at the conventional level. After controlling for other firm-level characteristics, the coefficient decreases to −0.09. Both findings suggest a negative relationship between China's adoption of the 156 Projects and its long-run innovation.

As previously discussed, the OLS estimate may be biased by endogeneity problems. Column 3 shows the IV estimate. The coefficient of interest decreases substantially to −0.36,

[13] According to the matched firm-level data, about 23 percent firms were located in cities that ended the armed conflict after October 1, 1949, when Chairman Mao Zedong announced the establishment of the PRC.

suggesting that the 156 Projects reduced the average firm's probability of innovation by 0.36. The OLS estimate is biased upward for at least two reasons. First, innovative firms are more likely to relocate to areas where the 156 Projects have been adopted to improve their access to technology frontier, resulting in reverse causality. Second, firms differ in their access to production technology, and when the access to production technology is positively associated with the adoption of the 156 Projects, omitting this variable causes the OLS estimate to be biased upward.

The first-stage results reported in Column 4 show that a one-standard-deviation increase in the geographical distance between each mainland Chinese city and Jinmen leads to a probability of adopting the 156 Projects that is 0.18 higher on average. The bottom rows of **Table 1** report the results of the weak identification test and the endogeneity test. The Kleibergen-Paap rk Wald F statistic is 15, which rejects the null hypothesis that the IV suffers from weak identification problems. Moreover, the p-values from the endogeneity test of endogenous regressors leads to rejecting the null hypothesis that the OLS estimator is consistent and efficient at the 5 percent level. This evidence collectively does not reject the validity of my IV approach.

To mitigate the concern that the IV exclusion restriction assumption is violated, I control for and investigate other likely channels (e.g., size of local population, access to global market, human capital stocks) through which the IV may affect long-run innovation. After controlling for all these likely channels that are observable, I find that the coefficient of interest changes slightly to −0.33 (Column 1 of **Table 2**), suggesting that controlling for these channels does not seriously threaten the main findings. I further regress a measure of past human capital stocks on the IV with the included controls. Using the manually collected city-level number of universities and colleges in 1949 that had been accumulated prior to the establishment of the PRC to proxy for past human capital stocks, I find no obvious impact of the IV on past human capital stocks (Column 2 of **Table 2**), further mitigating the concern that the IV assumption is violated. Finally, I propose a new IV by taking advantage of a plausible exogenous shock on the date of ending armed conflict in each mainland city. Specifically, I construct a dummy variable indicating whether the armed conflict ended before October 1, 1949, and use it as an instrument for the adoption of the 156 Projects. The coefficient of interest is −0.25 (Column 3 of **Table 2**). The first-stage result also confirms that cities that ended the armed conflict before October 1, 1949, were more likely to adopt the 156 Projects, on average (Column 4 of **Table 2**). Additionally, I exploit both instruments to test the validity of IVs. The coefficient of interest

is −0.32 (Column 5 of **Table 2**). The bottom row of Table 2 reports results of the Hansen overidentification test (p-value is 0.1886), which fails to reject the null hypothesis that the instruments are valid.

[Place Tables 1 and 2 about here]

III.B. How Does China's Adoption of the 156 Projects Hamper Long-run Innovation?

A possible explanation for the negative impact of China's adoption of the 156 Projects on its long-run innovation is that the Soviet-style management technology adopted by firms created persistent low incentives of production and innovation. Studies have shown that incentive pay affects worker productivity (Lazear 2000; Shearer 2004) and innovation (Lerner and Wulf 2007; Ederer and Manso 2013). This article further explores whether incentive pay, as an important component of management technology (Bloom, Sadun, and Van Reenen 2016), is a likely underlying mechanism discouraging long-run innovation.

I estimate the causal impact of the 156 Projects on the intensity of incentive pay adopted by local firms as follows:

$$M_{ic} = \beta_M^T \cdot T_c + \beta_M^K \mathrm{K}_{ic} + \epsilon_{ic} \quad (3)$$

This approach is identical to equation (2), except M_{ic} replaces Y_{ic}. The first-stage equation (1) remains the same. M_{ic} is the intensity of incentive pay adopted by firm i in county c, defined as the percentage of bonuses and piece-rate wages in total compensation among permanent workers. β_M^T is the parameter of interest. I cluster standard errors at the city level.

Table 3 reports the main results. Columns 1 and 2 show the OLS estimate of the impact of the 156 Projects on the intensity of incentive pay. The coefficient of interest is −8.20, without any control variables. After controlling for other firm-level characteristics, the coefficient of interest is −8.04. As previously discussed, the OLS estimates are likely to be biased due to endogeneity problems. Using the same IV approach, the coefficient of interest decreases substantially to −24.32, suggesting that the 156 Projects led to a 24-unit decrease in the intensity of incentive pay on average. This evidence demonstrates a negative impact of the 156 Projects on the adoption of incentive pay in the long run. To some extent, the persistent management technology findings echo those of a recent study by Bloom et al. (2020).[14] Further details on the first-stage results and relevant tests for the IV are presented in **Table 3**.

[Place Table 3 about here]

[14] They revisited Indian weaving firms nine years after a randomized experiment that changed their management practices and demonstrated lasting impacts of effective management interventions.

The extent to which the 156 Projects has affected China's long-run innovation via intensity of incentive pay remains unclear. Thus, a mediation analysis is needed. A mediation model consists of a treatment variable T, a final outcome Y, and a mediating variable M, which represents a mechanism through which T affects Y. Essentially, mediation models decompose the "total effect" of T on Y into an "direct effect" and an "indirect effect" running through M. Traditional approaches to mediation analysis assume that both T and M are exogenous (Baron and Kenny 1986; MacKinnon 2008). However, such approaches cannot deal with setups in which T, M, or both T and M are endogenous. I therefore employ an identification framework for a causal mediation analysis in IV settings, as developed by Dippel et al. (2019, 2020). This framework enables use of the same instrument Z to assess the causal effect of intermediate outcome M on the final outcome Y. I further estimate the following two-stage model:

$$M_{ic} = \gamma_M^Z \cdot Z_c + \gamma_M^T \cdot T_c + \gamma_M^K \mathrm{K_{ic}} + \epsilon_{ic} \quad (4)$$

$$Y_{ic} = \beta_Y^M \cdot M_{ic} + \beta_Y^T \cdot T_c + \beta_Y^K \mathrm{K_{ic}} + \eta_{ic} \quad (5)$$

The estimation procedure associated with equations (1) and (2) is the standard IV approach. By contrast, the estimation procedure associated with equations (4) and (5) is novel to the framework of Dippel et al. (2019), where Z_c is the IV to identify the causal effect of M_{ic} on Y_{ic} when conditioned on T_c. All variables are the same as before. β_Y^M and β_Y^T are the coefficients of interest. I cluster standard errors at the city level.

According to Dippel et al. (2019), identifying β_Y^M and β_Y^T using a single instrument variable Z_c requires an additional partial confounding assumption. That is, unobserved confounding variables that jointly cause the treatment and intermediate outcomes (first causal relation) are independent of the confounders that cause the intermediate and final outcomes (second causal relation). In my context, confounders in the first causal relation capture unobserved characteristics of workers in a locality that adopted the 156 Projects. The greater adoption of incentive pay could be due to workers' preferences (e.g., risk preference) or to the adoption of the 156 Projects in that locality. By contrast, the confounders in the second causal relation represent firms' production technology that supports both adoption of incentive pay and innovation. If workers' preferences are uncorrelated with firms' production technology, the partial confounding assumption is likely to hold.

Table 4 reports the main results. Panel A presents the results of the second-stage equation (4). Column 1 assesses the mediating effect changes in the adoption of incentive pay. The point estimate $\hat{\beta}_Y^M$ in column 1 indicates that a 10-percentage-point increase in the intensity of

incentive pay raises the average probability of firm innovation by 0.16. This is the overall effect of the adoption of incentive pay on firms' probability of innovation, whether caused by the adoption of the 156 Projects or not.

The real importance of the point estimates $\hat{\beta}_Y^M$ lies in generating the indirect effect $IE = \hat{\beta}_Y^M \times \hat{\beta}_M^T$, as reported in Panel B of **Table 4**, along with other relevant parameters of the mediation model. The $\hat{\beta}_M^T$ of the 156 Projects on the intensity of incentive pay is estimated at −24. The indirect effect IE is the effect of changing the intensity of incentive pay, as caused by the adoption of the 156 Projects, on long-run innovation. If an adopting locality, the intensity of incentive pay decreases, which in turn reduces firms' probability of innovation by 0.39 on average. Relating this to the total effect of adoption on long-run innovation estimated in **Table 4**, the intensity of incentive pay can, as mediator *M*, explain around 111 percent of the overall effect of adoption on long-run innovation. β_Y^T and $\beta_M^T \cdot \beta_Y^M$ add up to the effect estimated in **Table 4** (i.e., DE+IE=TE).

[Place Table 4 about here]

The indirect effect of the adoption of the 156 Projects is larger than the total effect, implying a moderating direct effect whereby adoption raises the probability of firm innovation through channels unrelated to the intensity of incentive pay (e.g., access to production technology). This finding suggests that adoption would have a stronger negative effect on long-run innovation if it affected the intensity of incentive pay alone. However, the effect would be different: adoption of the 156 Projects would not negatively affect or even positively affect long-run innovation if the impact of adoption on incentive pay intensity could be mitigated (e.g., widespread adoption of incentive-compatible management technology across firms).

III.C. Effects of the 156 Projects on Different Types of Innovation

It remains unclear whether adoption of the 156 Projects affects firm innovation or whether the innovation effects are heterogeneous for different types of innovation. In this subsection, I resort to an additional dataset linking China's State Intellectual Property Office patents to firms in China's annual survey of industrial enterprises (1998–2015). This dataset contains rich information on innovation at the firm level, such as total number of patents and number of patents by category (i.e., invention, utility model, and design).

Using the same IV approach, I find that adoption of the 156 Projects reduces the average firms' probability of patenting by 0.08. By further analyzing the heterogeneous effects by category of patents, I find that the impact is more pronounced for design patents (−0.17), followed by utility model patents (−0.05). By contrast, I find a smaller impact for invention

patents (−0.02), which is not statistically significant at the conventional level. These findings indicate that adoption disproportionately affects different types of innovation, perhaps because increasing the intensity of incentive pay alone is inadequate to induce breakthrough innovation. Further details for the estimation can be found in **Table 5**.

[Place Table 5 about here]

III.D. Robustness Checks

I conduct several robustness checks for the main findings. First, I use an alternative measure of the adoption of the 156 Projects: the logarithm of total amounts of investments actually made by the central government for the 156 Projects in each locality. Second, I use alternative measures of incentive pay as follows: (1) the percentage of bonuses in total compensation (excluding piece-rate wages) among permanent workers; (2) the percentage of piece-rate wages in total compensation (excluding bonuses) among permanent workers; (3) the percentage of bonuses and piece-rate wages in total compensation among all workers (including temporary workers); (4) a dummy variable indicating whether the general manager's annual income is directly related to the company's performance to measure firms' intensity of incentive pay. Third, I use an alternative measure of innovation: the percentage of R&D expenditure in total sales. I find no obvious evidence that the main findings are rejected. Further details on these robustness checks are in **Appendix A2** (**Tables A2–A4**).

IV. Effects of the 156 Projects on Other Firm-Level Outcomes

To highlight the management technology channel, I further analyze the effects of the adoption of the 156 Projects on other firm-level outcomes such as total employment, total capital, capital-labor ratio, total compensation, wage gap within firms, total sales, and percentage of exports in total sales. Using the same IV approach, I find no obvious evidence that adoption affects local firms' total employment, total capital, or capital-labor ratio, further mitigating the concern that the negative impact of adoption on long-run innovation is driven by other channels.

Moreover, I find that adoption of the 156 Projects decreases total compensation and the wage gap between the highest and lowest salaries in the firms. This evidence suggests that adoption lowers and equalizes workers' compensation, possibly through lower intensity of incentive pay, which in turn reduces workers' incentives to innovate. Finally, I find that adoption reduces total sales and percentage of exports in total sales, suggesting that it reduces firms' market size, possibly through lower intensity of incentive pay, which in turn decreases firms' incentives to innovate. This evidence further supports the management technology channel. Further details on the estimation results can be found in **Appendix A3** (**Table A5**).

V. Conclusion

To the best of my knowledge, this is the first study to investigate the causal impact of China's adoption of Soviet-aided industrialization programs on its long-run innovation. The most important lesson of this study is that the adoption of Soviet-style (i.e., incentive-incompatible) systems discourages innovation in the long run. Another important finding is that the negative effect is entirely driven by the lower intensity of incentive pay among local firms. These findings, to some extent, show how Soviet aid pushed the Chinese economy toward more "controls" and less "market", in contrast with the U.S. aid to Western Europe (DeLong and Eichengreen 1991). Considering the substantial differences in management technology across countries and firms (Bloom et al. 2019), this article suggests that widespread adoption of incentive-compatible management technology can promote innovation and sustainable development in countries like China, particularly in regions (e..g, the northeast) affected by the Soviet-aided industrialization programs of the 1950s.

Table 1 Impact of the adoption of the 156 Projects on firm innovation

Variables	(1) OLS	(2) OLS	(3) IV	(4) First Stage
Access to 156 Projects	-0.0430	-0.0917***	-0.3554***	
	(0.0266)	(0.0162)	(0.0917)	
Distance between each mainland Chinese city and Jinmen (IV)				0.0003***
				(0.0001)
Observations	11200	11192	11192	11192
R-squared	0.0013	0.1904	0.1471	0.2495
F-stat	2.6132	106.2700	67.2285	4.1260
Weak identification test (Kleibergen-Paap rk Wald F statistic)	.	.	15.0960	.
Endogeneity test of endogenous regressors (p-value)			0.0000	
Firm-level variables	NO	YES	YES	YES

Notes: This table reports the impact of the adoption of the 156 Projects on firms' propensity to innovate. Columns 1 and 2 report the OLS results, with and without firm-level control variables, respectively. Columns 3 and 4 report the IV estimates and first-stage results. Control variables consist of firm-level variables such as age, skill composition of workers and general managers, percentage of permanent workers, percentage of exports, the logarithm of total employment, the logarithm of total capital, ownership dummies, 2-digit industry dummies, and the logarithm of the distance between the county in which firms are located and the coastline. The 156 Projects variable is constructed based on a city's access to the 156 Projects in the 1950s. Firm-level variables come from World Bank's Enterprise Survey in 2005. Standard errors are clustered at the city level. Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2 Test the validity of the IV exclusion restriction assumption

Variables	(1) Control other channels	(2) Human capital (1949)	(3) New IV	(4) First Stage	(5) Two IVs
Access to 156 Projects	-0.3298***		-0.2493***		-0.3206***
	(0.1095)		(0.0692)		(0.0787)
Distance between each mainland Chinese city and Jinmen (IV)		-0.0004			
		(0.0003)			
Ending armed conflict before October 1, 1949 (New IV)				0.0236***	
				(0.0066)	
Observations	11192	11192	11192	11192	11192
R-squared	0.1891	0.1077	0.1749	0.2211	0.1578
F-stat	122.8304	1.7644	85.6241	3.6420	73.0420
Weak identification test (Kleibergen-Paap rk Wald F statistic)	10.8383	.	12.9877	.	10.2992
Endogeneity test of endogenous regressors (p-value)	0.0001	.	0.0015	.	0.0000
Hansen overidentification test of all instruments (p-value)	.	.	.	.	0.1886

Notes: This table tests the validity of the IV exclusion restriction assumption. Column (1) shows the IV estimate by controlling for other likely channels (e.g., size of local population, access to global market, human capital stocks, etc.) through which the IV may affect the local firm innovation. Column (2) regress past human capital stocks in 1949, accumulated prior to the establishment of the People's Republic of China, on the IV with included controls. Column (3) and (4) show the IV estimate and first stage estimate using a new IV i.e. a dummy variable indicating whether or not the armed conflict in each mainland Chinese city ended before October 1, 1949. Column (5) shows the IV estimate by using two IVs together. The IV refers to the geographical distance between each mainland Chinese city and Jinmen. Firm-level variables come from World Bank's Enterprise Survey in 2005. City-level variables come from China City Statistical Yearbook (1985-1986). Standard errors are clustered at the city level. Standard errors are in parentheses. *** $p < .01$, ** $p < .05$, * $p < .1$.

Table 3 Impact of the adoption of the 156 Projects on the intensity of incentive pay

Variables	(1) OLS	(2) OLS	(3) IV	(4) First Stage
Access to 156 Projects	-8.1950***	-8.0367***	-24.3214***	
	(1.6699)	(1.4128)	(6.8230)	
Distance between each mainland Chinese city and Jinmen (IV)				0.0003***
				(0.0001)
Observations	10942	10935	10935	11192
R-squared	0.0103	0.1206	0.0856	0.2495
F-stat	24.0822	31.2285	25.4531	4.1260
Weak identification test (Kleibergen-Paap rk Wald F statistic)	.	.	14.8047	.
Endogeneity test of endogenous regressors (p-value)	NO	YES	YES	YES

Notes: This table reports the impact of the adoption of 156 Projects on the intensity of incentive pay. Columns 1 and 2 report the OLS results, with and without firm-level control variables, respectively. Columns 3 and 4 report the IV estimates and first-stage results. Control variables are the same as those used in Table 1. Firm-level variables come from World Bank's Enterprise Survey in 2005. Standard errors are clustered at the city level. Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 4 Estimates of the mediation model

Mediating Variables	(1)
Panel A: Second Stage (Equation 5)	
β_Y^M	0.0161***
	(0.0038)
DE: β_Y^T	0.0408
	(0.0377)
F-Stat Instruments	22.065
Panel B: Model Parameters	
β_M^T	-24.2877
IE: $\beta_M^T \cdot \beta_Y^M$	-0.3925
TE	-0.3518
IE+DE	-0.3518
S=IE/TE	1.11
S=IE/(IE+DE)	1.11
Panel C: First Stage Equation (Equation 4)	
γ_M^Z	-0.0048***
	(0.0010)
γ_M^T	-5.6732***
	(1.3973)
Observations	10,935
R-Squared	0.1257

Notes: This table reports estimates of the mediation model. Panel A reports the second stage results, based on equation (4). Panel C reports the first stage results based on equation (3). Panel B reports main parameters of the mediation model. I use the STATA code *ivmediate* to estimate the main results above (Dippel, Ferrara, and Heblich 2020). Control variables are the same as those used in Table 1. Firm-level variables come from World Bank's Enterprise Survey in 2005. Standard errors are clustered at the city level. Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 5 Impact of the adoption of the 156 Projects on firm patenting

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All patenting				Invention only	Utility only	Design only
	OLS	OLS	IV	First Stage	IV	IV	IV
Access to 156 Projects	-0.0033	0.0040	-0.0779***		-0.0171	-0.0481**	-0.1729***
	(0.0087)	(0.0099)	(0.0262)		(0.0245)	(0.0203)	(0.0486)
Distance between each mainland Chinese city and Jinmen (IV)				0.0003*** (0.0001)			
Observations	378912	266987	266987	266987	266987	266987	266987
R-squared	0.0235	0.0637	0.0610	0.2717	0.1065	0.1317	0.0481
F-stat	145.8002	313.0965	282.3216	1.7262	224.3190	682.9614	212.6036
Weak identification test (Cragg-Donald Wald F statistic)	.	.	14.7861	.	14.7861	14.7861	14.7861
Firm-level variables	NO	YES	YES	YES	YES	YES	YES

Notes: This table reports the impact of the adoption of the 156 Projects on firms' propensity to patenting. Columns 1 and 2 report the OLS results, with and without firm-level control variables, respectively. Columns 3 and 4 report the IV estimates and first-stage results. Columns 5-7 further report IV estimates by the category of patenting, namely invention patenting (Column 5), utility patenting (Column 6), and design patenting (Column 7). Control variables consist of firm-level variables such as age, percentage of exports, the logarithm of total employment, the logarithm of total capital, 3-digit ownership dummies, 2-digit industry dummies, and the logarithm of the distance between the county in which firms are located and the coastline. The 156 Projects variable is constructed based on a city's access to the 156 Projects in the 1950s. Firm-level date come from Chinese Annual Survey of Industrial Firms (1998–2015), matched with China's State Intellectual Property Office patents. Standard errors are clustered at the city level. Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

References

Acemoglu, Daron, Simon Johnson, and James A Robinson. 2001. “The Colonial Origins of Comparative Development: An Empirical Investigation.” *American Economic Review* 91 (5): 1369–1401.

Banerjee, Abhijit, and Lakshmi Iyer. 2005. “History, Institutions, and Economic Performance: The Legacy of Colonial Land Tenure Systems in India.” *American Economic Review* 95 (4): 1190–1213.

Baron, Reuben M, and David A Kenny. 1986. “The Moderator--Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations.” *Journal of Personality and Social Psychology* 51 (6): 1173. https://psycnet.apa.org/buy/1987-13085-001.

Becker, Sascha O, and Ludger Woessmann. 2009. “Was Weber Wrong? A Human Capital Theory of Protestant Economic History.” *The Quarterly Journal of Economics* 124 (2): 531–96.

Bianchi, Nicola, and Michela Giorcelli. 2019. “Reconstruction Aid, Public Infrastructure, and Economic Development: The Case of the Marshall Plan in Italy.” *Public Infrastructure, and Economic Development: The Case of the Marshall Plan in Italy (December 30, 2019)*.

Bloom, Nicholas, Erik Brynjolfsson, Lucia Foster, Ron Jarmin, Megha Patnaik, Itay Saporta-Eksten, and John Van Reenen. 2019. “What Drives Differences in Management Practices?” *American Economic Review* 109 (5): 1648–83. https://doi.org/10.1257/aer.20170491.

Bloom, Nicholas, Benn Eifert, Aprajit Mahajan, David Mckenzie, and John Roberts. 2013. “Does Managment Matter? Empirical Evidence from India.” *Quarterly Journal of Economics* 128 (1): 1–51. https://doi.org/10.1093/qje/qjs044.Advance.

Bloom, Nicholas, Aprajit Mahajan, David McKenzie, and John Roberts. 2020. “Do Management Interventions Last? Evidence from India.” *American Economic Journal: Applied Economics* 12 (2): 198–219.

Bloom, Nicholas, Kalina Manova, John Van Reenen, Stephen Teng Sun, and Zhihong Yu. 2018. “Managing Trade: Evidence from China and the US.” https://doi.org/10.3386/w24718.

Bloom, Nicholas, and John Van Reenen. 2010. “Why Do Management Practices Differ across Firms and Countries?” *Journal of Economic Perspectives* 24 (1): 203–24.

https://doi.org/10.1257/jep.24.1.203.

Bloom, Nicholas, Raffaella Sadun, and John Van Reenen. 2016. “Management as a Technology?” NBER Working Paper NO.22327. National Bureau of Economic Research. https://doi.org/10.3386/w22327.

Bo, Yibo. 1991. “Review of Several Major Decisions and Events.” *The Chinese Communist Party School Press, Beijing*.

Brandt, Loren, Debin Ma, and Thomas G Rawski. 2017. “Industrialization in China.” *The Spread of Modern Industry to the Periphery Since 1871*, 197.

Chen, Ting, James Kai-sing Kung, and Chicheng Ma. 2020. “Long Live Keju! The Persistent Effects of China’s Civil Examination System.” *The Economic Journal* 130 (631): 2030–64.

Chen, Xi. 2020. *Laying the Foundation*. Tiandi Press.

DeLong, J Bradford, and Barry Eichengreen. 1991. “The Marshall Plan: History’s Most Successful Structural Adjustment Program.” National Bureau of Economic Research Cambridge, Mass., USA.

Dippel, Christian, Andreas Ferrara, and Stephan Heblich. 2020. “Causal Mediation Analysis in Instrumental-Variables Regressions.” *The Stata Journal* 20 (3): 613–26. https://doi.org/10.1177/1536867X20953572.

Dippel, Christian, Robert Gold, Stephan Heblich, and Rodrigo Pinto. 2019. “Mediation Analysis in IV Settings With a Single Instrument.” https://www.anderson.ucla.edu/faculty_pages/christian.dippel/DGHP-IVmediate.pdf.

Dong, Zhikai, and Jiang Wu. 2004. *The Cornerstone of New China’s Industry-a Study of the 156 Projects 1950-2000*. Guangdong jingji chubanshe.

Ederer, Florian, and Gustavo Manso. 2013. “Is Pay for Performance Detrimental to Innovation?” *Management Science* 59 (7): 1496–1513.

Eichengreen, Barry, and Marc Uzan. 1992. “The Marshall Plan: Economic Effects and Implications for Eastern Europe and the Former USSR.” *Economic Policy* 7 (14): 13–75.

Frederiksen, Anders, and Colleen Manchester. 2020. “Personnel Practices and Regulation How Firm-Provided Incentives Respond to Changes in Mandatory Retirement Law.” *Journal of Labor Economics*. https://doi.org/10.1086/712610.

Giorcelli, Michela, and Bo Li. 2021. “Technology Transfer and Early Industrial Development: Evidence from the Sino-Soviet Alliance.” *Available at SSRN*.

Hau, Harald, Yi Huang, and Gewei Wang. 2020. “Firm Response to Competitive Shocks:

Evidence from China's Minimum Wage Policy." *The Review of Economic Studies* 87 (6): 2639–71. https://doi.org/10.1093/restud/rdz058.

He, Zi-Lin, Tony W Tong, Yuchen Zhang, and Wenlong He. 2018. "A Database Linking Chinese Patents to China's Census Firms." *Scientific Data* 5 (1): 1–16.

Jia, Ruixue. 2014. "The Legacies of Forced Freedom: China's Treaty Ports." *Review of Economics and Statistics* 96 (4): 596–608.

Kornai, Janos. 1992. *The Socialist System: The Political Economy of Communism*. Princeton University Press.

Lazear, Edward P. 2000. "Performance Pay and Productivity." *American Economic Review* 90 (5): 1346–61. https://doi.org/10.1257/aer.90.5.1346.

Lerner, Josh, and Julie Wulf. 2007. "Innovation and Incentives: Evidence from Corporate R&D." *The Review of Economics and Statistics* 89 (4): 634–44.

Lowes, Sara, and Eduardo Montero. 2021. "The Legacy of Colonial Medicine in Central Africa." *American Economic Review* 111 (4): 1284–1314.

MacKinnon, David Peter. 2008. *Introduction to Statistical Mediation Analysis*. Routledge. https://books.google.com/books?hl=zh-CN&lr=&id=vHUVYKfrdtYC&oi=fnd&pg=PP2&dq=Introduction+to+Statistical+Mediation+Analysis&ots=QD0WN3mdFv&sig=v6hZpwV_lM076aZtMmkT6P-TemE#v=onepage&q=Introduction to Statistical Mediation Analysis&f=false.

Markevich, Andrei, and Ekaterina Zhuravskaya. 2018. "The Economic Effects of the Abolition of Serfdom: Evidence from the Russian Empire." *American Economic Review* 108 (4–5): 1074–1117.

Nunn, Nathan. 2009. "The Importance of History for Economic Development." *Annu. Rev. Econ.* 1 (1): 65–92.

Nunn, Nathan, and Leonard Wantchekon. 2011. "The Slave Trade and the Origins of Mistrust in Africa." *American Economic Review* 101 (7): 3221–52.

Roemer, John E. 1994. "A Future for Socialism." *Politics & Society* 22 (4): 451–78.

Shearer, Bruce. 2004. "Piece Rates, Fixed Wages and Incentives: Evidence from a Field Experiment." *The Review of Economic Studies* 71 (2): 513–34.

Zhang, Baichun, Jiuchun Zhang, and Fang Yao. 2006. "Technology Transfer from the Soviet Union to the People's Republic of China: 1949-1966." *Comparative Technology Transfer and Society* 4 (2): 105–67.

Supplementary Appendix: The Legacies of the Soviet Influence in the 1950s: China's 156 Major Industrial Projects

A1 Summary Statistics for Main Variables

Table A1 Summary statistics for main variables

Variables	N	Mean	Median	Std. Dev.	min	max
RD or not (0/1)	11200	0.56	1.00	0.50	0.00	1.00
RD intensity (%)	11200	1.04	0.04	3.00	0.00	64.34
Percentage of piece rate wage plus bonuses among permanent workers (%)	10942	42.07	38.95	33.98	0.00	100.00
Percentage of piece rate wage among permanent workers (%)	10942	29.54	0.00	36.48	0.00	100.00
Percentage of bonuses among permanent workers (%)	10942	12.53	5.00	17.07	0.00	100.00
Percentage of fixed salary among permanent workers (%)	10942	46.91	50.00	35.17	0.00	100.00
Firm age	11195	13.76	9.00	13.64	3.00	140.00
State-owned firms (0/1)	11200	0.09	0.00	0.29	0.00	1.00
Non-State-owned firms (0/1)	11200	0.73	1.00	0.44	0.00	1.00
Foreign-owned firms (0/1)	11200	0.18	0.00	0.38	0.00	1.00
Total employment in log	11200	5.58	5.51	1.48	1.79	13.50
Total assets in log	11200	16.27	16.31	2.32	0.00	25.61
Percentage of exports to other countries (%)	11199	15.95	0.00	31.23	0.00	100.00
Percentage of exports to other cities (%)	11199	60.63	73.00	36.65	0.00	100.00
Percentage of workers with high school degree and above (%)	11198	48.97	49.00	27.47	0.00	100.00
Percentage of workers with college degree and above (%)	11198	17.80	12.00	17.19	0.00	100.00
General manager with master degree (0/1)	11200	0.15	0.00	0.36	0.00	1.00
General manager with undergraduate degree (0/1)	11200	0.42	0.00	0.49	0.00	1.00
General manager with college degree (0/1)	11200	0.28	0.00	0.45	0.00	1.00
General manager with high school degree or below (0/1)	11200	0.14	0.00	0.35	0.00	1.00
Percentage of permanent workers (%)	11200	77.00	90.00	29.34	0.00	100.00
The distance between each mainland Chinese county in which firms are located and (km)	11200	399.85	293.58	401.38	0.04	2575.14
Total population (in 10,000 person)	11200	273.02	219.64	232.62	14.06	867.73
Foreign direct investment (in 10,000 dollars)	11200	1490.03	9.50	6761.36	0.00	58906.00
Total exports (in 10,000 dollars)	11200	16003.74	0.00	71023.95	0.00	546725.00
Number of scientists	11200	23029.20	14440.00	26188.92	765.00	144738.00
Number of social scientists	11200	16450.85	12381.00	15221.64	20.00	78963.00
The geographical distance between each mainland Chinese city and Jinmen (km)	11200	1189.79	1139.95	613.16	35.65	3507.98
Armed conflict ended before October 1, 1949 (0/1)	11200	0.77	1.00	0.42	0.00	1.00
Access to 156 projects (0/1)	11200	0.23	0.00	0.42	0.00	1.00

Notes: Firm-level variables come from the Enterprise Survey in 2005. City-level variables come from China City Statistical Yearbook (1985-1986).

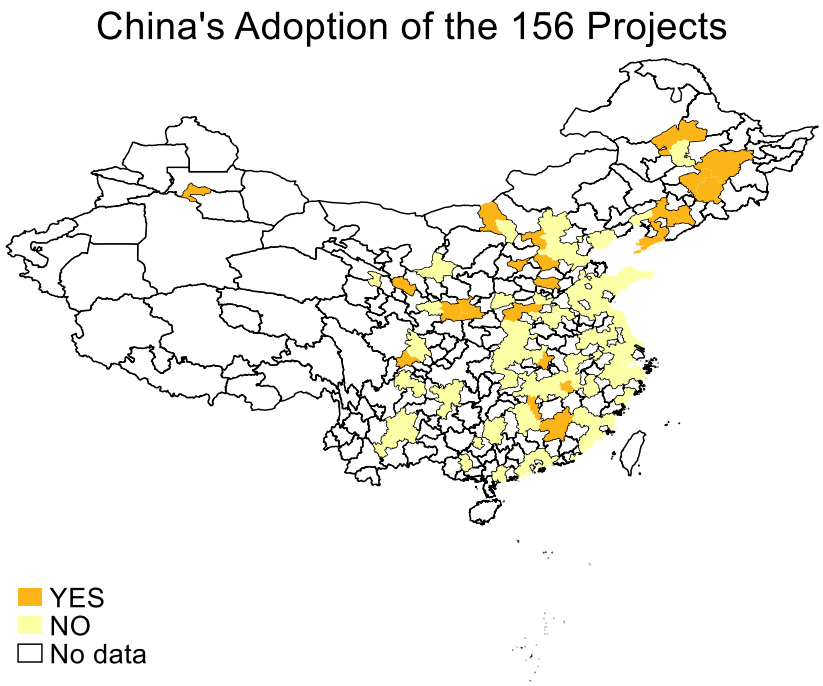

Figure A1 The adoption of the 156 Projects across Chinese cities

Notes: YES=adopted the 156 Projects; No=did not adopt the 156 Projects. I only focus on cities that can be matched with World Bank's Enterprise Survey in 2005.

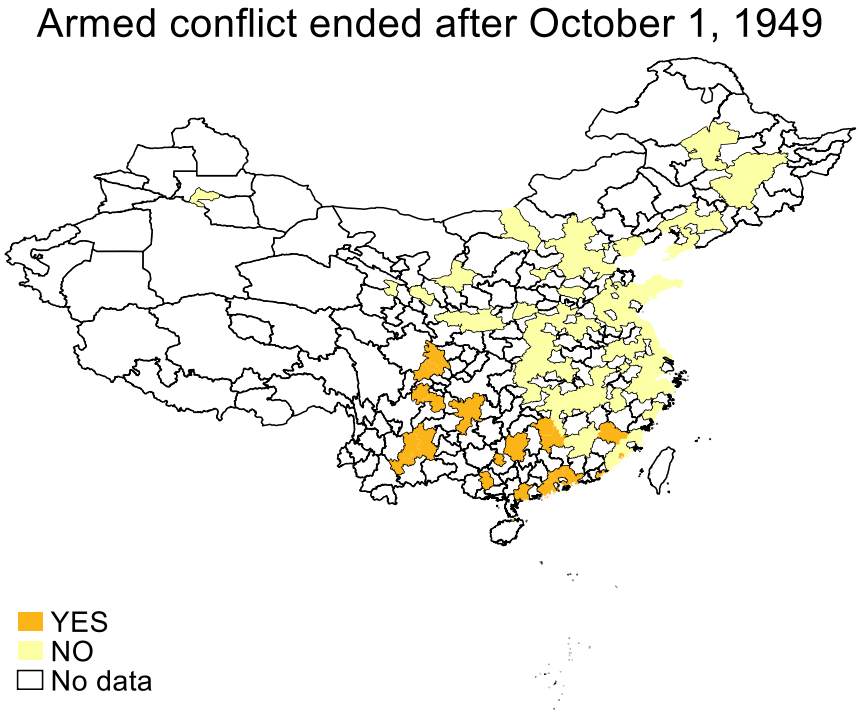

Figure A2 Cities that ended the armed conflict after October 1, 1949 or not

Notes: YES=Cities that ended the armed conflict after October 1, 1949; No= Cities that ended the armed conflict before October 1, 1949. I only focus on cities that can be matched with World Bank's Enterprise Survey in 2005.

A2 Robustness Checks
A2.1 Alternative Measure of the Adoption of the 156 Projects

Table A2 Estimates of the mediation model using an alternative measure of the adoption of 156 Projects

Mediating Variables	(1)
Panel A: Second Stage (Equation 5)	
β_Y^M	0.0163***
	(0.0039)
DE: β_Y^T	0.0042
	(0.0036)
F-Stat Instruments	22.444
Panel B: Model Parameters	
β_M^T	-2.3026***
IE: $\beta_M^T \cdot \beta_Y^M$	-0.0376
TE	-0.0333
IE+DE	-0.0333
S=IE/TE	1.12
S=IE/(IE+DE)	1.12
Panel C: First Stage Equation (Equation 4)	
γ_M^Z	-0.00***
	(0.00)
γ_M^T	-0.55***
	(0.13)
Observations	10935
R-Squared	0.13

Notes: This table shows the estimates of the mediation model using an alternative measure of the adoption of the 156 Projects, defined as the logarithm of total amounts of investments received from the central government for the 156 Projects in each locality. Panel A reports the second stage results, based on equation (4). Panel C reports the first stage results based on equation (3). Panel B reports main parameters of the mediation model. I use the STATA code *ivmediate* to estimate the main results above (Dippel, Ferrara, and Heblich 2020). Firm-level control variables consist of age, skill composition of workers and general managers, percentage of permanent workers, percentage of exports, total employment in log, total capital in log, ownership dummies, 2-digit industry dummies, and the logarithm of the distance between the mainland Chinese county in which firms are located and the coastline. Firm-level variables come from World Bank's Enterprise Survey in 2005. Standard errors are clustered at the city level. Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

A2.2 Alternative Measures of Incentive Pay

Table A3 Estimates of the mediation model using alternative measures of incentive pay

Mediating Variables	(1)	(2)	(3)	(4)
	Bonuses	Piece-rate wages	All employees	General manager
Panel A: Second Stage (Equation 5)				
β_Y^M	0.0263***	0.0198***	0.0167***	1.1073***
	(0.0073)	(0.0061)	(0.0043)	(0.2373)
DE: β_Y^T	-0.0062	0.0632	0.0600	-0.0152
	(0.0304)	(0.0577)	(0.0487)	(0.0242)
F-Stat Instruments	21.107	10.561	20.918	30.394
Panel B: Model Parameters				
β_M^T	-13.0722	-20.9201	-24.5538	-0.3114
IE: $\beta_M^T \cdot \beta_Y^M$	-0.3444	-0.4152	-0.4117	-0.3448
TE	-0.3504	-0.3521	-0.3518	-0.3601
IE+DE	-0.3504	-0.3521	-0.3518	-0.3601
S=IE/TE	0.98	1.17	1.17	0.95
S=IE/(IE+DE)	0.98	1.17	1.17	0.95
Panel C: First Stage Equation (Equation 4)				
γ_M^Z	-0.00***	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
γ_M^T	-1.88**	-5.74***	-6.61***	-0.03**
	(0.80)	(1.55)	(1.56)	(0.02)
Observations	10302	10919	10935	11066
R-Squared	0.07	0.17	0.17	0.06

Notes: This table shows the estimates of the mediation model using alternative measures of incentive pay. Panel A reports the second stage results, based on equation (4). Panel C reports the first stage results based on equation (3). Panel B reports main parameters of the mediation model. I use the STATA code *ivmediate* to estimate the main results above (Dippel, Ferrara, and Heblich 2020). Firm-level control variables consist of age, skill composition of workers and general managers, percentage of permanent workers, percentage of exports, total employment in log, total capital in log, ownership dummies, 2-digit industry dummies, and the logarithm of the distance between the mainland Chinese county in which firms are located and the coastline. Columns (1) to (4) use the percentage of bonuses in total compensation (excluding piece-rate wages) among permanent workers, the percentage of piece-rate wages in total compensation (excluding bonuses) among permanent workers, the percentage of bonuses and piece-rate wages in total compensation among all workers (including temporary workers), a dummy variable on whether the general manager's annual income is directly related to the company's performance, to measure firms' intensity of incentive pay, respectively. Firm-level variables come from World Bank's Enterprise Survey in 2005. Standard errors are clustered at the city level. Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

A2.3 Alternative Measure of Innovation

Table A4 Estimates of the mediation model using an alternative measure of innovation

Mediating Variables	(1)
Panel A: Second Stage (Equation 5)	
β_Y^M	0.0217*
	(0.0131)
DE: β_Y^T	0.0448
	(0.1392)
F-Stat Instruments	22.065
Panel B: Model Parameters	
β_M^T	-24.2877
IE: $\beta_M^T \cdot \beta_Y^M$	-0.5287
TE	-0.4836
IE+DE	-0.4836
S=IE/TE	1.09
S=IE/(IE+DE)	1.09
Panel C: First Stage Equation (Equation 4)	
γ_M^Z	-0.00***
	(0.00)
γ_M^T	-5.67***
	(1.40)
Observations	10935
R-Squared	0.13

Notes: This table shows the estimates of the mediation model using an alternative measure of innovation, defined as the ratio of R&D expenditure to total sales. Panel A reports the second stage results, based on equation (4). Panel C reports the first stage results based on equation (3). Panel B reports main parameters of the mediation model. I use the STATA code *ivmediate* to estimate the main results above (Dippel, Ferrara, and Heblich 2020). Firm-level control variables consist of age, skill composition of workers and general managers, percentage of permanent workers, percentage of exports, total employment in log, total capital in log, ownership dummies, 2-digit industry dummies, and the logarithm of the distance between the mainland Chinese county in which firms are located and the coastline. Firm-level variables come from World Bank's Enterprise Survey in 2005. Standard errors are clustered at the city level. Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

A3 Effects of the Adoption of the 156 Projects on Other Outcomes

Table A5 Effects of the Adoption of the 156 Projects on Other Outcomes

Variables	(1) Employment	(2)	(3) Capital	(4)	(5) Capital-labor ratio	(6)	(7) Total compensation	(8)	(9) Wage gap	(10)	(11) Total sales	(12)	(13) Percentage of exports to other countries	(14)	(15) Percentage of exports to other cities	(16)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Access to 156 Projects	0.03	-0.02	-0.04	0.12	-0.06	0.17	0.00	-0.35*	-0.16	-1.20**	-0.12*	-0.29*	-1.49	-12.78***	-5.08***	-19.47***
	(0.08)	(0.29)	(0.14)	(0.43)	(0.08)	(0.24)	(0.04)	(0.21)	(0.14)	(0.55)	(0.06)	(0.16)	(0.97)	(4.60)	(1.68)	(6.73)
Observations	11192	11192	11192	11192	11192	11192	11191	11191	11186	11186	11192	11192	11192	11192	11192	11192
R-squared	0.31	0.31	0.29	0.29	0.17	0.17	0.70	0.70	0.08	0.07	0.77	0.77	0.52	0.50	0.41	0.38
F-stat	65.62	67.10	70.29	70.26	56.50	57.76	1006.94	967.03	15.91	13.79	379.65	362.20	72.49	59.99	412.54	293.01
Weak identification test (Cragg-Donald Wald F statistic)	.	14.99	.	14.99	.	14.99	.	15.09	.	15.09	.	15.10	.	15.06	.	15.39
Endogeneity test of endogenous regressors (p-value)	.	0.8570	.	0.6764	.	0.2502	.	0.0178	.	0.0072	.	0.2696	.	0.0006	.	0.0234

Notes: this table reports the effects of the adoption of the 156 Projects on other outcomes. Column (1) and (2) show the effect on total employment (in log). Columns (3) and (4) show the effect on total capital (in log). Columns (5) and (6) show the effect on capital-labor ratio (in log). Columns (7) and (8) show the effect on total compensation (in log). Columns (9) and (10) show the effect on wage gap between the highest salary and the lowest salary in the firm. Column (11) and (12) show the effect on total sales (in log). Columns (13) and (14) show the effect on the percentage of exports to other countries. Columns (15) and (16) show the effect on the percentage of exports to other cities. Columns (1) (3) (5) (7) (9) (11) (13) and (15) report OLS estimates. Columns (2) (4) (6) (8) (10) (12) (14) and (16) report IV estimates. The instrumental variable refers to the geographical distance between each mainland Chinese city and Jinmen. Firm-level variables come from World Bank's Enterprise Survey in 2005. Standard errors are clustered at the city level. Standard errors are in parentheses. *** p < .01, ** p < .05, * p < .1.

Reference

Dippel, Christian, Andreas Ferrara, and Stephan Heblich. 2020. “Causal Mediation Analysis in Instrumental-Variables Regressions.” *The Stata Journal* 20 (3): 613–26. https://doi.org/10.1177/1536867X20953572.