

# **Time Consistency of Industrial Policy and Local Economic Performance**

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## **Abstract**

Utilizing comprehensive firm-level data from China for 2011-2016, we construct an innovative indicator to measure the time consistency of a prevalent industrial policy tool – the government subsidy, and identify the causal relationship between the time consistency of industrial policy and local economic performance. Employing the occurrence of abrupt public safety incidents as an instrumental variable to capture the exogenous changes in subsidy, we find that the time consistency of subsidy has a significant and positive effect on local economic performance, as gauged by local GDP and GDP per capita. The effect is more pronounced in non-western provinces and in prefectures with a greater level of autonomy in economic affairs, and weaker when industrial policy changes are predictable. Micro-level analysis further reveals that higher consistency of subsidy is associated with an increase in firm entry, employees, fixed assets, outputs, and sales, particularly within targeted industries and high-tech manufacturing industries. Together, we provide the first evidence of the impact of time consistency on the effectiveness of industrial policy.

**Keywords:** time consistency, industrial policy, subsidy, China

**JEL Code:** O25, E61, H25, O47

# 1. Introduction

Recent years have witnessed the fall of debates on the legitimacy and desirability of industrial policy and the rise of discussions on how to improve the effectiveness of industrial policy (Rodrik, 2009; Harrison & Rodriguez-Clare, 2010; Lin, 2011). While existing literature has mainly concentrated on the characteristics of targeted sectors (Aghion et al., 2015; Liu, 2019) and the heterogeneous effects of different policy tools (Bloom et al., 2019; Barwick et al., 2019), this study shifts its focus to a lesser-explored facet of industrial policy implementation. Specifically, we investigate the time consistency during the implementation of government subsidy, a prevalent industrial policy tool (Juhász et al., 2022), with empirical evidence derived from China.

The time consistency of policy refers to the stability and predictability of policy actions in terms of time (Kydland & Prescott, 1977). Provided the fact that government subsidy is usually adopted to stimulate firm entry, investment, production, and R&D activities – many of which involve irreversible commitments – it is a natural deduction that the incentivization effect of subsidy largely depends on the time consistency of subsidy policy, especially under the assumption that entrepreneurs make business decisions based on their expectations of future policy actions (Rodrik, 1991; Julio & Yook, 2016; Bhattacharya et al., 2017; Chen et al., 2020). The ideal scenario of governments providing a stable and consistent industrial policy landscape for entrepreneurs, however, is distorted by China's unique fiscal decentralization system and meritocratic political promotion system (Xu, 2011), where sub-national officials are empowered to determine local industrial development strategies while they are incentivized to change the industrial planning once they take the office (Yao & Zhang, 2015; Lin et al., 2023). China's unique institutional context offers us a chance to look at the overarching impact stemming from exogenous changes in the time consistency of subsidy.

This paper provides empirical evidence on the impact of the time consistency of government subsidy as an industrial policy tool on local economic performance. In addressing our first challenge – developing a measure for the time consistency of subsidy – we introduce a unique prefecture-level indicator, the “cosine similarity”. For each prefecture and each year, we construct a vector reflecting the allocation of subsidies across industries using firm-level

data, then calculate the cosine similarity between vectors of consecutive years. A higher cosine value signifies a more similar allocation of subsidies across industries, thereby indicating higher time consistency of subsidy. Using this novel measure, we uncover a significant and positive relationship between the time consistency of subsidy and local economic performance, as gauged by local GDP and GDP per capita.

Our second challenge is how to resolve the endogeneity problem. The variation in the consistency measure is clearly subject to some endogenous forces, among which the omitted variable bias is the primary concern. For example, changes in industrial policy might result from endogenous industrial upgrading. We employ the occurrence of abrupt public safety incidents in the previous period as an instrumental variable to extract the exogenous changes in industrial policy. Following the comprehensive implementation of the accountability system for officials in 2009 in China, the occurrence of public safety incidents is highly associated with local political personnel transitions, which will in turn result in industrial policy changes. On the other hand, after we control for necessary covariates, public safety incidents can be regarded as sudden, unforeseeable events and will not have direct impacts on local economic performance through alternative channels.

The instrumental variable regressions demonstrate the importance of the time consistency of government subsidy for local economic performance. Specifically, a one percentage point increase in the cosine similarity between subsidy vectors of period  $t$  and  $t-1$  is associated with a 0.349% increase in the local GDP and a 0.380% in the local GDP per capita at period  $t+1$ . These findings are robust to various robustness checks, including considering the development stage of local industries and making comparisons within prefectures with similar industrial structures.

Heterogeneous tests and extended analysis with disaggregate data help us further explore the mechanism of industrial policy consistency's influence on local economic performance. We find the marginal effect of time consistency significantly lower when the policy changes are relatively predictable, indicating that policy consistency affects local development by shaping entrepreneurs' expectations of policy actions. Moreover, we identify a significantly more pronounced marginal effect in non-western provinces and in prefectures with a greater level of autonomy in economic affairs, implying a link between local officials and changes in industrial

policy. Leveraging the prefecture-industry level data, we further demonstrate that an increase in the time consistency of subsidy is associated with a higher level of firm entry, employees, fixed assets, outputs, and sales, particularly within targeted industries that once received subsidies at period  $t$  or  $t-1$  and high-tech manufacturing industries. Based on our findings, we assert that time consistency of industrial policy plays an important role in the local industrial development and overall economic performance.

Our paper contributes to several strands of literature. First, the paper mainly contributes to the empirical literature focusing on government commitment and the time consistency of policy. Following Kydland & Prescott (1977)'s pioneering theoretical work which provides a theoretical foundation of policy consistency and highlights the importance of policy plans, a series of theoretical literature that study the optimal policies with consideration of time consistency steadily emerge (Calvo, 1978; Kydland & Prescott, 1980; Klein & Ríos-Rull, 2003; Athey et al., 2005; Halac & Yared, 2014; Moser & Yared, 2022). Empirical literature, on the other hand, concentrates on the effect of discretion during the implementation of fiscal and monetary policy (Fatás & Mihov, 2003; Taylor, 2009; Agnello et al., 2011; Abo-Zaid & Tuzemen, 2012), and the relationship between time consistency and industrial policy is rarely discussed. This paper is, to our knowledge, the first empirical endeavor that establishes a causal relation between the time consistency of industrial policy and local economic performance.

The paper also closely connects to the literature focusing on the effectiveness of industrial policy. Critiques over industrial policy revolve around two practical objections, the information shortcomings and the political capture (Juhász et al., 2023). While the former concern has been thoroughly discussed in both theoretical and empirical contexts (Aghion et al., 2015; Maloney & Nayyar, 2018; Liu, 2019; Bloom et al., 2019; Barwick et al., 2019), discussions on the latter remain inadequate. The most related literature is Cingano et al. (2022), which identifies a negative impact of political discretion on the effectiveness of an Italian public investment subsidy programme. As they only compare politicians' discretion during the granting process with objective criteria, our paper contributes to the introduction of a dynamic perspective, demonstrating the intertemporal impact of political discretion on the effectiveness of industrial policy.

The rest of the paper is organized as follows. Section 2 introduces the institutional

backgrounds for this study. Section 3 describes data, empirical settings, and identification strategy. Section 4 presents the main empirical findings. Section 5 discusses the extended analysis using micro-level data. Section 6 concludes the paper.

## **2. Institutional Backgrounds**

### **2.1 Fiscal Decentralization and Local Officials' Autonomy**

Since the tax-sharing reform in 1994, China has developed a comprehensive and explicit fiscal decentralization system, under which local governments are tasked with stimulating local economic growth to generate fiscal revenues and meet expenditure demands (Shen et al., 2012). With the completion of this reform, local governments have been assigned a great level of autonomy in local economic affairs and a wide range of policy tools at their disposal, among which industrial policy is one of the most frequently employed ones. Given that industrial development relies on local endowments such as capital stocks, labor intensity, and natural resources, local government officials possess an even greater level of autonomy in the decision of local industrial strategies and the corresponding implementation of industrial policies. They hold the capacity to determine, or at least exert significant influence over, the industries to be supported, the choice of industrial policy tools to be deployed, and the duration for which these industrial policies remain in effect.

### **2.2 Meritocracy and Promotion Incentives of Local Officials**

China's prefecture-level governments generally have two main officials in charge, the party secretary and the mayor. The party secretary, who serves as the number-one person in the prefecture and the leader of the local Chinese Communist Party (CCP) organization, steers the overall development direction of the prefecture. The mayor serves as the number-two person and is responsible for various economic and social affairs. In the industry development area, it is usually the party secretary who crafts the blueprint for local industrial development and determines which industries to support. Thus, our discussions will mainly revolve around prefecture-level party secretaries in this paper.

In China's political promotion system, a meritocratic approach prevails wherein officials are promoted primarily based on their ability to stimulate local economic development (Li &

Zhou, 2005; Yao & Zhang, 2015; Chen et al., 2017). For prefecture-level party secretaries, the trajectory of their political careers after their current terms is determined by provincial-level supervisors, including the provincial party secretary and the organizational department of the CCP. According to the Organic Law of the Local People's Congress and Local Governments of the PRC, prefecture-level officials are supposed to serve in their roles for five years before they are rotated to another prefecture or promoted. However, in practice, the decisions regarding such turnovers possess considerable temporal flexibility, resulting in an irregular and unpredictable pattern of political turnovers. In Figure A1, we show the distribution of term length of prefecture-level party secretaries from 2009 to 2016. The average term length is 4.88 years, and only 14.6% of party secretaries fulfill the five-year term. Besides, more than 21.5% of party secretaries serve for only two to three years.

The meritocratic system, together with the unexpected and uncertain nature of political turnovers, has created a powerful incentive for party secretaries to swiftly signal their competencies, given that the evaluation process by supervisors could occur at any time. Within the realm of industrial development, a common strategic choice for an ambitious party secretary is to develop new industries immediately after she takes office. This proactive stance serves not only to signal her ability but, more importantly, to highlight her divergence from her predecessor. Recent research has uncovered some empirical evidence of the relationship between sub-national political rotation and local industrial planning in China. For example, Lin et al. (2023) finds that the coming-in of a new city party secretary is associated with a significant increase in the revealed comparative advantage in industries where her/his previous position location has better performance, providing evidence that sub-national officials will affect the local industrial planning at their arrival based their own experiences, ability, and incentives.

### **2.3 Public Safety Incidents and the Accountability System**

Public safety incident refers to incidents that result in a certain number of deaths, serious injuries, or a large amount of direct economic losses. The most common public safety incidents include explosions, traffic accidents, fires, collapses and falls, etc. China's Ministry of Emergency Management classifies public safety incidents into three levels based on the severity of consequences: 1) particularly serious incident, which causes more than 30 deaths, or more

than 100 serious injuries, or a direct economic loss of more than 100 million yuan, 2) serious incident, which causes 10-30 deaths, or 50-100 serious injuries, or a direct economic loss of 50-100 million yuan, and 3) major incident, which causes 3-10 deaths, or 10-50 injuries, or a direct economic loss of 10-50 million yuan. Among these incidents, the particularly serious incidents will be investigated directly by the Ministry of Emergency Management, and the other two types of incidents will be investigated by the provincial government under the supervision of the central government.

In May 2009, the General Office of the CCP Central Committee and the General Office of the State Council jointly issued the Temporary Implementation of the Accountability System of Party and Government Leading Cadres. This policy mandated the imposition of accountability on local officials in cases involving public safety incidents. The ways of imposing accountability on local officials include ordering a public apology, suspension and inspection, taking the blame and resigning, ordering resignation, and removal from office. Later in 2010, the Ministry of Emergency Management began publicly disclosing all public safety incidents that occurred across the country on its official website. These disclosures encompassed critical details such as the severity level of incidents, as well as pertinent information like dates and locations. In instances of particularly serious incidents, comprehensive investigation reports were published online, outlining the causes of the incident and the corresponding accountability results. For serious and major incidents, notifications regarding supervisory investigations were published, prompting provincial governments to investigate the cause of the incident and hold those responsible accountable. Notably, there is typically a time lag of several months between the actual occurrence of incidents and the subsequent publication of reports or notifications.

### **3. Data and Empirical Strategy**

#### **3.1 Measuring Time Consistency of Subsidy**

We follow two steps to construct a measure for the time consistency of subsidy between consecutive periods. First, we construct a dummy  $Ind_{sct}$  indicating whether industry  $s$  of prefecture  $c$  receives any subsidies at period  $t$ , from which we can obtain a vector of subsidy allocation across industries for each prefecture. Then, we calculate the cosine value between vectors of period  $t$  and  $t-1$  according to the following formula:

$$Cosine\_sub\_d_{ct} = \frac{\sum_{s=1}^n Ind_{sct} * Ind_{sc,t-1}}{\sqrt{\sum_{s=1}^n Ind_{sct}^2} * \sqrt{\sum_{s=1}^n Ind_{sc,t-1}^2}}$$

The cosine similarity value falls between 0 and 1 since the indicator takes either 0 or 1. Higher cosine value reflects smaller angles between the two vectors, implying that the subsidy allocation across industries at period  $t$  is more consistent with the allocation at period  $t-1$ .

The subsidy data are obtained from the China Tax Survey Enterprise Database 2010-2016, which documents the detailed information of all Chinese enterprises. We only keep the samples from the manufacture sectors, and we delete all the samples with non-positive industrial output, sales, costs, assets, fixed assets and debts, and those with zero employee and negative subsidies and investments.

### 3.2 Empirical Specification

To examine the relationship between time consistency of subsidy and local economic performance, we begin with the following specification:

$$y_{c,t+1} = \beta_1 * Cosine\_sub\_d_{ct} + X_{ct} * \beta + \delta_c + \tau_t + \epsilon_{ct} \quad (1)$$

where  $c$  and  $t$  denote prefectures and years respectively. The primary outcome variables consist of the logarithm of local GDP at period  $t+1$  and the logarithm of GDP per capita at period  $t+1$ . The former variable stands for the overall local economic scale while the latter one indicates the level of local economic development of prefecture  $c$ . We choose one-period-forward outcome variables to avoid the potential reverse causality problem. Our key explanatory variable of interest is  $Cosine\_sub\_d_{ct}$ , which measures the intertemporal consistency of subsidy. We control for prefecture ( $\delta_c$ ) and year ( $\tau_t$ ) fixed effects to reduce the impact of time-invariant prefecture characteristics and national-level time characteristics. Standard errors are clustered at the prefecture level.

We also control for a number of prefecture-level covariates ( $X_{ct}$ ) that are likely to influence both industrial policy consistency and local economic performance. We classify them into the following categories.

*Local economic conditions.* We control for the logarithm of local GDP, the proportion of industrial sector GDP, and the logarithm of manufacturing employment at period  $t$ .

*Local industrial characteristics.* We control for the number of industries at period  $t$ . We



also control for the ratio of subsidy received by local enterprises to local fiscal revenue, which indicates the importance of subsidy as an industrial policy in prefecture  $c$ .

*Political turnover.* We control for a dummy variable indicating whether the turnover of party secretary happens at period  $t$  to address the concern that both local GDP performance and policy consistency are simultaneously correlated with political turnover.

### **3.3 Identification Strategy**

The variation in the consistency measure is subject to some endogenous forces, among which the omitted variable bias is the primary concern. For example, the endogenous industrial upgrading process over time would promote the reallocation of government subsidies across industries. With the evolution of industrial structure where new industries emerge and old industries get mature, the reallocation of industrial policy seems to be natural and at least harmless to local economic development. Confounding factors like these will deviate the estimated coefficients from our expectation, as they bias the estimations towards zero.

To address the endogeneity problem and identify the effect of unexpected changes in industrial policy, we adopt an instrumental variable for the endogenous variable of interest. As discussed in Section 2, with the implementation of the accountability system in May 2009, the occurrence of public safety incidents is highly associated with local political transitions, which will in turn result in changes in regional industrial policy. Within our sample, we discover a significantly positive correlation between public safety incidents and prefecture-level political turnover (as shown in Figure A2). Specifically, the probability (or mean value) of political turnover is 0.322 when there are no public safety incidents happening in the previous period, and the probability becomes 0.391 when at least one public safety incident occurs in the previous period. The t-test result suggests that we can reject the hypothesis at 1% level that the probability of political turnover after a public safety incident occurs is equal to that when there are no public safety incidents.

The exclusion condition, on the other hand, can be satisfied after we further control for some necessary covariates. A common worry is whether the occurrence of public safety incidents is endogenously correlated with local economic performance, considering the fact that social conflicts are more likely to arise in regions suffering from economic downturns. To

address this concern, we control for  $L4\_growth_{ct}$ , the average GDP growth rates in the previous 4 periods (from  $t-1$  to  $t-4$ ), to capture the average-level economic growth conditions before the policy changes happen<sup>1</sup>.

Another potential omitted variable is the local industrial structure. Specific types of public safety accidents, such as mining accidents, are more likely to occur in regions with special endowment and industrial structure, which is obviously correlated with local economic development (Lin, 2011). For example, regions rich in mineral resources are more likely to develop related industries, while these resource-based regions are often under-developed. To address this concern, we control for  $Mining\_pct_{ct}$ , the employment in the mining sector as a share of the employment in the secondary sector. This covariate measures the extent to which prefecture's economy is dependent on the mining industry.

To construct the instrumental variable, we obtain relevant information from the Ministry of Emergency Management's website using Python, and identify the corresponding prefecture and year of each incident. The summary statistics of different types of public safety incidents are presented in Table 1. The three most frequent types of public safety incidents are explosion, traffic accidents, and fire, all of which are not industry-specific. Therefore, after controlling for necessary covariates, we assume that the occurrence of public safety incidents is not systematically correlated with the local industrial structure.

Table 1. Public Safety Incidents: Summary Statistics

Incident Type	No. of Obs.	Percentage
Explosion (gas and fireworks)	137	31.1%
Traffic Accidents	121	27.5%
Fire	38	8.6%
Collapse and Fall (in building sites)	37	8.4%
Flooding Accidents (in coal mines)	34	7.7%
Others	73	16.6%
All	440	100%

<sup>1</sup> Replacing this covariate with the average GDP growth rates in the previous 3 periods will not influence the robustness of the results.

The two-stage regression specification is as follows:

$$\text{Cosine\_sub\_d}_{ct} = \alpha_1 * \text{Incident}_{c,t-1} + X_{ct} * \alpha_2 + Z_{ct} * \alpha_3 + \delta_c + \tau_t + v_{ct} \quad (2)$$

$$y_{c,t+1} = \beta_1 * \widehat{\text{Cosine\_sub\_d}}_{ct} + X_{ct} * \beta_2 + Z_{ct} * \beta_3 + \delta_c + \tau_t + \epsilon_{ct} \quad (3)$$

where  $\text{Incident}_{ct}$  is the instrumental variable indicating whether there is a public safety incident being investigated in prefecture  $c$  in year  $t$ , and  $Z_{ct}$  are the newly-controlled covariates. We expect  $\alpha_1$  to be negative, as the occurrence of public safety incidents is supposed to result in unexpected policy changes.

The summary statistics of all the variables are presented in Table 2. The cosine similarity value between subsidy vectors of period  $t$  and  $t-1$  is 0.643 on average, with a range between 0 and 0.927.

Table 2. Summary Statistics

Variable	N	Mean	S.D.	Min	Medium	Max
lnGDP	1352	16.16	0.843	14.12	16.05	18.58
lnGDPpc	1350	10.27	0.643	8.597	10.22	11.97
Cosine_sub_d	1366	0.643	0.161	0	0.667	0.927
Turnover	1375	0.337	0.473	0	0	1
gdpsecond	1352	49.52	9.543	21.24	49.79	75.80
lnmanu	1346	11.30	1.117	8.132	11.26	14.03
Nind	1375	68.06	36.47	1	64	158
Subpct	1357	0.169	0.145	0.001	0.132	0.904
Incident	1375	0.173	0.378	0	0	1
Mining_pct	1338	0.124	0.175	0	0.043	0.755
L4_growth	1351	0.110	0.0400	0	0.111	0.229

## 4. Results

### 4.1 Baseline Results

The baseline results are presented in Table 3. The first dependent variable is the logarithm of local GDP at period  $t+1$ . To provide a benchmark, we only control for prefecture and year fixed effects in Column (1), and we find a significantly positive correlation between the time consistency of subsidy and local GDP. We add covariates step by step in Columns (2) – (4). In Column (2), we control for political turnover. In Columns (3) and (4), we further control for

local economic conditions and local industrial characteristics, and the key coefficient remains significantly positive. A one percentage point increase in the time consistency of subsidy is associated with an 0.086% increase in the local GDP level.

To further exclude the possibility that the growth of GDP is mainly driven by the growth of population, we replace the dependent variable with the logarithm of GDP per capita in Columns (5) – (8). We only control for prefecture and year fixed effects in Column (5), and gradually control for covariates in Columns (6) – (8). In all cases, we find the estimated coefficient of interest significantly positive. A one percentage point increase in the time consistency of subsidy is associated with an 0.067% increase in the local GDP per capita. Therefore, the time consistency of subsidy will not only promote the growth of local economic scale, but also improve the level of local economic development.

Table 3. Industrial Policy Consistency and Local Development: OLS estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	lnGDP <sub>t+1</sub>				lnGDPpc <sub>t+1</sub>			
Cosine_sub_d <sub>t</sub>	0.091** (2.442)	0.091** (2.442)	0.074*** (4.036)	0.086*** (4.153)	0.073** (2.135)	0.074** (2.135)	0.052*** (2.650)	0.067*** (3.026)
Turnover <sub>t</sub>		-0.005 (-0.723)	0.000 (0.093)	0.000 (0.071)		-0.003 (-0.501)	0.001 (0.258)	0.001 (0.325)
lnGDP <sub>t</sub>			1.011*** (15.604)	1.007*** (15.701)			0.939*** (13.165)	0.930*** (13.197)
gdpsecond <sub>t</sub>			-0.001 (-1.127)	-0.001 (-1.178)			-0.001 (-0.962)	-0.001 (-0.958)
lnmanu <sub>t</sub>			0.013 (1.198)	0.013 (1.252)			0.011 (1.028)	0.013 (1.202)
Nind <sub>t</sub>				-0.000 (-1.263)				-0.001** (-2.088)
Subpct <sub>t</sub>				-0.020 (-1.186)				-0.026 (-1.512)
Constant	16.136*** (662.211)	16.137*** (653.695)	-0.247 (-0.234)	-0.154 (-0.148)	10.252*** (453.274)	10.253*** (448.278)	-4.974*** (-4.278)	-4.815*** (-4.181)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1124	1124	1091	1076	1133	1133	1087	1072
adj. R <sup>2</sup>	0.990	0.990	0.996	0.996	0.984	0.984	0.993	0.993

t statistics in parentheses. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01. Standard errors are clustered at prefecture level.

## 4.2 Instrumental Variable Results

The baseline OLS estimates suggest that the time consistency of subsidy has a positive effect on both local GDP and GDP per capita. However, the time consistency measure for subsidy might be associated with a complex myriad of factors, some of which are also correlated with local economic performance. In this section, we employ the instrumental variable approach described in Section 3.3 to identify the causal relationship between policy consistency and local economic performance.

The instrumental variable results are presented in Table 4. In Panel A, we control for only one additional covariate, the average GDP growth rates of the previous 4 periods,  $L4\_growth_{ct}$ . We first show the OLS estimates with the extra covariate for comparison in Columns (1) – (2). We find a significantly positive correlation between industrial policy consistency and local GDP (per capita). The results in Column (1) – (2) suggests that a one percentage increase in the time consistency of subsidy is associated with a 0.083% increase in the local GDP, and a 0.063% increase in the local GDP per capita.

Column (3) shows the first stage regression results. We find the key coefficient significantly negative at 1% level. Specifically, the occurrence of public safety incidents at period  $t-1$  will significantly reduce the time consistency of subsidy at period  $t$  by 2 percentage point, which accounts for 12.4% of the standard deviation of the consistency measure. The F-statistic in the first stage is 8.19. In Column (4) – (5), we conduct the second stage regression using the predicted value of the consistency measure as the key explanatory variable of interest. The second stage results suggest that the time consistency of subsidy has a significant and positive effect on local GDP and GDP per capita. A one percentage increase in the time consistency of subsidy is associated with a 0.349% increase in the local GDP, and a 0.380% increase in the local GDP per capita, both of which are non-negligible magnitude in terms of local economic growth. In Panel B, we control for another additional covariate, the employment in the mining sector as a share of the employment in the secondary sector  $Mining\_pct_{ct}$ , to ensure the exclusion condition holds, and the empirical results remain robust.

Table 4. Industrial Policy Consistency and Local Development: IV estimates

Panel A					
	(1)	(2)	(3)	(4)	(5)
	OLS		First Stage	Second Stage	
	lnGDP <sub>t+1</sub>	lnGDPpc <sub>t+1</sub>	Cosine_sub_d <sub>t</sub>	lnGDP <sub>t+1</sub>	lnGDPpc <sub>t+1</sub>
Cosine_sub_d <sub>t</sub>	0.083*** (4.033)	0.063*** (2.899)			
Incident <sub>t-1</sub>			-0.020*** (-2.640)		
Cosine <sub>sub_d_t</sub>				0.349* (1.710)	0.380* (1.782)
L4_growth <sub>t</sub>	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
N	1067	1064	1248	1067	1064
adj. R <sup>2</sup>	0.997	0.994	0.561	0.996	0.994
Panel B					
	(1)	(2)	(3)	(4)	(5)
	OLS		First Stage	Second Stage	
	lnGDP <sub>t+1</sub>	lnGDPpc <sub>t+1</sub>	Cosine_sub_d <sub>t</sub>	lnGDP <sub>t+1</sub>	lnGDPpc <sub>t+1</sub>
Cosine_sub_d <sub>t</sub>	0.079*** (3.937)	0.059*** (2.756)			
Incident <sub>t-1</sub>			-0.021*** (-2.708)		
Cosine <sub>sub_d_t</sub>				0.372* (1.962)	0.394** (1.988)
L4_growth <sub>t</sub>	Yes	Yes	Yes	Yes	Yes
Mining_pct <sub>t</sub>	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
N	1044	1041	1223	1044	1041
adj. R <sup>2</sup>	0.997	0.994	0.560	0.996	0.994

t statistics in parentheses. \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01. Standard errors are clustered at prefecture level. We control for political turnover, local economic conditions, and the local industrial characteristics of prefecture c in year t.

It is obvious that the instrumented coefficients are larger than the OLS estimates. We attribute it to the fact that the endogenous measure of time consistency of subsidy has the effect of biasing the estimation towards zero, and thus underestimates the effect of policy consistency

on local economic performance. As discussed before, there are some cases when changes in industrial policy result from the industrial upgrading process and the rises and falls of local industries, and thus are harmless to local development. With the implementation of instrumental variable, we can extract variations in the policy consistency that are caused solely by unexpected and abrupt incidents. When the changes in industrial policy are exogenous and have nothing to do with the development of local industrial structure, we find higher time consistency much more matters for local economic performance.

### **4.3 Robustness Checks**

In this section, we perform several robustness checks to exclude potential alternative explanations and address other concerns about omitted variables.

#### **4.3.1 Convergence of Industrial Structure**

We first discuss an alternative explanation arguing that the simultaneous increases in policy consistency and local economic performance are driven by the convergence of industrial structure. Based on the assumption that the speed of industrial upgrading will slow down as the economy grows, and the industrial structure will eventually converge to the technological frontier, the intertemporal similarity of industrial policy may naturally stay higher in more developed regions. To rule out this alternative explanation, we further control for the developing stage of local industries,  $\text{Cosine\_highest}_{ct}$ . We first group all the samples based on province-year and identify the prefecture with the highest GDP per capita in each group as the “most developed prefecture”<sup>2</sup>. Then, we calculate the cosine similarity of industrial structures between each prefecture and the “most developed prefecture” to measure the developing stage of certain prefectures.

The empirical results are presented in Table 5 Columns (1) – (3). After we control for the developing stage of industries, the previous conclusion remains robust. Besides, we find that the coefficient of  $\text{Cosine\_highest}_{ct}$  is positive but insignificant in Column (1). Hence, there is no evidence that time consistency of subsidy is correlated with the developing stage of industries.

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<sup>2</sup> Due to the vase size of China and the differences in endowment structure between different regions, it is sound and reasonable to identify the “most developed prefecture” within each province instead of within the whole nation.

### 4.3.2 Comparison between Prefectures with Similar Industrial Structure

Another concern is whether prefectures with different industrial structures are comparable in terms of industrial policy consistency. In regions dominated by labor-intensive industries, for example, the industrial policy pattern might be systematically different from that in capital-intensive regions. To control for the local industrial structure once and for all, we separate the samples into groups based on their industrial structure and control for group fixed effect. In this way, we can make comparisons within prefectures with similar industrial structures. Specifically, we first construct variables indicating whether industry  $s$  exists in prefecture  $c$  in year  $t$ . Then, we conduct K-mean clustering based on these indicators and divide the samples into 10 groups. Samples with the most similar industries will be grouped together.

We repeat the two-stage regressions controlling for the K-mean cluster fixed effects. The results are presented in Columns (4) – (6). When we compare the marginal effect of industrial policy consistency within samples with similar industrial structure, we still find it significant and positive.

Table 5. Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
	First Stage	Second Stage		First Stage	Second Stage	
	Cosine_sub_d <sub>t</sub>	lnGDP <sub>t+1</sub>	lnGDPpc <sub>t+1</sub>	Cosine_sub_d <sub>t</sub>	lnGDP <sub>t+1</sub>	lnGDPpc <sub>t+1</sub>
Incident <sub>t-1</sub>	-0.021*** (-2.679)			-0.021*** (-2.678)		
Cosine <sub>sub_d_t</sub>		0.374* (1.960)	0.396** (1.987)		0.355* (1.871)	0.388* (1.960)
Cosine_highest <sub>t</sub>	0.019 (0.515)	-0.009 (-0.408)	0.001 (0.043)			
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
K-mean Cluster FE	No	No	No	Yes	Yes	Yes
N	1208	1044	1041	1223	1044	1041
adj. R <sup>2</sup>	0.559	0.996	0.994	0.562	0.996	0.994

t statistics in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Standard errors are clustered at prefecture level. We control for political turnover, local economic conditions, local industrial characteristics, previous average GDP growth rate and the employment share in mining industry of prefecture  $c$  in year  $t$ .



## 4.4 Heterogeneous Effects

In this section, we will examine several heterogeneous effects of the time consistency of government subsidy on local economic performance. The results are shown in Table 6.

### 4.4.1 Expectations of Industrial Policy Changes

The first heterogeneity arises from the entrepreneurs' expectations of industrial policy changes. Notably, there are specific periods when changes in industrial policy are relatively predictable and foreseeable for entrepreneurs, leading to a smaller marginal effect of policy consistency. In China, each province holds its own Provincial Party Congress (PPC) every five years, usually one year or half a year before the National Party Congress. This temporal alignment often coincides with a notable uptick in prefecture-level rotations, creating a consensus that the likelihood of political turnovers increases during this period. We thus assume that the marginal effect of policy consistency will decrease during the PPC period, as entrepreneurs will expect political turnover and consequent policy changes. In Columns (1) – (2), we interact the consistency measure with a dummy variable indicating whether the PPC is held in prefecture  $c$ 's province in year  $t$ . We find the coefficient of the interaction term significantly negative while the coefficients of the consistency measure remain significantly positive, suggesting that the marginal effect of policy consistency is indeed smaller during the PPC period.

Another period when entrepreneurs would expect industrial policy changes is the release year of Five-year Plans (FYP). Every five years, the Chinese central government will unveil a Five-year Plan indicating several key industries in the next 5-year period, and the sub-national governments will follow and unveil their own Five-year Plans. We thus assume that the marginal effect of policy consistency will decrease during the FYP period, as entrepreneurs will also expect wholesale changes in industrial policy. In Columns (3) – (4), we interact the consistency measure with a dummy variable indicating whether the central government released a Five-year Plan in year  $t$ . The coefficient of the interaction term is significantly negative in Column (3) and negative but insignificant in Column (4), while the coefficients of the consistency measure remain significantly positive. We find preliminary evidence that the marginal effect of industrial policy consistency is smaller when the Five-year Plan is released.

#### **4.4.2 Prefectures' Autonomy in Economic Affairs**

The second heterogeneity arises from prefectures' autonomy in local economic affairs. In China, there are five prefectures with independent planning status under the National Social and Economic Development, including Dalian, Qingdao, Ningbo, Xiamen, and Shenzhen. These prefectures are assigned administrative power equal to those of the provinces, and thus have a higher level of autonomy in the decisions of economic policies. We thus assume that the marginal effect of policy consistency will be higher in these prefectures, as the party secretaries are more likely to decide the local industrial planning. In Columns (5) – (6), we interact the consistency measure with a dummy variable indicating whether the prefecture belongs to the five independent-planning ones. The coefficient of the interaction term is positive but insignificant in Column (5) and significantly positive in Column (6), while the coefficients of the consistency measure remain significantly positive, suggesting that the marginal effect of industrial policy consistency is larger in prefectures with higher administrative power.

Finally, we take a glance at the effect of regional heterogeneity. We exclude all the prefectures in western regions of China in Columns (7) - (8) and obtain larger coefficients with both dependent variables compared to the coefficients in Table 4. This is probably because the industrial policies in the western provinces usually follow the central government's planning and demonstrate less autonomy, as illustrated and discussed by Zhao & Chen (2019). Due to the imbalance of regional development in China, Western local governments have to seek for more financial and policy support from the central government by following the central industrial policies.

### **5. Extended Analysis**

Why would the time consistency of subsidy influence local GDP and GDP per capita? A direct mechanism is through the business decisions of entrepreneurs, such as entry and exit, expansion, investment, and production. The inconsistency of industrial policy will break the stability of entrepreneurs' expectations of future policy actions, thus dampening the incentive effect of industrial policy (Rodrik, 1991). In this section, we will conduct some extended analysis focusing on the entrepreneurs' reactions to industrial policy consistency based on prefecture-industry level data.

Table 6. Heterogeneous Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Expectations of Industrial Policy Changes				Prefectures with Higher Administrative Power		Exclude Prefectures in Western Province	
	lnGDP <sub>t+1</sub>	lnGDPpc <sub>t</sub>	lnGDP <sub>t+1</sub>	lnGDPpc <sub>t</sub>	lnGDP <sub>t+1</sub>	lnGDPpc <sub>t+1</sub>	lnGDP <sub>t+1</sub>	lnGDPpc <sub>t+1</sub>
Cosine_sub_d <sub>t</sub>	0.373**	0.393**	0.388**	0.407**	0.367*	0.387*	0.559**	0.581***
	(1.988)	(2.003)	(2.035)	(2.030)	(1.933)	(1.953)	(2.598)	(2.672)
x Provincial Party Congress	-0.075**	-0.059*						
	(-2.394)	(-1.940)						
x Five-year Plans			-0.066**	-0.049				
			(-2.104)	(-1.573)				
x Independent Planning Status					0.677	0.850**		
					(1.532)	(2.266)		
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	1044	1041	1044	1041	1044	1041	745	746
adj. <i>R</i> <sup>2</sup>	0.996	0.994	0.996	0.994	0.996	0.994	0.996	0.993

t statistics in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Standard errors are clustered at prefecture level. We control for political turnover, local economic conditions, local industrial characteristics, previous average GDP growth rate and the employment share in mining industry of prefecture  $c$  in year  $t$ .

Table 7 Panel A demonstrates the effect of the predicted time consistency of subsidy on a battery of industry-level variables at period  $t+1$ , including the number of firms, employees, fixed assets, output, and sales. We find that on average, industrial policy consistency will have a significant and positive impact on employees, fixed assets, and sales, but no significant impact on firm entry and industrial output. As the cosine similarity of industrial policy increases by 1 percentage point, employees will increase by 2.363%, fixed assets will increase by 3.083%, and sales will increase by 2.582%.

There are some industries in the sample that did not receive subsidies from the local government in both periods. We expect the actions of enterprises in these industries will be less likely to be influenced by the industrial policy consistency, as the industrial policy change will not directly harm their interests. To further examine the direct impact of policy consistency on entrepreneurs' actions, we only keep the samples that received subsidies at period  $t-1$  or  $t$  or

both in Panel B and repeat the analysis above. Compared to the results in Panel A, the marginal effects of policy consistency on firm entry and industrial output become significantly positive in Panel B. As the cosine similarity of industrial policy increases by 1 percentage point, the number of firms will increase by 2.654%, and the industrial output will increase by 2.373%. Besides, the marginal effect on other variables also becomes larger. These results suggest that for the industries that once received subsidies from the local government, industrial policy consistency is much more important.

Finally, we look at the sub-sample containing only high-tech manufacturing industries. These industries should be more demanding for the time consistency of industrial policy as they feature in high level of inputs and long cycles of R&D and production. Therefore, we expect a larger marginal effect of policy consistency within these industries. The definition of high-tech manufacturing industries comes from China's High-tech Industry (Manufacturing) Classification (2013)<sup>3</sup>. The empirical results in Panel C verify our conjectures, as all the coefficients are significant and a lot larger than that in Panel A and B. For industries with long-term and substantial inputs, the time consistency of subsidy plays an important role in the entrepreneurs' investment and production decisions.

## 6. Conclusion

This paper first provides empirical evidence highlighting the importance of time consistency during policy implementation in understanding the factors that influence the effectiveness of industrial policy. With a newly introduced indicator for the time consistency of subsidy and the occurrence of abrupt public safety incidents as an instrumental variable, we find that the time consistency of subsidy has a significant and positive effect on local GDP and GDP per capita. The empirical results are robust to a variety of robustness checks. Heterogeneous tests show that the marginal effect of policy consistency on local GDP growth is greater in non-western provinces and in prefectures with a greater level of autonomy in economic affairs, and lower when the industrial policy changes are predictable. By exploiting the industry-prefecture level data, we further find that the increase in industrial policy consistency is associated with a greater

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<sup>3</sup> We identify pharmaceutical manufacturing, aviation, spacecraft and equipment manufacturing, electronic and communication equipment manufacturing, computer and office equipment manufacturing, medical equipment manufacturing, and information chemical manufacturing as high-tech manufacturing industries.

level of firm entry, employees, fixed assets, outputs, and sales, especially in industries that received subsidies at period  $t$  or  $t-1$  and high-tech manufacturing industries.

Table 7. Extended Analysis: Prefecture-Industry Level

Panel A: Full Sample					
	(1)	(2)	(3)	(4)	(5)
	$\ln N_{firm_{t+1}}$	$\ln Employee_{t+1}$	$\ln FixedAssets_{t+1}$	$\ln Output_{t+1}$	$\ln Sales_{t+1}$
$\widehat{Cosine\_sub\_d_t}$	1.752 (1.628)	2.363** (2.307)	3.083** (2.566)	1.989 (1.557)	2.582** (2.232)
Controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
City-Ind FE	Yes	Yes	Yes	Yes	Yes
$N$	64194	63622	63243	61818	63465
adj. $R^2$	0.818	0.785	0.748	0.751	0.788
Panel B: Industries that received subsidies at either period t-1 or period t or both					
	(1)	(2)	(3)	(4)	(5)
	$\ln N_{firm_{t+1}}$	$\ln Employee_{t+1}$	$\ln FixedAssets_{t+1}$	$\ln Output_{t+1}$	$\ln Sales_{t+1}$
$\widehat{Cosine\_sub\_d_t}$	2.654** (2.185)	2.832*** (2.823)	3.629*** (2.999)	2.373* (1.840)	3.266*** (2.964)
Controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
City-Ind FE	Yes	Yes	Yes	Yes	Yes
$N$	39936	39730	39501	39000	39606
adj. $R^2$	0.831	0.792	0.746	0.750	0.789
Panel C: High-tech industries					
	(1)	(2)	(3)	(4)	(5)
	$\ln N_{firm_{t+1}}$	$\ln Employee_{t+1}$	$\ln FixedAssets_{t+1}$	$\ln Output_{t+1}$	$\ln Sales_{t+1}$
$\widehat{Cosine\_sub\_d_t}$	2.825** (2.412)	5.165*** (3.085)	6.665*** (3.330)	4.340* (1.865)	4.204** (2.090)
Controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
City-Ind FE	Yes	Yes	Yes	Yes	Yes
$N$	6980	6879	6879	6692	6873
adj. $R^2$	0.824	0.774	0.730	0.727	0.773

t statistics in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ . Standard errors are clustered at prefecture level. We control for political turnover, local economic conditions, local industrial characteristics, previous average GDP growth rate and the employment share in mining industry of prefecture  $c$  in year  $t$ .

Our findings contribute to the empirical literature discussing the time consistency of policy. More importantly, they have encouraging practical implications for the design and

implementation of industrial policy in countries with centralized and meritocratic political systems such as China. In essence, maintaining the time consistency of industrial policy is about stabilizing the entrepreneurs' expectations for the future, which is a necessary condition for industrial policies to be effective. We are looking forward to the emergence of more rigorous and detailed studies concerning this topic.

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## Appendix

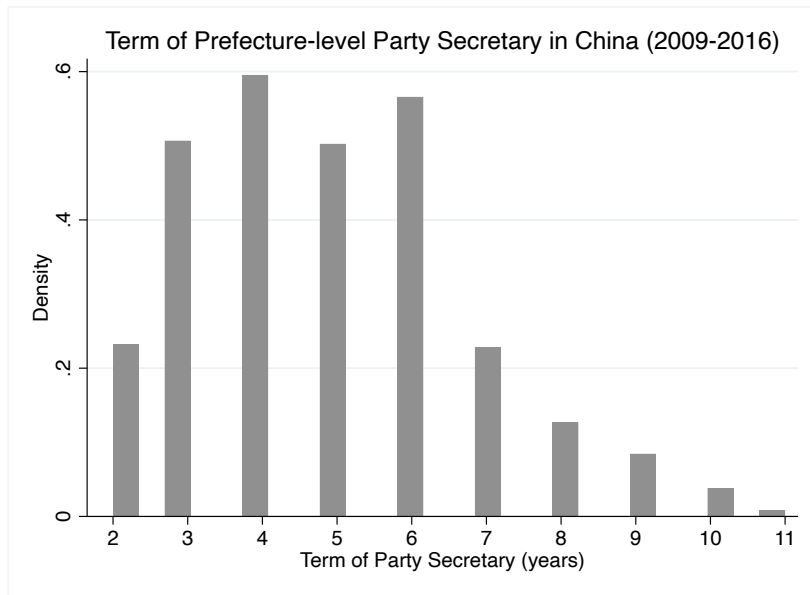


Figure A1. Term of prefecture-level party secretary in China (2009-2016)



Figure A2. The mean value of Turnover at period t between sample groups with and without Incident at period t-1