Mild Government Failure

Shang-Jin Wei [1]

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[1] drawing on joint work with Jianhuan Xu, Ge Yin and Xiaobo Zhang

Introduction

- Industrial policy - the use of subsidy or tax by the government to influence economic activities - is no longer a taboo even in the United States, and has been widely practiced in countries rich and poor.
- Examples: US, Europe, Japan, China
- When there is a market failure (e.g., positive spillover from innovation), would a government intervention (e.g., a subsidy to innovating firms) improve the welfare?
- The answer depends on the relative importance of government failure versus market failure (e.g., Harrison and Rodriguez-Clare, 2010)
- Anne Kruger vs. Justin Lin

Introduction

- When might industrial policy fail?

Types of gov failure	Examples
	Corruption or Lobbying (Shleifer-Vishny, Mauro, Fisman-Wei, Grossman-Helpman, and many others)

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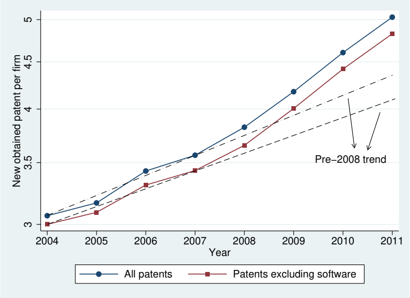
Semi-strong form	Bureaucrats being less competent or exerting less effort (Lazear 2000)

Introduction

- Can mild government failure have significant efficiency effects?

Types of gov failure	Examples
Strong form	Corruption or Lobbying (Shleifer-Vishny, Mauro, Fisman-Wei)
Semi-strong form	Bureaucrats being less competent or exerting less effort (Lazear 2000)
Mild form	Bureaucrats being "average" and "not omniscient" (this talk)

Case Study: China's InnoCom Program - the largest pro-innovation industrial policy



Growth of patent count accelerated after the InnoCom program;
More new patents in China every year than in the US

Preview of the results

- Program size: 100 billions RMB or more per year; larger than the US Science and CHIP Act
- Verify that the mild form of government failure exists
- The policy has inspired mostly more low-quality patents which waste resources
- The return to the subsidy is -19.7%
- If the bureaucrats can tell quality and only subsidize the firms with high-quality patents, the return to the subsidy would have been 7.8%.
- Welfare loss enabled by patent trade is quantitatively more important than the direct welfare loss.
- Without patent trade, the return to the subsidy would be -10.1%

Note on the role of patent trade

- Existing literature on patent trade emphasizes its welfare-improving property (Serrano, 2010; Akcigit et al., 2016)
- Here I note a possible "dark side": patent trade could augment the welfare loss due to the distortion in the subsidy program.
  - Without patent trade, the subsidy program only induces subsidy-eligible firms to waste resources in producing low-quality patents.
  - With patent trade, the program may also induce firms not eligible for a subsidy to produce and sell low-quality patents to subsidy-eligible firms
  - With patent trade, a new form of mis-allocation can emerge: high-value users of a patent that is not eligible for a subsidy may sell it to a low-value user that is eligible for a subsidy

Outline of Analysis

- More details on the InnoCom Subsidy Program
- Four Data Patterns
- Sketch of a Structural Model
- Welfare Analysis

The Pro-innovation Subsidy Programs in China

- Many industrial policies (Aghion, Cai, Dewatripon, Du, Harrison, and Legros, AEJ: Applied 2015)
- 16 pro-innovation programs with a combined budget of 154 billion RMBs in 2015 (China Science and Technology Yearbook 2015)
- InnoCom is the largest, with a budget of 100 billion RMBs in 2015, greater than the sum of all other programs

The InnoCom Program

- The subsidy program targets eight "industries of the future"
  - Six advanced manufacturing industries: pharmaceutical (CSIC 27), special equipment (CSIC 36), transportation equipment (CSIC 37), computers and communication equipment (CSIC 40), precision instruments (CSIC 41), and environment protection (CSIC 80)
  - Two modern services: computer services (CSIC 61), and software services (CSIC 62)

  - A subset of the firms in the targeted industries are certified as "high and new technology enterprises" (HNEs)
  - The HNEs receive a big subsidy (10 percentage points reduction in the corporate income tax)
  - The HNEs certification can be renewed

Major Reform in InnoCom in 2008 (the Policy Shock)

- Coverage (and budget) increase sharply: negligible before 2008; 60% applicant firms receive a subsidy after 2008.
- Explicit linkage between eligibility and the number of innovations (6 is a magic number)
- Externally purchased patents can also qualify

- How does a firm become a HNEs?
  * prerequisites: (a) in a targeted industry, and (b) with sufficiently high R&D intensity, high tech product share, and college degree share
  * with enough patents (or sophisticated software)
  * 60% probability

Part 2: Four Sets of Salient Data Patterns

- Bureaucrats
- Patents
- Firms
- Patent Trade

Data

- For each subsidy recipient (HNTE) in one big city during 2008-2011, we obtain the scores that the bureaucrats assign to the application
- For each enterprise, we know the number of patents (and software) it owns and its balanced sheet (matching data from the tax records from the Tax Bureau and the patent assignment data from China Intellectual Property Rights Bureau).
- For each patent: we know the inventor, owner (therefore who sells it to whom though not the price), year of invention, and renewal, and citation (China Intellectual Property Rights Bureau)

How do bureaucrats score the applicant firms?

- Unique data on bureaucrats' scores on successful applicant firms in a large city

- (a) does the quantity of the patents matter?
- (b) does the quality of the patents matter?
- (c) does the origin of the patents matter?
- control variables: industry, ownership, and size

Fact 1: How do bureaucrats score applicant firms?

	Subsidy or Not (Linear Prob)			Total Points (OLS)		
	Ave. citation	Ave. renewal rate		Ave. citation	Avg renewal rate	
Patent count=1 or 2	0.062	0.063	0.043	0.000	0.000	0.000
	(0.075)	(0.076)	(0.118)	(0.000)	(0.000)	(0.000)
Patent count=3	0.147	0.148	0.025	0.945**	0.912**	-1.037
	(0.084)	(0.086)	(0.131)	(0.418)	(0.335)	(1.526)
Patent count=4	0.167***	0.169***	0.057	0.965**	0.914*	1.809
	(0.026)	(0.029)	(0.065)	(0.442)	(0.547)	(1.674)
Patent count=5	0.238**	0.239**	0.128	3.131***	3.133***	3.040***
	(0.085)	(0.087)	(0.121)	(0.419)	(0.856)	(1.964)
Patent count=6	0.319***	0.311**	0.198*	6.643***	6.590***	6.624***
	(0.069)	(0.071)	(0.107)	(0.417)	(0.551)	(1.871)
Patent count>6	0.353***	0.354***	0.203*	7.693***	7.614***	7.452
	(0.046)	(0.048)	(0.101)	(0.499)	(0.473)	(1.697)
Quality proxy	0.007	0.011	0.007	0.007	-0.727	-0.459
	(0.016)	(0.009)	(0.103)	(0.007)	(0.473)	(1.697)
In-house IPRs sh.	0.001	0.001	-0.005	-0.007	-0.007	-0.006
	(0.013)	(0.014)	(0.015)	(0.004)	(0.006)	(0.008)
Sh. of college workers				1.062	1.095	0.563
				(0.769)	(0.761)	(1.613)
Sh. of R&D workers				-0.205	-0.264	0.825
				(0.628)	(0.752)	(0.926)
ln(sale)	0.003	0.003	0.002	1.307***	1.302***	1.279***
	(0.002)	(0.002)	(0.002)	(0.145)	(0.131)	(0.190)
ln(TFP)	0.002	0.001	0.001	-0.712***	-0.712***	-0.596***
	(0.001)	(0.001)	(0.001)	(0.159)	(0.102)	(0.187)
Industry FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	-	-	-
Only with patents			Y			Y
Obs.	7,166	7,166	5,289	2,470	2,470	791
Adj. R2	0.16	0.16	0.15	0.17	0.17	0.22

	Subsidy or Not (Linear Prob)		
	Ave. citation	Ave. renewal rate	
Patent count=1 or 2	0.062	0.063	0.043
	(0.075)	(0.076)	(0.118)
Patent count=3	0.147	0.148	0.025
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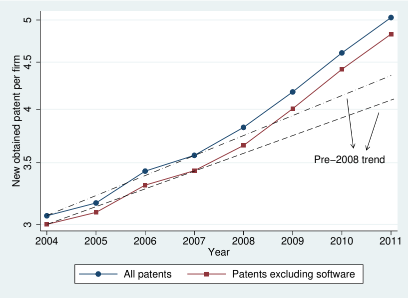
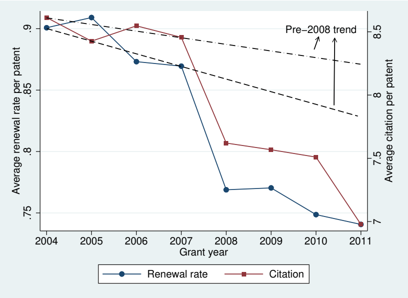
ln(TFP)	0.002	0.001	0.001
	(0.001)	(0.001)	(0.001)

Fact 2: Patent quantity increases but quality declines



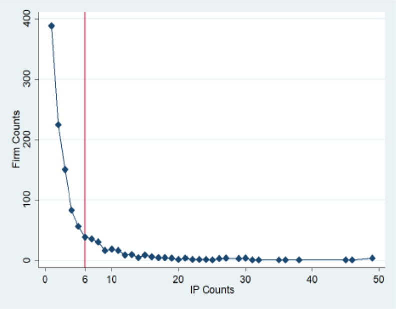
growth of quantity accelerates



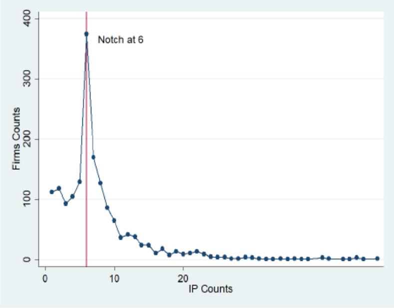
but quality declines

Fact 3: Less innovative Subsidy-competing enterprises (SCEs) show a fast growth in IPRs but a large decline in quality

Figure 1: IPR count distributions of SCEs

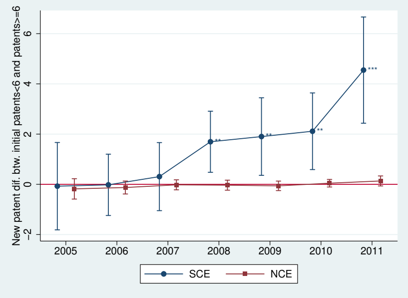


Year 2007

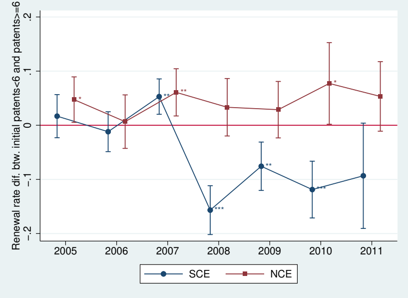


Year 2008

Difference in innovation increase btw SCEs with initially low and high patent counts



diff in quantity

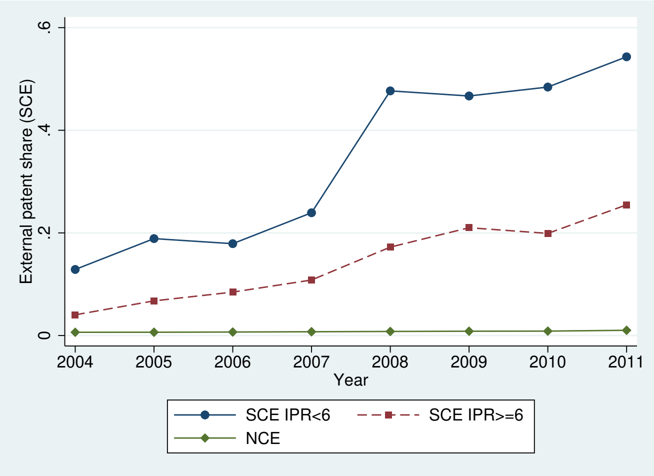


diff in quality

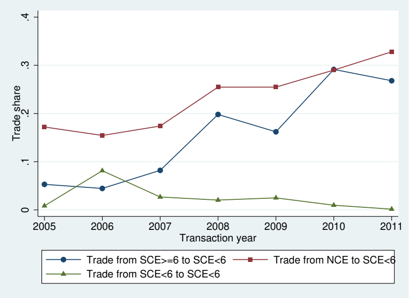
Capped spikes represent 90% confidence intervals. Controls: Firm/year FEs.

Fact 4: Less innovative SCEs become major patent buyers

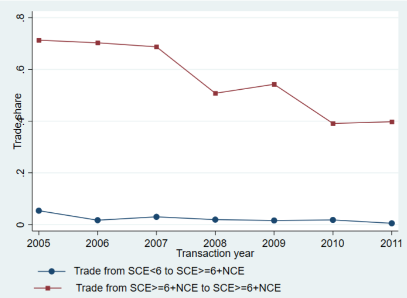
Figure 2: External patent share of SCEs and NCEs



Shares of patent sold to less innovative SCEs and other firm types



Shares sold to less innovative SCEs



Shares sold to other firms

Part 3: Structural Model

- Model setup and solution
- Parameters
- Definition of the welfare
- How does the subsidy program affect welfare?

Model environment

- Firm types:
  - Subsidy Competing Enterprises, SCEs (S)
  - NCEs in the targeted industry (N_1)
  - NCEs outside the targeted industry (N_2)
- Autonomous profit (even without patents) π
  - $\pi = Az$
    - A: **endogenous** industry-component of the productivity.
    - z: firm-specific productivity
  - Patents can bring additional value
- Binominal patent quality x: $x_H > x_L = 0$
- A firm hold n_H high- and n_L low-quality patents.
  - 1 patent in the model = 1 invention or 6 other patents in the data

Three stages

- A firm is summarized by: type $i \in \{S, N_1, N_2\}$; initial patent portfolio; productivity z; innovation cost.
- Stage 1: Innovating inside the firm
  - Each firm chooses the number of new patents, θ_H and θ_L
  - Innovation cost $C(\theta_H, \theta_L; v)$
- Stage 2: Participating in patent trade (competitive market)
  - Market friction: A firm can trade with probability σ.
  - Patent prices p_H and p_L are determined competitively
- Stage 3: Subsidy received or denied/Patent renewed or not/Production taking place
  - With probability $\rho(n)$, an SCE receives a subsidy of $T\pi$, where T is the reduction in the corporate income rate.

Knowledge spillover

- Aggregate R&D spending on high-quality patents.

$$K = \sum \frac{v}{1+\zeta} \theta_H^{1+\zeta}$$

- Targeted industry's aggregate productivity is

$$A = A_0(1 + \omega K^{\eta})$$

  - A_0: initial productivity

- Aggregate welfare

$$Welfare = \sum V_1 - (1+\tau)\,\text{Subsidy}$$

The net welfare effect of the policy

- Gains from the subsidy policy
  - Increases in firm profits
  - Both SCEs and those NCEs in the targeted industry may benefit from a rise in knwoledge spillover due to more high-quality patents
  - Firms outside the targeted industry benefit from being able to sell more patents to the SCEs
- Costs of the subsidy policy
  - The fiscal cost of the subsidy
  - Resource waste by SCEs producing low-quality patents
  - Resource waste by NCEs producing low-quality patents (enabled by patent trade)
  - Mis-allocation of patents from high-value users not eligible for a subsidy to lower-value users who are eligible for a subsidy (also enabled by patent trade)

Calibration

Table 1: Parameter Values Used in the Baseline Simulation

Parameter	Value	Description	Source
$v(S, X)$	0.02	SCE ($n = 0$): high quality patent innov. cost	Calibration
$v(S, Y)$	0.04	SCE ($n > 0$): high quality patent innov. cost	Calibration
$v(N1, X)$	1.57	NCE1 ($n = 0$): high quality patent innov. cost	Calibration
$v(N2, X)$	0.01	NCE2 ($n = 0$): high quality patent innov. cost	Calibration
$v(N1, Y)$	0.04	NCE1 ($n > 0$): high quality patent innov. cost	Calibration
$v(N2, Y)$	0.75	NCE2 ($n > 0$): high quality patent innov. cost	Calibration
$\bar{v}$	0.003	Low quality patent innovation cost	Calibration
$\hat{v}$	0.0001	Low quality patent innovation cost	Calibration
σ	0.33	Probability of participating in patent trade	Calibration
c	0.01	Renewal cost	Calibration
Ω_ϵ	0.11	Prob of obsolescence shock	Calibration
ω	7.99	Level of knowledge spillover	Calibration
ζ	2.00	Curvature of innovation cost	Acemoglu et al. (2018)
α	0.70	Span of control	Lucas (1978)
x_H	0.03	Value of high quality patent	Estimated from data
η	0.20	Elasticity of knowledge spillover	Lucking et al. (2019)
τ	0.20	Marginal shadow cost of 1 RMB public funding	Chen et al. (2021)

Notes: The model value is 1 million RMB.

Table 2: Model Fitness

Targeted Moments	Data	Model
Pre-subsidy new patent count		
by firms with no initial patent:		
- SCEs	3.18	3.21
- NCEs in targeted industries	2.10	2.08
- NCEs outside targeted industries	0.36	0.36
Pre-subsidy new patent count		
by firms with some initial patents:		
- SCEs	3.60	3.52
- NCEs in targeted industries	2.16	2.13
- NCEs outside targeted industries	0.48	0.47
Pre-subsidy external patent share	0.03	0.03
Pre-subsidy patent renewal rate:		
- All firms	0.83	0.83
- Firms with above median productivity	0.89	0.89
Relative difference in new patent count due to subsidy between intrinsically less and more innovative SCEs	1.80	1.80
Relative difference in patent renewal rate due to subsidy between intrinsically less and more innovative SCEs	-0.13	-0.15
Non-targeted Moments		
Relative difference in renewal rates due to subsidy between intrinsically less and more innovative NCEs	0.01	0.03
Relative difference in patent counts due to subsidy between intrinsically less and more innovative NCEs	0.03	0.01
Relative difference in shares of purchased patents due to subsidy between intrinsically less and more innovative SCEs	0.13	0.07
Relative difference in shares of purchased patents due to subsidy between intrinsically less and more innovative NCEs	0.00	0.00

Part 4: Welfare Assessment

- Compare economies with and without the subsidies
- Alternative policies
- Extension: possible mislabeling of R&D

Effect of the subsidy program

Table 5: Comparing the Patent Quality and Quantity With and Without the Subsidy Program (unit=1,000 patents)

		Laissez Faire			Under Subsidy			Δ patents from subsidy
	(1) Initial patents	(2) pre-trade	(3) post-trade	(4) net buy	(5) pre-trade	(6) post-trade	(7) net buy	(8)=(6)-(3)
Total high quality patents (a)	68.1	150.7	**150.7**		151.6	**151.6**		**0.9**
- SCEs with initial patents < 6	12.4	21.5	20.4	-1.1	21.8	23.0	1.2	2.6
- SCEs with initial patents ≥ 6	9.5	32.7	21.6	-11.1	33.3	20.9	-12.4	-0.6
- NCEs in targeted industry	20.4	53.5	54.2	0.6	53.5	54.0	0.5	-0.2
- NCEs outside targeted industry	25.8	42.9	54.6	11.6	42.9	53.7	10.7	-0.9
Total low quality patents (b)	0.0	0.0	**0.0**		48.2	**48.2**		**48.2**
- SCEs with initial patents < 6	0.0	0.0	0.0	0.0	13.6	25.3	11.7	25.3
- SCEs with initial patents ≥ 6	0.0	0.0	0.0	0.0	0.4	0.0	-0.4	0.0
- NCEs in targeted industry	0.0	0.0	0.0	0.0	8.0	5.4	-2.6	5.4
- NCEs outside targetted industry	0.0	0.0	0.0	0.0	26.2	17.5	-8.6	17.5
Total number of patents(c= a+b)	68.1	150.7	**150.7**		199.8	**199.8**		**49.1**
Share of low quality patents (d = b/c in%)	0.0	0.0	0.0	-	24.1	24.1	-	**98.1**

Notes: This table reports the patent quantity and quality for each firm type in two scenarios: laissez faire (no subsidy) and the economy with subsidy. The unit is 1,000 patents except for the last row.

	(A) Laissez Faire	(B) With Subsidy
(1) Innovation Expenditure	**6.15**	**6.33**
(1.1) R&D cost for high quality patents	6.15	6.23
- SCEs with initial patents < 6	0.65	0.82
- SCEs with initial patents ≥ 6	1.68	1.59
- NCEs in targeted industry	2.44	2.44
- NCEs in non-targeted industry	1.38	1.38
(1.2) R&D cost for low-quality patents	0.00	0.10
- SCEs with initial patents < 6	0.00	0.08
- SCEs with initial patents ≥ 6	0.00	0.003
- NCEs in targeted industry	0.00	0.01
- NCEs in non-targeted industry	0.00	0.01
(2) Value from Trade	**0.00**	**0.00**
- SCEs with initial patents < 6	-0.38	0.46
- SCEs with initial patents ≥ 6	-3.87	-4.66
- NCEs in targeted industry	0.22	0.21
- NCEs in non-targeted industry	4.04	3.99
Price of high-quality patent p_H (in 1,000 RMBs)	*350*	*351*
Price of low-quality patent p_L (in 1,000 RMBs)	*0*	*3*
(3) Revenue from Production and Subsidy	**271.89**	**280.75**
(3.1) Output Value Excluding Subsidy	271.89	272.10
- SCEs with initial patents < 6	14.45	14.49
- SCEs with initial patents ≥ 6	37.21	37.32
- NCEs in targeted industry	77.24	77.33
- NCEs in non-targeted industry	143.00	142.97
(3.2) Subsidy	0.00	8.65
- *Average ρ among SCEs*	*0%*	*67%*
(4) Total Firm Profit Inclusive of Subsidy		
= (3) +(2)-(1)	**265.74**	**274.42**
(5) Increase in Total Firm Value (=(4B)-(4A))		**8.68**
(6) Social Cost of the Subsidy (=(1+τ)*Subsidy)		**10.38**
(7) Return to the Subsidy (= ((5)-(6))/Subsidy)		**-19.7%**

Sensitivity check

- Sensitivity check 1: Increase each targeted moment by 5%
- Sensitivity check 2: Increase each calibrated parameter directly by 5%

	Panel A: % Parameter changes to 5% increase in a data moment												Ret. to subsidy
	$v(S, n=0)$	$v(N1, n=0)$	$v(N2, n=0)$	$v(S, n>0)$	$v(N1, n>0)$	$v(N2, n>0)$	$\bar{v}$	$\hat{v}$	σ	c	Ω_ϵ	ω	(%)
Parameter values / Data moments	0.04	1.57	0.75	0.02	0.04	0.01	0.003	0.0001	0.33	0.01	0.11	7.99	-19.7
Responding to 5% increase in each data moment													
Patent # by firms w/o initial patent													
- SCEs	-9.9	0.0	-0.1	-0.2	0.1	0.1	0.0	0.0	0.0	-	-	-0.6	-20.1
- NCEs in targeted industry	0.0	-9.8	0.0	-0.3	0.1	0.0	0.0	0.0	0.0	-	-	-1.0	-19.5
- NCEs in non-targeted industry	0.0	0.0	-9.8	-0.3	0.1	0.0	0.0	0.0	0.0	-	-	0.0	-19.8
Patent # by firms with initial patent													
- SCEs	0.0	0.0	0.0	-9.8	0.1	0.0	0.0	0.0	0.0	-	-	-1.5	-19.7
- NCEs in targeted industry	0.0	0.0	0.0	-0.3	-9.4	0.0	0.0	0.0	0.0	-	-	-1.3	-19.8
- NCEs in non-targeted industry	0.0	0.0	0.0	-0.3	0.1	-9.4	0.0	0.0	0.0	-	-	0.0	-19.8
Renewal rates w/o subsidy													
- All firms	0.3	0.5	0.8	0.2	0.6	0.5	0.0	0.0	0.0	-44.2	0.0	-0.4	-19.1
- Firms with $z >$ median	1.6	1.8	1.6	1.7	1.9	1.7	0.0	0.0	0.0	38.3	-40.5	-2.0	-19.7
External patent share w/o subsidy	0.4	0.7	0.6	0.5	0.8	0.7	0.0	0.0	1.3	-	-	-0.4	-19.8
Relative patent renewal rate	-0.2	0.0	0.0	-0.3	0.1	0.0	1.8	0.0	0.0	-	-	0.0	-19.6
Relative patent count	0.0	0.0	0.0	0.0	0.0	0.0	-32.7	-11.4	0.0	-	-	0.0	-20.9
	Panel B: Sensitivity of the return to subsidy to 5% increase in each parameter												
Return to subsidy (%)	-19.9	-19.6	-20.0	-19.5	-19.9	-19.9	-19.7	-19.1	-19.7	-19.7	-19.7	-19.2	

Alternative policies

	$\sigma = 0.64$		Only count In-house patent		Optimal subsidy	
	Laissez Faire	With subsidy	$T = 0.1$	with a fixed budget	Not tell quality	Tell quality
(1) Innovation Expenditure	9.00	9.38	6.47	6.45	6.22	6.67
(1.1) R&D cost for x_H	9.00	9.02	6.20	6.20	6.18	6.67
- SCEs with initial patents < 6	0.97	1.19	0.67	0.67	0.67	0.94
- SCEs with initial patents ≥ 6	2.52	2.32	1.68	1.68	1.69	1.87
- NCE in targeted industry	3.62	3.62	2.46	2.46	2.44	2.46
- Other NCE	1.89	1.89	1.39	1.39	1.38	1.39
(1.2) R&D cost for x_L	0.00	0.36	0.25	0.27	0.04	0.00
- SCEs with initial patents < 6	0.00	0.21	0.25	0.27	0.04	0.00
- SCEs with initial patents ≥ 6	0.00	0.01	0.00	0.00	0.00	0.00
- NCE in targeted industry	0.00	0.04	0.00	0.00	0.00	0.00
- Other NCE	0.00	0.10	0.00	0.00	0.00	0.00
(2) Value from Trade	0.00	0.00	0.00	0.00	0.00	0.00
- SCEs with initial patents < 6	-2.27	0.75	0.14	0.14	0.02	0.23
- SCEs with initial patents ≥ 6	-7.19	-10.80	-4.08	-4.07	-4.21	-4.23
- NCE in targeted industry	1.20	1.21	0.14	0.14	0.19	0.19
- Other NCE	8.26	8.84	3.80	3.79	4.00	3.81
Price of high-quality patent p_H (in 1,000 RMBs)	*340*	*340*	*350*	*350*	*340*	*340*
Price of low-Quality patent p_H (in 1,000 RMBs)	*0*	*3*	*0*	*0*	*0*	*0*
(3) Revenue from Production and Subsidy	295.97	304.99	281.34	281.29	272.87	276.92
(3.1) Output value excluding subsidy	295.97	296.01	273.02	272.64	272.11	273.39
- SCEs with initial patents < 6	15.61	16.16	14.74	14.64	14.01	14.25
- SCEs with initial patents ≥ 6	38.21	37.70	37.89	37.63	37.89	38.52
- NCE in targeted industry	88.02	88.02	77.65	77.65	77.26	77.84
- Other NCE	154.13	154.13	142.74	142.72	142.95	142.78
(3.2) Subsidy	0.00	8.98	8.32	8.65	0.76	3.53
- *Ave. ρ within SCEs*	*0%*	*69%*	*58%*	*59%*	*47%*	*40%*
(4) Tot. Value Inclusive of Subsidy(= (3)+(2)-(1))	286.97	295.606	274.884	274.82	266.652	270.256
Welfare ((4) - (1+τ)*(3.2))	286.97	284.83	264.90	264.44	265.74	266.02
Return (**Δwelfare/subsidy**)	0%	-24%	-10.1%	-15.0%	0.2%	7.8%

Extension: possible mislabeling of R&D

- Each N_1 firm can choose to pretend to be an SCE at the beginning of the innovation stage
- Fixed cost q to manipulate innovation
- The overall innovation cost is

$$C(\theta_H, \theta_L; v) + q$$

- Choose q so that the relabelling cost is 24% of true R&D (following Chen et al. [2021])

	Laissez Faire	With subsidy	Count In-house patent
(1) Innovation Expenditure	6.15	6.82	7.09
(1.1) R&D cost for x_H	6.15	6.19	6.28
- SCEs with initial patents < 6	0.63	0.62	0.63
- SCEs with initial patents ≥ 6	1.70	1.64	1.70
- NCE in targeted industry	2.44	2.60	2.60
- Other NCE	1.38	1.33	1.35
(1.2) R&D cost for x_L	0.00	0.63	0.81
- SCEs with initial patents < 6	0.00	0.07	0.23
- SCEs with initial patents ≥ 6	0.00	0.08	0.02
- NCE in targeted industry	0.00	0.48	0.56
- Other NCE	0.00	0.00	0.00
Share of NCE pretend to be SCE	*0%*	*23%*	*22%*
(2) Value from Trade	0.00	0.00	0.00
- SCEs with initial patents < 6	-1.06	0.10	0.03
- SCEs with initial patents ≥ 6	-3.19	-3.64	-3.53
- NCE in targeted industry	0.19	-2.24	-1.68
- Other NCE	4.07	5.78	5.18
Price of high-quality patent p_H (in 1,000 RMBs)	350	330	330
Price of low-Quality patent p_H (in 1,000 RMBs)	0	4	0
(3) Revenue from Production and Subsidy			
(3.1) Output value excluding subsidy	271.76	271.29	275.22
- SCEs with initial patents < 6	14.97	10.72	10.36
- SCEs with initial patents ≥ 6	36.65	29.00	31.07
- NCE in targeted industry	77.17	86.61	89.62
- Other NCE	142.98	144.96	144.18
(3.2) Subsidy	0.00	20.93	20.17
- *Ave. ρ within SCEs*	*0%*	*59%*	*57%*
(4) Total Value Inclusive Subsidy $=(3)+(2)-(1)$	265.61	285.41	288.30
Welfare ((4) - $(1+\tau)$*(3.2))	265.61	260.29	264.10
Return (Δwelfare/subsidy)	0%	-26.1%	-7%

Conclusion

- Mild government failure (e.g., bureaucrats doing bean counting) can make a big difference in the success/failure of an industrial policy
- China's largest pro-innovation industrial policy as designed likely has a negative return.
- Patent trade can significantly amplify the welfare loss given the distortions in the subsidy program.
- Disallowing purchased patents in the subsidy applications could help, but manipulation by subsidy applicants can also make it fail