Econometrica Supplementary Material

SUPPLEMENT TO "THE IMPACTS OF MANAGERIAL AUTONOMY ON FIRM OUTCOMES"

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APPENDIX A: ROBUSTNESS CHECKS AND ADDITIONAL OUTCOMES

IN THIS SECTION, I report additional results, and show that the main results are robust to several alternative specifications and sample restrictions.

A.1. *Additional Results*

A.1.1. *Ability to Use Autonomy to Undertake Capital Expenditure*

There were three different levels of autonomy. The first two levels of autonomy capped the amount of capital expenditure on each project, while firms in the third level of autonomy had the ability to conduct unlimited capital expenditure. This last level was reserved only for 9 firms, a very limited sample. When the autonomy program was first announced, for the first level of autonomy, the maximum cap per project was ₹1.5 billion, or 50% of net worth, whichever is lower. For the second level of autonomy, the maximum cap per project was ₹3 billion, or 100% of net worth, whichever is lower.[1]

Using mean baseline net worth levels (between 1992–1996), I create the amount of capital expenditure a firm could undertake based on the category of autonomy they are eligible for, and assign them the level-1 capital expenditures if they are eligible for level-1 autonomy (earned profits for 3 years running and had a positive net worth), and level-2 capital expenditures if they are eligible for level-2 autonomy (earned profits for 3 years running with profits in 1 year $\geq$ ₹300 million, and had a positive net worth). Pre-program ineligible firms are assigned zero levels of capital expenditure.[2]

I show results separately for firms with high (above median) levels of ability to undertake capital expenditures versus ineligible firms, and for firms with low (below median) levels of ability to undertake capital expenditures versus ineligible firms. Results are presented in Table A.6, and show that there is substantial heterogeneity in the outcomes. The effects are driven by firms with a greater ability to undertake capital expenditure, with no effects on firms with low ability to expand capital.

A.1.2. *Amount of Autonomy*

The levels of autonomy differed in the amount of capital expenditure per project firms could undertake (and size of the joint venture or subsidiaries). Does this higher ability to spend more translate into better outcomes? I present generalized difference-in-difference results by grades of autonomy in Table A.7 (with a discrete treatment variable with increasing levels of autonomy (1, 2, and 3, respectively, with 1 denoting the least and 3 the

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[1]The cap was increased in 2005.

[2]I drop the 9 firms that received the highest level of autonomy for this estimation, since these were picked directly by the government, and also not subject to any cap on capital expenditure.

TABLE A.1

OTHER OUTCOMES.

	(1) 𝟙(Exit)	(2) Profits (Millions of ₹)	(3) Capacity Utilization (%)
𝟙(Pre-Program Eligible) × 𝟙(Post 1996)	−0.058	1246.294	−5.297
	(0.038)	(454.595)	(3.800)
N	3760	2965	1180
Mean of Dependent Variable	0.176	1647.222	67.817

Note: Standard errors clustered at the firm-level in parentheses. Capacity utilization is available between 1993–2006 for manufacturing firms. All regressions include firm fixed effects, year fixed effects, and 2-digit sector linear trends.

TABLE A.2

FIRM OUTCOMES NORMALIZED BY PRE-PROGRAM AVERAGES.

	(1) 𝟙(Exit)	(2) Value Added (Millions of ₹)	(3) TFP	(4) Capital (Millions of ₹)	(5) Salaries and Benefits (Millions of ₹)	(6) Profits (Millions of ₹)
𝟙(Pre-Program Eligible) X 𝟙(Post)	−1.715	1.201	0.802	1.033	0.901	3.518
	(1.131)	(0.326)	(0.571)	(0.351)	(0.331)	(1.122)
N	3760	2965	2806	2961	2965	2965
Mean of Dependent Variable	5.164	2.111	1.338	2.050	2.056	3.908

Note: Standard errors clustered at the firm-level in parentheses. Data on all outcomes available from 1992–2009. TFP calculated using the production function estimation method from Ackerberg, Caves, and Frazer (2015). All regressions include firm fixed effects, year fixed effects, and 2-digit sector linear trends.

TABLE A.3

IMPACT OF ELIGIBILITY ON AUTONOMY STATUS BY BASELINE INCENTIVE CONFLICT.

	𝟙(Firm Received Autonomy)			
	(1)	(2)	(3)	(4)
𝟙(Eligible Pre-Program)	0.398		0.391	
	(0.0712)		(0.0727)	
𝟙 (High Baseline Conflict)	−0.0395	−1.95e-15	−0.0432	−2.10e-15
	(0.0655)	(0.0998)	(0.0689)	(0.104)
𝟙(Eligible Pre-Program) × 𝟙(High Baseline Conflict)	0.366		0.341	
	(0.0960)		(0.0996)	
𝟙(Ever Eligible)		0.381		0.367
		(0.0970)		(0.101)
𝟙(Ever Eligible) × 𝟙(High Baseline Conflict)		0.381		0.345
		(0.118)		(0.122)
Constant	0.102	1.61e-15	0.0930	1.83e-15
	(0.0516)	(0.0880)	(0.0530)	(0.0920)
Dependent Variable Mean	0.340	0.350	0.340	0.350
Observations	235	228	235	228
R-Squared	0.429	0.398	0.441	0.420

Note: Robust standard errors in parentheses. Columns 3 and 4 include controls for pre-program mean profits, pre-program sales, and the interaction of each of these variables with the relevant eligibility measure.

TABLE A.4

CENTRAL GOVERNMENT AND OTHER BORROWING.

	(1) Loans from Central Government (Millions of ₹)	(2) Other Loans (Millions of ₹)	(3) 𝟙(Any Bank Reported)	(4) 𝟙(Private Bank Reported)
𝟙(Pre-Program Eligible) X 𝟙(Post)	−4553.355	7235.153	0.002	0.314
	(1557.177)	(5391.630)	(0.118)	(0.159)
N	2393	2391	2965	1300
Mean of Dependent Variable	2490.616	14,628.015	0.438	0.358

Note: Standard errors clustered at the firm-level in parentheses. Data for outcomes in the first two columns is available from 1994–2009, and for the third and fourth columns from 1992–2009. All regressions include firm fixed effects, year fixed effects, and 2-digit sector linear trends.

TABLE A.5

FIRM OUTCOMES: COMPARING UNTREATED PRE-PROGRAM ELIGIBLE FIRMS WITH INELIGIBLE FIRMS.

	(1) Value Added (Millions of ₹)	(2) TFP	(3) Capital (Millions of ₹)	(4) Salaries and Benefits (Millions of ₹)
𝟙(Pre-Program Eligible) X 𝟙(Post)	629.927	0.155	−2370.258	10.425
	(884.716)	(0.302)	(6192.147)	(179.332)
N	1581	1483	1581	1581
Mean of Dependent Variable	2641.188	−0.319	7630.177	965.150

Note: Standard errors clustered at the firm-level in parentheses. Data on all outcomes available from 1992–2009. TFP calculated using the production function estimation method from Ackerberg, Caves, and Frazer (2015). All regressions include firm fixed effects, year fixed effects, and 2-digit sector linear trends.

TABLE A.6

MAIN OUTCOMES BY BASELINE ALLOWED CAPITAL EXPENDITURE.

	(1) Value Added (Millions of ₹)	(2) TFP	(3) Capital (Millions of ₹)	(4) Salaries and Benefits (Millions of ₹)
Panel A: Firms with Greater Ability to Expand Capital				
𝟙(Pre-Program Eligible) X 𝟙(Post)	6435.094	−0.177	11,906.592	527.384
	(1528.449)	(0.229)	(5944.897)	(261.233)
N	1975	1881	1971	1975
Mean of Dependent Variable	6689.318	−0.884	15,907.441	1689.890
Panel B: Firms with Lower Ability to Expand Capital				
𝟙(Pre-Program Eligible) X 𝟙(Post)	169.571	−0.274	−1525.008	−29.110
	(689.757)	(0.246)	(2270.472)	(170.545)
N	2157	2004	2157	2157
Mean of Dependent Variable	2428.288	−0.272	5073.291	896.114

Note: Standard errors clustered at the firm-level in parentheses. Data on all outcomes available from 1992–2009. TFP calculated using the production function estimation method from Ackerberg, Caves, and Frazer (2015). All regressions include firm fixed effects, year fixed effects, and 2-digit sector linear trends.

TABLE A.7

GENERALIZED DIFFERENCE-IN-DIFFERENCE FOR THE MAIN OUTCOMES: GRADES OF AUTONOMY.

	(1) Value Added (Millions of ₹)	(2) TFP	(3) Capital (Millions of ₹)	(4) Salaries and Benefits (Millions of ₹)
Grade of Autonomy X 𝟙(Post)	4185.108	−0.134	9535.837	777.458
	(1185.846)	(0.085)	(2671.333)	(187.330)
N	2965	2806	2961	2965
Mean of Dependent Variable	9615.042	−0.442	22,642.828	1807.848

Note: Standard errors clustered at the firm-level in parentheses. Data on all outcomes available from 1992–2009. TFP calculated using the production function estimation method from Ackerberg, Caves, and Frazer (2015). Grade of autonomy takes the value 0 for untreated firms, and 1, 2, or 3 for treated firms, with 1 denoting the least autonomy and 3 the most. All regressions include firm fixed effects, year fixed effects, and 2-digit sector linear trends.

most autonomy), with untreated firms assigned a value of 0. More autonomy does lead to greater capital expansion, but also higher value added consistent with greater autonomy allowing managers to emphasis firm outcomes more preferred by them. There is no differential impact on TFPR, consistent with the main specification.

A.2. *Additional Robustness Checks*

A.2.1. *Manipulation of Reported Profits*

Firms that make small losses might be able to falsely report small positive profits instead to increase their eligibility probability. Because I consider firms that were already eligible before the program as treated, this ensures that the results are not driven by such misreporting (if it exists). To further test that results do not change if firms around the zero profit threshold are removed, Table A.8 presents the results from a "donut" estimator, which after removes 5 firms around the zero profits threshold in each year (as well as all firms reporting exactly zero profits). The results are quite similar to those in Table IV, indicating that the results are not driven by firms manipulating their profits.

TABLE A.8

MAIN OUTCOMES: DONUT ESTIMATION.

	(1) Value Added (Millions of ₹)	(2) TFP	(3) Capital (Millions of ₹)	(4) Salaries and Benefits (Millions of ₹)
𝟙(Pre-Program Eligible) X 𝟙(Post)	5878.773	−0.173	12,067.604	860.995
	(1605.312)	(0.164)	(4096.961)	(313.577)
N	2764	2613	2760	2764
Mean of Dependent Variable	9991.857	−0.484	24,169.963	1882.282

Note: Standard errors clustered at the firm-level in parentheses. Data on all outcomes available from 1992–2009. TFP calculated using the production function estimation method from Ackerberg, Caves, and Frazer (2015). All regressions include firm fixed effects, year fixed effects, and 2-digit sector linear trends.

TABLE A.9

MAIN OUTCOMES: PRE-PROGRAM PROFITABLE FIRMS ONLY.

	(1) Value Added (Millions of ₹)	(2) TFP	(3) Capital (Millions of ₹)	(4) Salaries and Benefits (Millions of ₹)
𝟙(Pre-Program Eligible) X 𝟙(Post)	5698.754	−0.135	11,085.189	732.137
	(1382.669)	(0.255)	(3791.799)	(287.210)
N	2356	2266	2352	2356
Mean of Dependent Variable	11,737.283	−0.501	27,342.240	2165.694

Note: Standard errors clustered at the firm-level in parentheses. Data on all outcomes available from 1992–2009. TFP calculated using the production function estimation method from Ackerberg, Caves, and Frazer (2015). All regressions include firm fixed effects, year fixed effects, and 2-digit sector linear trends.

A.2.2. *Keeping Only Profitable Firms Pre-Program*

In this section, I present additional evidence to show that the results are not driven by using an unsuitable comparision group; namely, unprofitable firms pre-progam. Table A.9 presents the results using only the sample of firms that reported positive profits at least once pre-progam, dropping the 34 firms that are not profitable in any of the 5 pre-program years. Results are similar to Table IV, indicating this is not driving the results.

A.2.3. *Effects Across the Outcome Distribution*

Tables A.10 and A.11 present results from estimating the effects across the outcome distribution for the four main outcomes of interest, using the Athey and Imbens (2006) estimator. I show results for median effects, as well as by tercile, using the same fixed effects as the main specification. The results at the median are substantially smaller than mean effects across outcomes. While the program led to improvements in firm perfor-

TABLE A.10

EFFECTS ACROSS THE OUTCOME DISTRIBUTION USING MAIN SPECIFICATION.

	(1) Value Added (Millions of ₹)	(2) TFP	(3) Capital (Millions of ₹)	(4) Salaries and Benefits (Millions of ₹)
Panel A: Median Effects				
𝟙(Pre-Program Eligible) X 𝟙(Post)	3198.593	−0.066	1983.299	508.776
	(970.357)	(0.056)	(1160.606)	(148.201)
Panel B: Tercile Effects				
First Tercile: 𝟙(Pre-Program Eligible) X 𝟙(Post)	6423.929	−0.067	5834.183	623.204
	(2070.364)	(0.064)	(2395.062)	(160.503)
Second Tercile: 𝟙(Pre-Program Eligible) X 𝟙(Post)	832.437	−0.077	972.712	135.465
	(419.256)	(0.058)	(544.586)	(93.093)
N	2965	2806	2961	2965

Note: Standard errors clustered at the firm-level in parentheses. Data on all outcomes available from 1992–2009. TFP calculated using the production function estimation method from Ackerberg, Caves, and Frazer (2015). All regressions include firm fixed effects, year fixed effects, and 2-digit sector linear trends.

TABLE A.11

EFFECTS ACROSS THE OUTCOME DISTRIBUTION USING GENERALIZED DIFFERENCES IN DIFFERENCES.

	(1) Value Added (Millions of ₹)	(2) TFP	(3) Capital (Millions of ₹)	(4) Salaries and Benefits (Millions of ₹)
Panel A: Median Effects				
$\mathbb{1}$(Treatment) X $\mathbb{1}$(Post-Treatment)	7912.197	0.003	4746.659	947.904
	(1567.133)	(0.061)	(2524.721)	(306.444)
Panel B: Tercile Effects				
First Tercile: $\mathbb{1}$(Treatment) X $\mathbb{1}$(Post-Treatment)	7479.588	0.059	8113.328	1216.939
	(1871.524)	(0.069)	(3746.822)	(276.022)
Second Tercile: $\mathbb{1}$(Treatment) X $\mathbb{1}$(Post-Treatment)	4541.977	0.026	3637.058	185.242
	(1226.429)	(0.056)	(1407.551)	(158.66)
N	2965	2806	2961	2965
Mean of Dependent Variable	9615.042	0.266	22,642.828	1807.848

Note: Standard errors clustered at the firm-level in parentheses. Data on all outcomes available from 1992–2009. TFP calculated using the production function estimation method from Ackerberg, Caves, and Frazer (2015). All regressions include firm fixed effects, year fixed effects, and 2-digit sector linear trends.

mance across the distribution, the estimates for the first tercile are much larger, indicating that the program had larger effects for smaller firms.

APPENDIX B: PROOF OF CLAIM 1

PROOF: I begin the proof by deriving the highest revenue

$$R(A, w) = \max_{k,\ell}\{Ak^{\alpha}\ell^{\beta}\} \quad \text{subject to } c_k k + c_\ell \ell = w$$

achievable when an amount w is spent on inputs. Taking first-order conditions with respect to k and ℓ yield

$$\begin{aligned} \alpha A k^{\alpha-1}\ell^{\beta} &= \eta c_k \\ \beta A k^{\alpha}\ell^{\beta-1} &= \eta c_\ell \end{aligned} \quad \Longrightarrow \quad \alpha c_\ell \ell = \beta c_k k,$$

where η is the Lagrangian multiplier corresponding to the constraint. Plugging this equation into the constraint, I get the optimal input quantities

$$k^*(A) = \frac{w\alpha}{c_k(\alpha+\beta)} \quad \text{and} \quad \ell^*(A) = \frac{w\beta}{c_\ell(\alpha+\beta)},$$

which in turn implies

$$R(A, w) = A\gamma w^{\alpha+\beta},$$

where the constant

$$\gamma := \left(\frac{\alpha}{c_k(\alpha+\beta)}\right)^{\alpha}\left(\frac{\beta}{c_\ell(\alpha+\beta)}\right)^{\beta}. \tag{8}$$

Consider the pre-autonomy cheap talk game. For any posterior belief p, the government solves the following problem:

$$\max_{w\in[0,\overline{w}]}\big\{R\big(p\overline{A}+(1-p)\underline{A},w\big)+\lambda_G(\overline{w}-w)\big\}, \tag{9}$$

which I have written in terms of the revenue function R, which I derived above. Plugging in the expression for R, this problem becomes

$$\max_{w\in[0,\overline{w}]}\big\{\big(p\overline{A}+(1-p)\underline{A}\big)\gamma w^{\alpha+\beta}+\lambda_G(\overline{w}-w)\big\}$$

and the maximizer is determined by the solution to the first-order condition

$$\hat{w}(p)=\left(\frac{\big(p\overline{A}+(1-p)\underline{A}\big)(\alpha+\beta)\gamma}{\lambda_G}\right)^{\frac{1}{1-(\alpha+\beta)}}, \tag{10}$$

since the objective function is concave and I have assumed $\overline{w}$ is high enough to ensure an interior solution. Note that $\hat{w}(\cdot)$ is convex in p.

By replacing p with 1 or 0 (depending on the realized value of A) and λ_G with λ_M in the above expression, I can derive the optimal amount of resources $\overline{w}$ and $\underline{w}$ that the manager would choose for each value of A post autonomy. These are given by

$$\overline{w}=\left(\frac{\overline{A}(\alpha+\beta)\gamma}{\lambda_M}\right)^{\frac{1}{1-(\alpha+\beta)}} \quad \text{and} \quad \underline{w}=\left(\frac{\underline{A}(\alpha+\beta)\gamma}{\lambda_M}\right)^{\frac{1}{1-(\alpha+\beta)}}. \tag{11}$$

Note that $\overline{w}>\hat{w}(1)$, $\underline{w}>\hat{w}(0)$ (because $\lambda_G>\lambda_M$).

Now consider any PBE of the pre-autonomy cheap talk game. Let $q(m)=\overline{p}\hat{\sigma}(\overline{A},m)+(1-\overline{p})\hat{\sigma}(\underline{A},m)$ be the probability that message $m\in\mathcal{M}$ is sent by the manager given her equilibrium strategy $\hat{\sigma}$. Note that the $\hat{\sigma}(A,m)$ determines the probability that the manager chooses m for a given value of A. Let $p(m)$ be the belief (that $A=\overline{A}$) of the government upon receiving message m; this is formed via Bayes' rule for on path messages and is chosen arbitrarily for off path messages (i.e., messages $m\in\mathcal{M}$ for which $q(m)=0$). Note that Bayesian updating implies that the posterior

$$\sum_{m\in\mathcal{M}} q(m)p(m)=\overline{p}$$

must average to the prior.

This in turn implies that

$$\begin{aligned}\sum_{m\in\mathcal{M}} q(m)\hat{w}\big(p(m)\big) &\le \sum_{m\in\mathcal{M}} q(m)\big[p(m)\hat{w}(1)+\big(1-p(m)\big)\hat{w}(0)\big]\\ &=\overline{p}\hat{w}(1)+(1-\overline{p})\hat{w}(0)\\ &<\overline{p}\overline{w}+(1-\underline{p})\underline{w},\end{aligned} \tag{12}$$

where the first inequality follows from the convexity of $\hat{w}$. This shows that the average expenditure on inputs is strictly higher under autonomy which, in turn, implies that the amount spent on both capital and labor is strictly higher.

Now consider the function

$$\begin{aligned}\hat{\pi}(p) &= R\big((p\overline{A}+(1-p)\underline{A}),\hat{w}(p)\big)-\hat{w}(p)\\ &= \big(p\overline{A}+(1-p)\underline{A}\big)^{\frac{1}{1-(\alpha+\beta)}}\gamma^{\frac{1}{1-(\alpha+\beta)}}\left[\left(\frac{\alpha+\beta}{\lambda_G}\right)^{\frac{\alpha+\beta}{1-(\alpha+\beta)}}-\left(\frac{\alpha+\beta}{\lambda_G}\right)^{\frac{1}{1-(\alpha+\beta)}}\right]\end{aligned}$$

that determines the profit of the firm (net of input expenses) when the government chooses inputs in response to the belief p (i.e., the government solves (9)). Note that this function is convex in p because the term in the square brackets is positive since $\alpha+\beta<1$ and $\lambda_G>1$. Additionally, note that the function

$$\lambda \mapsto \left(\frac{\alpha+\beta}{\lambda}\right)^{\frac{\alpha+\beta}{1-(\alpha+\beta)}}-\left(\frac{\alpha+\beta}{\lambda}\right)^{\frac{1}{1-(\alpha+\beta)}}$$

(that maps λ to the term in the square brackets) is decreasing in λ when $\lambda>1$; to see this, observe that the derivative with respect to λ is

$$\begin{aligned}&-\left[\frac{\alpha+\beta}{1-(\alpha+\beta)}\left(\frac{\alpha+\beta}{\lambda}\right)^{\frac{\alpha+\beta}{1-(\alpha+\beta)}-1}-\frac{1}{1-(\alpha+\beta)}\left(\frac{\alpha+\beta}{\lambda}\right)^{\frac{1}{1-(\alpha+\beta)}-1}\right]\left(\frac{\alpha+\beta}{\lambda^2}\right)\\ &=\frac{1}{1-(\alpha+\beta)}\left(\frac{\alpha+\beta}{\lambda}\right)^{\frac{\alpha+\beta}{1-(\alpha+\beta)}}\left(\frac{\alpha+\beta}{\lambda^2}\right)\left[1-(\alpha+\beta)\frac{\lambda}{\alpha+\beta}\right]<0.\end{aligned}$$

Therefore,

$$\overline{\pi}=\overline{A}^{\frac{1}{1-(\alpha+\beta)}}\gamma^{\frac{1}{1-(\alpha+\beta)}}\left[\left(\frac{\alpha+\beta}{\lambda_M}\right)^{\frac{\alpha+\beta}{1-(\alpha+\beta)}}-\left(\frac{\alpha+\beta}{\lambda_M}\right)^{\frac{1}{1-(\alpha+\beta)}}\right]>\hat{\pi}(1)\quad\text{and}$$

$$\underline{\pi}=\underline{A}^{\frac{1}{1-(\alpha+\beta)}}\gamma^{\frac{1}{1-(\alpha+\beta)}}\left[\left(\frac{\alpha+\beta}{\lambda_M}\right)^{\frac{\alpha+\beta}{1-(\alpha+\beta)}}-\left(\frac{\alpha+\beta}{\lambda_M}\right)^{\frac{1}{1-(\alpha+\beta)}}\right]>\hat{\pi}(0).$$

I can then use the identical argument to (12) to show that average profits go up after autonomy is granted.

It remains to be shown that when $\lambda_G>\frac{\overline{A}}{\underline{A}}\lambda_M$, there is a unique PBE of the cheap talk game (the babbling equilibrium) and the value of autonomy to the manager is strictly increasing in λ_G. First, note that for such values of λ_G,

$$\hat{w}(1)=\left(\frac{\overline{A}(\alpha+\beta)\gamma}{\lambda_G}\right)^{\frac{1}{1-(\alpha+\beta)}}<\left(\frac{\underline{A}(\alpha+\beta)\gamma}{\lambda_M}\right)^{\frac{1}{1-(\alpha+\beta)}}=\underline{w},$$

that is, the government invests less in inputs than the manager even when the former believes that $A=\overline{A}$ and the latter knows that $A=\underline{A}$. Also, observe that the utility of the manager

$$R(A,w)+\lambda_M(\overline{w}-w)$$

for either value of A is increasing for all $w<\underline{w}$ since the above expression is concave and, therefore, increasing to the left of the peak (which is $\underline{w}<\overline{w}$ for $\underline{A}$, $\overline{A}$, respectively).

Now suppose for contradiction that there is a PBE of the pre-autonomy cheap talk game in which there are two on path messages $m, m' \in \mathcal{M}$ such that the government has distinct posterior beliefs $p(m) > p(m')$ following the receipt of these messages. Since the government's choice of input spending $\hat{w}(\cdot)$ is increasing in p, this implies that $\underline{w} > \hat{w}(1) \geq \hat{w}(p(m)) > \hat{w}(p(m'))$. Therefore, the utility of the manager satisfies

$$R(\hat{w}(p(m)), w) + \lambda_M(\overline{w} - \hat{w}(p(m))) > R(A, \hat{w}(p(m'))) + \lambda_M(\overline{w} - \hat{w}(p(m')))$$

for both $A \in \{\underline{A}, \overline{A}\}$, which in turn implies that m' cannot be an on-path message.

I complete the proof by observing that, for the unique PBE, the input expenditure $\hat{w}(\overline{p})$ given by expression (10) is decreasing in λ_G. So, take $\lambda'_G > \lambda_G > \frac{\overline{A}}{\underline{A}}\lambda_M$, and let $\underline{w} > \hat{w}(\overline{p}) > \hat{w}'(\overline{p})$ denote the input expenditures at each value λ_G, λ'_G, respectively. Then

$$R(\hat{w}(\overline{p}), w) + \lambda_M(\overline{w} - \hat{w}(\overline{p})) > R(A, \hat{w}'(\overline{p})) + \lambda_M(\overline{w} - \hat{w}'(\overline{p})),$$

which, in turn, implies that the value of autonomy is increasing. *Q.E.D.*

APPENDIX C: AUTONOMY PROGRAM BENEFITS

1. *Capital Expenditure*: Between 1997–2005, Mini-Ratna category-I enterprises could undertake capital expenditure on new projects, modernization, or purchase of equipment without government approval up to ₹3 billion, or equal to their net worth, whichever was lower. This expenditure was for each project, not each year (so a firm could undertake multiple projects each year). For Mini-Ratna category-II enterprises, this amount was ₹1.5 billion, or up to 50% of their net worth. Between 2005–2009, Mini-Ratna category-I enterprises could spend up to ₹5 billion per project, or up to their net worth, whichever was lower. Mini-Ratna category-II enterprises could spend up to ₹2.5 billion per project, or up to 50% of their net worth, whichever was lower. Throughout this period, Navratna enterprises could undertake capital expenditure without any ceiling. They could also (unlike the Mini-ratna enterprises) establish offices abroad without the government's permission.
2. *Labor Restructuring*: All firms with autonomy could implement initiatives around personnel training, and voluntary or compulsory retirement schemes to restructure their labor force. Navratna enteprises could additionally create and fill vacancies in the firm without any government involvement, up to the level of the Board of Directors (not including the directors themselves).
3. *Joint Ventures and Subsidiaries*: Between 1997–2005, Mini-Ratna category-I enterprises could establish joint ventures and subsidiaries (in India) as long as the equity investment of the firm was capped at ₹1 billion or 5% of the firm's net worth, whichever was lower. For Mini-Ratna category-II enterprises, this amount was ₹0.5 billion, or up to 5% of the firm's net worth per project, whichever was lower. For Navratna enterprises, this amount was ₹2 billion, or up to 5% of the firm's net worth per project, whichever was lower. The total equity investment could not exceed 15% of the firm's net worth across all joint ventures or subsidiaries in any firm with autonomy (regardless of the type of autonomy).

   In 2005, the cap on the value of these projects was increased—Mini-Ratna category-I enterprises could now invest equity up to ₹5 billion or 15% of the firm's net worth per project, Mini-Ratna category-II enterprises could now invest equity up to ₹2.5 billion or 15% of the firm's net worth per project, and Navratna enterprises could now invest equity up to ₹10 billion or 15% of the firm's net worth per project. Across all types of autonomy, total investment in such ventures was capped at 30% of the firm's net worth. In 2005, all firms with autonomy were also allowed to enter into mergers and acquisitions subject to the same value caps, and subject to these activities being in the SOE's core area of functioning.

4. All firms with autonomy were encouraged into strategic alliances such as technology joint ventures, though there were no specific guidelines around this.

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