Non-Compete Agreements and Bargaining Power

By BHARGAV GOPAL AND XIANGRU LI AND LUKE RAWLING *

Recent research shows that non-compete agreements (NCs) present a tradeoff between firm investment incentives and allocative efficiency (e.g., Shi, 2023). By preventing workers from moving to industry competitors, NCs encourage firm-provided industry-specific investments, but at the cost of limiting efficient mobility. Even if NCs increase the size of the economic pie by encouraging investment, they have distributional implications as workers bound under such agreements may receive a lower share of economic surplus, thus lowering the labor share of income. While Gopal, Li and Rawling (2025) formalize these ideas in the context of fixed-wage contracts, this paper changes the wage-setting process so that it is determined through bargaining. We observe that approximately 40% of NC signers report negotiating over pay using novel data on NC usage from the National Longitudinal Survey of Youth 1997 (NLSY97), so this modeling choice is empirically grounded.

Although negotiation is associated with a cross-sectional wage premium, in theory, negotiation can cause hold-up problems. It is well known that if employers anticipate that workers will capture returns on firm-provided investments, they will under-invest (e.g., Rubin and Shedd, 1981; Grout, 1984; Meccheri, 2009). We show in this paper that this logic holds even when a worker signs an NC: when worker bargaining power is sufficiently high, the NC and no-NC contracts are identical as neither yield firm-provided investments. In contrast, when firms have all the bargaining power and wages are marked-to-market, NCs encourage firm-provided industry-specific investments by compressing the external wage profile, as in Acemoglu and Pischke (1999). When labor markets are perfectly competitive, NCs increase total compensation but lower wage growth, matching the wage dynamics observed in Gopal, Li and Rawling (2025).

Empirically, we study the effects of signing NCs on wages by negotiation status. In the NLSY97, workers are asked whether their wage was set through a take-it-or-leave-it (TIOLI) offer or whether they negotiated over pay. We map the former to low worker bargaining power and the latter to high worker bargaining power in our theoretical model. Using the stacked difference-in-differences framework as in Gopal, Li and Rawling (2025), we find that the wage premium for signing NCs is driven by workers who do not negotiate for pay. We observe this pattern for both college-educated and non-college-educated workers, and our results are robust to detailed controls. Interestingly, conditional on negotiating over pay, there is no wage premium for signing NCs. These results align with our model's interpretation that NCs encourage firms to provide transferable skills when they have substantial bargaining power.

I. Theoretical Framework

Consider a two-period model between a risk-neutral firm F and a risk-neutral worker W. At the beginning of the first period, the worker and the firm agree to a contract $C = \{\delta, B_\delta\}$ that specifies whether an NC is signed $\delta \in \{0,1\}$ and an upfront transfer $B_\delta \in \mathbb{R}$. After the contract is signed, the firm chooses the level of productivity-enhancing investment i_δ in the worker at a cost of $c(i_\delta) = \frac{1}{2}i_\delta^2$. Investment is non-contractible (e.g., Grossman and Hart, 1986) and is a mixture of firm-specific and industry-specific investment. An additional unit of investment raises productivity by r within the firm and by ρ if the worker joins an industry-competitor ($\rho \leq r$). The worker's outside option is $v + (1-\delta)\rho i_\delta$: NCs prevent transitions to industry competitors and transform industry-specific investments to firm-specific investments.

At the beginning of the second period, the market demand for the worker v is realized and is public

* Gopal: Queen's University (b.gopal@queensu.ca); Li: Columbia University (xl3147@columbia.edu); Rawling: Queen's University (rawling.luke@queensu.ca).

information. We assume that at the contracting stage, only the distribution $v \sim Exponential(\lambda)$ is common knowledge, with density $f(v) = \lambda e^{-\lambda v}$ for $v \geq 0$. After v is observed, the firm and the worker decide whether to stay in the match or separate. If they stay, the worker is paid a wage w_δ determined through Nash Bargaining and produces $y(i_\delta) = ri_\delta$ for the firm. If they separate, no production occurs with the original firm, the worker moves to a competing firm and is paid the outside option. As in Gopal, Li and Rawling (2025), the efficient level of investment equates the marginal cost with the expected marginal social benefit and satisfies $r - (r-\rho)e^{-\lambda(r-\rho)i^\star} = i^\star$. Efficient turnover occurs when $v > (r-\rho)i^\star$.

The equilibrium is solved with backward induction. In the final period, trade will only occur when $ri_\delta \geq v + (1-\delta)\rho i_\delta$. Given the worker's bargaining power $\theta \in [0,1]$, the wage is the following:

$$w^*_\delta = \theta r i_\delta + (1-\theta)(v + (1-\delta)\rho i_\delta) \tag{1}$$

The firm makes non-contractible investments to maximize its expected profit following Equation 2, where $K_\delta = r - (1-\delta)\rho$.

$$\begin{aligned} i^*_\delta &= \arg\max_{i_\delta}\{-c(i_\delta) + \int_0^{K_\delta i_\delta} (ri_\delta - w^*_\delta(i_\delta, t)) f(t)\, dt\} \\ &\Rightarrow i^*_\delta = (1-\theta)K_\delta \cdot (1 - e^{-\lambda K_\delta i^*_\delta}) \end{aligned} \tag{2}$$

At the contracting stage, the firm and worker choose the contract that maximizes expected joint surplus subject to the worker's participation constraint $E(W_\delta) + B_\delta \geq \mu_0$, where μ_0 denotes worker's reservation utility and $E(W_\delta)$ denotes the expected wage in the second period. The expected joint surplus is Σ_δ, where

$$\Sigma_\delta(i^*_\delta) = ri^*_\delta - \frac{1}{2}(i^*_\delta)^2 + \frac{1}{\lambda}e^{-\lambda K_\delta i^*_\delta} \text{ and } \delta = \arg\max\{\Sigma_1(i^*_1), \Sigma_0(i^*_0)\} \tag{3}$$

PROPOSITION 1: *Denote the optimal investment under an NC as i^*_1 and No-NC as i^*_0.*
(a) Under an NC, optimal investment is higher ($i^*_1 \geq i^*_0$) and equilibrium quit probability is lower ($q^*_1 \leq q^*_0$)
(b) Investment without an NC is below the socially efficient level $i^*_0 < i^*$.
(c) Investment decreases with workers' bargaining power ($\frac{di^*_1}{d\theta} \leq 0, \frac{di^*_0}{d\theta} \leq 0$).
(d) Let $\bar{\theta}_0 = 1 - \frac{1}{\lambda(r-\rho)^2}$ and $\bar{\theta}_1 = 1 - \frac{1}{\lambda r^2}$.
If $\theta \in [0, \bar{\theta}_0), i^*_1 > i^*_0 > 0$. If $\theta \in [\bar{\theta}_0, \bar{\theta}_1), i^*_1 > i^*_0 = 0$. If $\theta \in [\bar{\theta}_1, 1], i^*_1 = i^*_0 = 0$.

NCs mitigate the hold-up problem but reduce quit probabilities and cause allocative inefficiencies. As worker bargaining power increases, firm investment decreases. If worker bargaining power is sufficiently high, no investment occurs, even with NCs.

$$\Delta\Sigma = \Sigma_1(i^*_1) - \Sigma_0(i^*_0) = \underbrace{(i^*_1 - i^*_0)[r - \frac{1}{2}(i^*_0 + i^*_1)]}_{\text{Investment Gain}(\geq 0)} + \underbrace{\frac{1}{\lambda}(e^{-\lambda r i^*_1} - e^{-\lambda(r-\rho)i^*_0})}_{\text{Allocative Efficiency Loss}(<0)} \tag{4}$$

$$\Delta w = w^*_1 - w^*_0 = \underbrace{\theta r(i^*_1 - i^*_0)}_{\text{Investment Gain}(\geq 0)} - \underbrace{(1-\theta)\rho i^*_0}_{\text{Outside Option Loss}(\geq 0)} \tag{5}$$

$$\Delta B = B^*_1 - B^*_0 = -\Delta w - \underbrace{\theta\frac{1}{\lambda}(e^{-\lambda r i^*_1} - e^{-\lambda(r-\rho)i^*_0})}_{\text{Quit Option Value Loss } \leq 0} \tag{6}$$

In our efficient contracting model, NCs will only be used if the investment gains outweigh the allocative efficiency losses. If firms have substantial bargaining power, NCs will lower wages within the firm. Since NCs also reduce search option values, workers will necessarily receive a compensating wage differential in this case, so $B_1 > B_0$. This logic is also present in Gottfries and Jarosch (2023), though our model presents NCs in a less restrictive light as workers still maintain a non-industry outside option with an NC (as opposed to just the value of unemployment). On the other hand, if workers have intermediate bargaining power, NCs may raise wages. The effect on upfront compensation is unclear, as there is a tradeoff ex-ante between higher future wages and lower quit option values.

PROPOSITION 2: *(Wages Marked-to-Market) When $\theta = 0$ and NCs are used:*
(a) $w_1^* \leq w_0^*$ (b) $B_1^* \geq B_0^*$ (c) Under perfect competition, total compensation is higher under an NC.

PROPOSITION 3: *(a) When $\theta > \bar{\theta}_1$, the NC and No-NC contracts are equivalent. (b) When $\theta \in [\bar{\theta}_0, \bar{\theta}_1]$, an NC will be used and $w_1^* > w_0^*, B_1^* < B_0^*$.*

When wages are marked-to-market and NCs are used, NCs lower wage growth but workers receive a compensating wage differential.[1] This wage dynamic matches patterns observed in Gopal, Li and Rawling (2025) and Shi (2023). In perfectly competitive labor markets, NCs further increase total compensation. If workers have sufficiently high bargaining power, no firm-provided investment occurs and the two contracts are identical. For intermediate bargaining power, NCs will be used and result in faster wage growth, as among the physicians studied in Lavetti, Simon and White (2020). This theory provides a potential explanation for NC usage among unionized workers, where 11% of such workers have NCs (Gopal, Li and Rawling, 2025) and where ex-post wage bargaining can reduce firms' returns to investment (Grout, 1984).

II. Empirical Analysis

A. Description of data and sample

We use the NLSY97 to examine how bargaining power shapes the wage effects of NCs. A key advantage of the NLSY97 is that it contains information on both NC coverage and wage-setting in worker panel data. Specifically, in the 2015 and 2017 survey years workers report whether the initial wage at their current job was set through a take-it-or-leave-it offer or whether they negotiated over their pay. We use survey waves 2013-2021 and follow the same sample restrictions as in Gopal, Li and Rawling (2025).

B. Proxying for bargaining power

To assess the role of bargaining power in shaping the causal effects of NCs on wages, we split the sample by whether a worker ever reports negotiating over their pay. We will use this negotiation indicator variable as a proxy for the worker's bargaining power. This proxy of bargaining power is imperfect (e.g., Caldwell, Haegele and Heining, 2025), but captures the distinction that workers who are able to negotiate over their pay are those able to extract more surplus from a match relative to those who always report accepting a take-it-or-leave-it offer.

In 2017, about 35% of workers report having negotiated over their pay before starting their current job, with the remaining having accepted a take-it-or-leave-it offer. These statistics align with those presented in Hall and Krueger (2012) and Rothstein and Starr (2022). Table 1 shows there are meaningful differences between these two groups of workers. Those who negotiate over their pay earn 26 log points higher hourly wages and work over two hours per week more. We observe a gender gap in bargaining, with negotiators being 4pp more likely to be male. Negotiators also have about 7 percentiles higher cognitive test scores and are 11pp more likely to be college-educated. Interestingly, workers who negotiate over their wages are also significantly more likely to have an NC in their

[1] A sufficient condition for NC usage is $\lambda \in (\frac{1}{r^2}, \frac{1}{(r-\rho)^2})$.

employment contract, which could indicate that NCs afford workers the opportunity to negotiate or that both NCs and wage negotiation are more common in certain types of jobs.

Table 1—: Worker Characteristics by Negotiation Status

	Non-Neg.	Neg.	Diff.	P-value	Obs: Non-Neg.	Obs: Neg.
Log Hourly Pay	3.01	3.27	.26	.00	2,668	1,156
Hours Per Week	38.95	41.24	2.29	.00	2,507	1,093
College	.43	.54	.11	.00	2,646	1,151
Black or Hispanic	.28	.27	-.02	.30	2,668	1,156
Male	.50	.54	.04	.02	2,668	1,156
ASVAB Percentile	52.20	58.94	6.74	.00	2,187	959
Non-Compete	.14	.20	.06	.00	2,635	1,144

Note: Data based on 2017 NLSY97. Negotiators are workers who report negotiating over pay in their current job; non-negotiators report accepting a take-it-or-leave-it offer. Columns 1 and 2 show averages conditional on not-negotiating and negotiating respectively.

C. *Stacked Difference-in-Differences*

To estimate the causal effects of NCs on workers' wages, we adopt the stacked difference-in-differences design used in Gopal, Li and Rawling (2025) and related studies such as Johnson, Lavetti and Lipsitz (2025). In this setting, we define a cohort c as all workers moving to a new job with known NC status at time c. Within cohort c, the treated group consists of workers who report signing an NC for the first time in year c and the control consists of workers who never report signing an NC over the sample period. This approach creates a panel dataset for each time period $c \in \{2015, 2017, 2019, 2021\}$, each with its own treatment and control group. We then stack these datasets together and estimate

$$w_{itc} = \alpha_{ic} + \lambda_{tc} + \beta d_{i,t,c} + \varepsilon_{itc}, \tag{7}$$

where w_{itc} is the real log hourly wage for individual i at time t in cohort c, where $d_{i,t,c}$ equals one for treated individuals in all periods $t \geq c$, and β captures the average post-treatment effect. Standard errors are clustered at the individual level. Identification relies on the standard parallel trends assumption, ruling out selection into NCs based on time-varying unobservables that could directly influence both wages and NC usage. Gopal, Li and Rawling (2025) run several robustness checks that suggest these potential biases are not a concern.

D. *Main Results*

We examine the impact of NCs on worker wages, splitting the sample by whether the worker is college-educated and whether they ever negotiated over their wage (Table 2). Our main result is that the effect of NCs on wages is smaller among workers who report negotiating over their pay. For college-educated workers, the NC wage premium is 10.2 log points and statistically significant among workers who typically accept take-it-or-leave-it offers (column 3), whereas it is 4.5 log points and insignificant among negotiators. Therefore, almost the entire NC wage premium among college workers is concentrated among workers who do not typically bargain over their pay. The differences between negotiators and non-negotiators only strengthen when controlling for industry and occupation fixed effects (columns 2 and 4), indicating that these differences are not due to certain sectors typically allowing for wage negotiation. We conduct the same analysis for the non-college sample (columns 5-8), and come to similar conclusions. Our results indicate that, conditional on negotiating over pay, there is no wage premium for NCs.

Table 2—: Effect of NCs on Log Wages by Education and Wage Negotiation Status

	College				No College			
	Negotiators		Non-Negotiators		Negotiators		Non-Negotiators	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Treat × Post	0.0452	0.00247	0.102**	0.104**	0.0844	0.0495	0.0945***	0.0844***
	(0.0513)	(0.0538)	(0.0468)	(0.0463)	(0.0546)	(0.0518)	(0.0319)	(0.0310)
Ind. and Occ. FEs	No	Yes	No	Yes	No	Yes	No	Yes
Observations	2,282	2,173	5,449	5,250	2,749	2,643	11,692	11,234
R-squared	0.764	0.787	0.733	0.756	0.717	0.755	0.687	0.716

Note: Based on 2015-2021 surveys of the NLSY97. Negotiators refer to workers who in the 2015 or 2017 samples reported negotiating over pay at their current employer; non-negotiators are those who always report accepting a take-it-or-leave-it offer. Coefficients estimated from equation (7). Standard errors are clustered at the individual level. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

REFERENCES

Acemoglu, Daron, and Jörn-Steffen Pischke. 1999. “The Structure of Wages and Investment in General Training.” *Journal of Political Economy*, 107(3): 539–572.

Caldwell, Sydnee, Ingrid Haegele, and Jörg Heining. 2025. “Bargaining and Inequality in the Labor Market.” *The Quarterly Journal of Economics*.

Gopal, Bhargav, Xiangru Li, and Luke Rawling. 2025. “Do Non-Compete Agreements Help or Hurt Workers? Evidence from the NLSY97.”

Gottfries, Axel, and Gregor Jarosch. 2023. “Dynamic Monopsony with Large Firms and Noncompetes.”

Grossman, Sanford J., and Oliver D. Hart. 1986. “The Costs and Benefits of Ownership: a Theory of Vertical and Lateral Integration.” *Journal of Political Economy*, 94(4): 691–719.

Grout, Paul A. 1984. “Investment and Wages in the Absence of Binding Contracts: a Nash Bargaining Approach.” *Econometrica*, 52(2): 449.

Hall, Robert E, and Alan B Krueger. 2012. “Evidence on the Incidence of Wage Posting, Wage Bargaining, and On-the-Job Search.” *American Economic Journal: Macroeconomics*, 4(4): 56–67.

Johnson, Matthew S., Kurt Lavetti, and Michael Lipsitz. 2025. “The Labor Market Effects of Legal Restrictions on Worker Mobility.” *Journal of Political Economy*, 133(9): 2735–2793.

Lavetti, Kurt, Carol Simon, and William D. White. 2020. “The Impacts of Restricting Mobility of Skilled Service Workers: Evidence from Physicians.” *Journal of Human Resources*, 55(3): 1025–1067.

Meccheri, Nicola. 2009. “A Note on Noncompetes, Bargaining and Training by Firms.” *Economics Letters*, 102(3): 198–200.

Rothstein, Donna, and Evan Starr. 2022. “Noncompete Agreements, Bargaining, and Wages.” *Monthly Labor Review*.

Rubin, Paul H., and Peter Shedd. 1981. “Human Capital and Covenants Not to Compete.” *The Journal of Legal Studies*, 10(1): 93–110.

Shi, Liyan. 2023. “Optimal Regulation of Noncompete Contracts.” *Econometrica*, 91(2): 425–463.

Supplemental Appendix: Non-Compete Agreements and Bargaining Power

By BHARGAV GOPAL AND XIANGRU LI AND LUKE RAWLING *

I. Empirical Appendix

We draw on data from the National Longitudinal Survey of Youth 1997 (NLSY97). Our analysis uses survey waves from 2013 through 2021 and is limited to employed individuals with real hourly wages between \$3 and \$200. For respondents holding more than one job in a given survey year, we focus on their main job, defined as the current or most recent job at the time of the interview. If multiple jobs are ongoing, we designate the main job as the one with the longest tenure. All estimates apply the NLSY-provided sampling weights to ensure national representativeness.

II. Theory Appendix

A. *Proof of Proposition 1*

A1. INVESTMENT AND QUIT PROBABILITY UNDER NC AND WITHOUT NC

Proof: We first show that investment is weakly higher under NC for all θ.
When $\theta \geq \bar{\theta}_0$, $i_1^* \geq 0, i_0^* = 0$, which implies that $i_1^* \geq i_0^*$
Thus we only need to consider the case of $\theta \in [0, \bar{\theta}_0)$, when both i_1^*, i_0^* are nonzero.
Let

$$H_\delta(i) = (1-\theta)K_\delta \cdot (1 - e^{-\lambda K_\delta i}) - i$$

We find i_0^*, i_1^* by solving $H_0(i_0^*) = 0, H_1(i_1^*) = 0$.
Given the optimal investment without NC, i_0^*

$$H_1(i_0^*) = (1-\theta)r \cdot (1 - e^{-\lambda r i_0^*}) - i_0^* > (1-\theta)(r-\rho) \cdot (1 - e^{-\lambda(r-\rho)i_0^*}) - i_0^* = H_0(i_0^*) = 0$$

By Intermediate Value Theorem, since $H_1(i_0^*) > 0$, $\lim_{i\to\infty} H_1(i) < 0$, there must be $i_1^* > i_0^*$.
Now we show quit probability is weakly lower under NC. The quit probability under NC and No-NC are given by

$$q_1^* = P(v > r i_1^*) = e^{-\lambda r i_1^*} \; ; \; q_0^* = P(v > (r-\rho) i_0^*) = e^{-\lambda(r-\rho) i_0^*}$$

Since $i_1^* \geq i_0^*$, $r i_1^* \geq (r-\rho) i_0^*$. Thus $q_1^* = e^{-\lambda r i_1^*} \leq e^{-\lambda(r-\rho)i_0^*} = q_0^*$

A2. INEFFICIENTLY LOW INVESTMENT WITHOUT NC

Proof: We show that i_0^* is lower than the socially efficient level of investment i^*.
Let

$$H_p(i) = \rho + (r-\rho)(1 - e^{-\lambda(r-\rho)i}) - i$$

* Gopal: Queen's University (b.gopal@queensu.ca); Li: Columbia University (xl3147@columbia.edu); Rawling: Queen's University (rawling.luke@queensu.ca).

The socially efficient investment, i^* satisfies $H_p(i^*)=0$. Given the optimal investment without NC, i_0^*

$$H_p(i_0^*)=\rho+(r-\rho)(1-e^{-\lambda(r-\rho)i_0^*})-i_0^*>(1-\theta)(r-\rho)(1-e^{-\lambda(r-\rho)i_0^*})-i_0^*=H_0(i_0^*)=0$$

Additionally, $\lim_{i\to\infty}H_p(i)=-\infty<0$. By Intermediate Value Theorem, we have $i^*>i_0^*$

A3. INVESTMENT VS BARGAINING POWER

Proof: We show that i_1^*,i_0^* are non-increasing with worker's bargaining power θ.
When $\theta\geq\bar{\theta}_\delta, i_\delta^*=0$. Thus $\frac{di_\delta^*}{d\theta}=0$.
When $\theta<\bar{\theta}_\delta$, the second order condition for i_δ^* is given by $-1+(1-\theta)\lambda K_\delta^2e^{-\lambda K_\delta i_\delta^*}<0$.
Using the implicit function theorem,

$$\frac{di_1^*}{d\theta}=-\frac{r(1-e^{-\lambda ri_1^*})}{1-(1-\theta)\lambda r^2e^{-\lambda ri_1^*}}<0$$
$$\frac{di_0^*}{d\theta}=-\frac{(r-\rho)(1-e^{-\lambda(r-\rho)i_0^*})}{1-(1-\theta)\lambda(r-\rho)^2e^{-\lambda(r-\rho)i_0^*}}<0$$

A4. CONDITION FOR NONZERO INVESTMENT

Proof: We prove that $i_\delta^*>0$ if $\theta<\bar{\theta}_\delta=1-\frac{1}{\lambda K_\delta^2}$ and $i_\delta^*=0$ otherwise.
From II.A we know i_δ^* is the solution to $H_\delta(i)=0$. For an arbitrary i, we can derive

$$H_\delta'(i)=\lambda(1-\theta)K_\delta^2e^{-\lambda K_\delta i}-1\ ;\ H_\delta''(i)=-\lambda^2(1-\theta)K_\delta^3e^{-\lambda K_\delta i}<0$$

This shows that $H_\delta(i)$ is strictly concave.
$i=0$ is always a solution to $H_\delta(i)=0$. We need to show whether there exists a nonzero solution.

$$H_\delta(0)=0\ ;\ H_\delta'(0)=\lambda(1-\theta)K_\delta^2-1$$

If $\theta>\bar{\theta}_\delta$

$$1-\theta<\frac{1}{\lambda K_\delta^2}\Rightarrow H_\delta'(0)<0$$

Since $H_\delta(i)$ is strictly concave, for all $i\geq0$, $H_\delta'(i)<0$. Then since $H_\delta(0)=0, H_\delta(i)<0\ \forall i>0$.
Thus $i_\delta^*=0$ is the only solution to $H_\delta(i)=0$.
If $\theta<\bar{\theta}_\delta$

$$1-\theta>\frac{1}{\lambda K_\delta^2}\Rightarrow H_\delta'(0)>0$$

Given $H_\delta(0)=0$, there exists an $i>0$ such that $H_\delta(i)>0$. Further we know that $\lim_{i\to\infty}H_\delta(i)=(1-\theta)K_\delta-i<0$.
By the Intermediate Value Theorem, there must exist some $i_\delta^*>0$ such that $H_\delta(i_\delta^*)=0$. Since $H_\delta(i)$ is strictly concave and continuous, the nonzero solution i_δ^* is unique.

B. Proof of Proposition 2

B1. Derivation of Expected Joint Surplus and Contract Choice

The expected joint surplus with NC ($\Sigma_1(i_1^*)$) and without NC can be derived as ($\Sigma_0(i_0^*)$)

$$\Sigma_1(i_1^*) = -0.5 i_1^{*2} + r i_1^* + \frac{e^{-\lambda r i_1^*}}{\lambda}$$
$$\Sigma_0(i_0^*) = -0.5 i_0^{*2} + r i_0^* + \frac{e^{-\lambda (r-\rho) i_0^*}}{\lambda}$$

NC is chosen if and only if $\Sigma_1(i_1^*) > \Sigma_0(i_0^*)$.
We can decompose the differences in expected surplus as

$$\Delta_\Sigma = [r i_1^* - \frac{1}{2} i_1^{*2} - (r i_0^* - \frac{1}{2} i_0^{*2})] + \frac{1}{\lambda}(e^{-\lambda r i_1^*} - e^{-\lambda(r-\rho) i_0^*}) = (i_1^* - i_0^*)[r - \frac{1}{2}(i_0^* + i_1^*)] + \frac{1}{\lambda}(q_1^* - q_0^*)$$

The first term is larger or equal to 0 since $i_1^* < r, i_0^* < r$ and $i_1^* \geq i_0^*$. The second term is smaller or equal to 0 since $q_1^* \leq q_0^*$

B2. Comparison of w^* and B^*

First we derive B_1^* and B_0^* using $E(W_\delta^*) + B_\delta^* = \mu_0$.

$$B_0^* = \mu_0 - E(W_0^*) = \mu_0 - \left(\frac{1}{\lambda} + \rho i_0^* + \theta\left[(r-\rho) i_0^* - \frac{1}{\lambda} + \frac{e^{-\lambda(r-\rho) i_0^*}}{\lambda}\right]\right)$$
$$B_1^* = \mu_0 - E(W_1^*) = \mu_0 - \left(\frac{1}{\lambda} + \theta\left[r i_1^* - \frac{1}{\lambda} + \frac{e^{-\lambda r i_1^*}}{\lambda}\right]\right)$$
$$\Rightarrow \Delta_B = B_1^* - B_0^* = -\theta r (i_1^* - i_0^*) + (1-\theta)\rho i_0^* - \theta \cdot \frac{1}{\lambda}(q_1^* - q_0^*)$$

The first term is less than or equal to 0 since $i_1^* \geq i_0^*$. The second term is nonnegative. The third term is greater than or equal to 0 since $q_1^* \leq q_0^*$. Lastly, the comparison for second period wage is derived below

$$\Delta_w = w_1^* - w_0^* = \theta r (i_1^* - i_0^*) - (1-\theta)\rho i_0^*$$

B3. Wages Marked-to-Market ($\theta = 0$)

$\Delta_w = -\rho i_0^* \leq 0$; $\Delta_B = \rho i_0^* \geq 0$. Thus first period wage is higher NC and second period wage is higher without NC.
In a competitive market the firm's expected profit is set to 0.
The expected profit functions can be derived as

$$E\Pi_F(i_1^*, B_1) = -0.5 i_1^{*2} - B_1 + (1-\theta)[r i_1^* - \frac{1}{\lambda} + \frac{e^{-\lambda r i_1^*}}{\lambda}]$$
$$E\Pi_F(i_0^*, B_0) = -0.5 i_0^{*2} - B_0 + (1-\theta)[(r-\rho) i_0^* - \frac{1}{\lambda} + \frac{e^{-\lambda(r-\rho) i_0^*}}{\lambda}]$$

Therefore we can derive

$$B_1^* = -0.5 i_1^{*2} + (1-\theta)[r i_1^* - \frac{1}{\lambda} + \frac{e^{-\lambda r i_1^*}}{\lambda}]$$
$$B_0^* = -0.5 i_0^{*2} + (1-\theta)[(r-\rho) i_0^* - \frac{1}{\lambda} + \frac{e^{-\lambda (r-\rho) i_0^*}}{\lambda}]$$

The expected second period wage is

$$E(w_0) = \frac{1}{\lambda} + \rho i_0^* + \theta\left[(r-\rho) i_0^* - \frac{1}{\lambda} + \frac{e^{-\lambda (r-\rho) i_0^*}}{\lambda}\right]$$
$$E(w_1) = \frac{1}{\lambda} + \theta\left[r i_1^* - \frac{1}{\lambda} + \frac{e^{-\lambda r i_1^*}}{\lambda}\right]$$

Thus total compensation $T = B + E(w)$ can be derived as

$$T_1 = -0.5 i_1^{*2} + r i_1^* + \frac{e^{-\lambda r i_1^*}}{\lambda}$$
$$T_0 = -0.5 i_0^{*2} + r i_0^* + \frac{e^{-\lambda (r-\rho) i_0^*}}{\lambda}$$

The comparison of total compensation is

$$\Delta_T = [r i_1^* - \frac{1}{2} i_1^{*2} - (r i_0^* - \frac{1}{2} i_0^{*2})] + \frac{1}{\lambda}(e^{-\lambda r i_1^*} - e^{-\lambda (r-\rho) i_0^*}) = (i_1^* - i_0^*)[r - \frac{1}{2}(i_0^* + i_1^*)] + \frac{1}{\lambda}(q_1^* - q_0^*)$$

We observe that $\Delta_T = \Delta_\Sigma$. So when NC is used, $\Delta_T > 0$ and total compensation is higher under perfect competition.

C. Proof for Proposition 3

C1. $\theta \in [\bar{\theta}_0, \bar{\theta}_1)$

Proof: When $\theta \in [\bar{\theta}_0, \bar{\theta}_1)$, $\Delta_w = \theta r i_1^* > 0$; Thus the second period wage is higher with NC. $\Delta_B = -\theta r i_1^* + \theta \frac{1-e^{-\lambda r i_1^*}}{\lambda}$. Plug in $i_1^* = r(1-\theta)(1-e^{-\lambda r i_1^*})$ to Δ_B we get

$$\Delta_B = \theta(\frac{i_1^*}{\lambda(1-\theta) r} - r i_1^*) = \theta(\frac{r i_1^*}{\lambda(1-\theta) r^2} - r i_1^*) \leq 0$$

$\lambda(1-\theta) r^2 > 1$ when $\theta \in [\bar{\theta}_0, \bar{\theta}_1)$. Thus the first period wage is lower under NCs.

C2. $\theta \in [\bar{\theta}_1, 1)$

Proof: When $\theta \in [\bar{\theta}_1, 1), i_1^* = i_0^* = 0$. Thus the two contracts are equivalent.