Why are Low-Wage Workers Signing Noncompete Agreements?

ONLINE APPENDIX *

Matthew S. Johnson
Duke University
Sanford School of Public Policy

Michael Lipsitz
Miami University
Department of Economics

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Abstract

Policymakers are concerned by evidence that noncompete agreements (NCAs) are widely used in low-wage jobs. We show that firms that would otherwise not use NCAs are induced to use them in the presence of frictions to adjusting wages downward. Using a new survey of salon owners, we find that declines in the terms of trade for employees and increases in the minimum wage lead to higher NCA use, but only at firms for which the employee's cost of an NCA likely exceeds the employer's benefit. Furthermore, minimum wage increases have a negative effect on employment only where NCAs are unenforceable.

*Email addresses: matthew.johnson@duke.edu and lipsitm@miamioh.edu.

Online Appendix for "Why Are Low-Wage Workers Signing Noncompete Agreements?"

A Theoretical Appendix

In this Appendix, we introduce a model which formalizes the intuition of Section II.

The major insight of our model is straightforward: in a frictionless contracting environment, employer–employee pairs will only use NCAs when the firm's net benefit (the benefit to the employer minus the cost to the employee) of NCA use is positive. With enough friction, such as a binding constraint on monetary transferability, pairs may use NCAs even when their net benefit of NCAs is negative.

Our model may be viewed as a synthesis, and extension, of Wickelgren (2017) and Basu (2003). The former paper illustrates how constraints on wages (explicit or implicit) can lead to use of NCAs that are surplus-*diminishing*. We extend this intrafirm result in two ways. First, we embed firms in an otherwise frictionless market (like firms in Basu (2003)) to identify the characteristics of labor markets that will affect how strictly a given constraint on the wage binds, and the conditions under which such constraints will affect NCA use. Second, we characterize the consequences of NCA use for the combined surplus of employers and employees. We show that NCA use obeys a law of one price, *i.e.*, the marginal firm's NCA use will determine the whole market's use. We show that when the inclusion of an NCA in the *marginal* firm's contract is required to meet that employer's participation constraint, this contract set by the marginal firm will induce inframarginal firms for which the employer's participation constraint is satisfied without NCA use to use one—*even though the NCA reduces the inframarginal employee/employer pair's surplus*. This result is similar to one found in Basu (2003), who finds a similar implication for the distribution of surplus for laws permitting sexual harassment in the workplace.[1]

[1] Specifically, the model in Basu (2003) implies that permitting sexual harassment in exchange for a greater wage makes some workers better off (a subset of those who choose such a contract), but makes other workers worse off (including all workers who opt for a contract that does not permit harassment), relative

We note here that, while our model assumes a frictionless market for parsimony, this assumption is not critical to our main results: we discuss how our framework generalizes to imperfectly competitive models of the labor market, such as a search-and-matching model, in Section III.A.2. Finally, though we focus on NCAs, our model could generalize other non-wage (dis)amenities, such as sexual harassment. However, we suggest that NCAs may be particularly attractive margins of adjustment for employers. For one, NCAs have the potential to directly affect the firm's productivity, e.g. by solving investment hold-up problems, whereas the value employers derive from another disamenity like harassment may be purely nonmonetary. Additionally, contracts with NCAs may shift the bargaining power between employers and workers at later stages of employees' tenure, which economists have speculated about in the popular media and in policy proposals[2].

A.1 Description of the Model

The model has uncountably many of two types of agents: employers (R) and employees (E), with measures μ_R and μ_E. R and E form "firms" in frictionless labor markets. A firm is comprised of at most one R and one E. When firms are formed, they engage in production of a consumer good, which sells for an exogenously determined price, P. A firm containing employer i (called firm i) produces an exogenously determined quantity, $\gamma(i)$, of the consumer good, which results in value of production equal to $\gamma(i)P$. The population distribution of γ is Γ, which has compact support $[\underline{\gamma}, \bar{\gamma}]$ and no mass points. Employers are denoted R_i, where the index i is ordered such that $\gamma(i)$ is decreasing in i. Employers have an outside option with value equal to π_R. Employee productivity is homogeneous,[3] and employees have an outside option with value equal to π_E. Singleton agents, whether they are of type R or

to the scenario when contracts permitting harassment are not available.

[2]See, for example, "A Proposal for Protecting Low-Income Workers from Monopsony and Collusion", by Alan Krueger and Eric Posner (available at `http://www.hamiltonproject.org/assets/files/protecting_low_income_workers_from_monopsony_collusion_krueger_posner_pp.pdf`).

[3]While this assumption may seem restrictive, it is plausible that, from the employer's perspective, potential employee productivity is ex ante homogeneous in expectation conditional on observable characteristics. That is, any differences in productivity that would affect contracting prior to production are only evident to the employer via observables.

E, do not produce the consumer good, and receive their outside option.

Contracts written by an R and an E consist of two elements: a wage payment (w) and, possibly, an NCA (A).[4] The wage may be constrained by a monetary transferability limitation, l, which requires that $w \geq l$. The constraint $w \geq l$ may reflect the inability of an employer to lower wages due to the need for incentive provision (Shapiro and Stiglitz, 1984; Arnott et al., 1988), an employee's borrowing constraints, turnover reduction (**?**), employee cooperation (Fehr and Falk, 1999), or a regulated minimum wage.

If a firm writes a contract with an NCA ($A = 1$), a positive benefit of B accrues to R and a positive cost of C is paid by E. B may represent many different elements: the ability of the employer to make investments in the employee without facing a hold-up problem, retention of the firm's client list if the employee quits, protection of trade secrets, or prolonging worker tenure (and thus reducing employee replacement costs, which can be substantial (**?**)), among others. C primarily represents the employee's foregone potential future outside employment opportunities (including the foregone ability for an employee to move up the job ladder, à la Burdett and Mortensen (1998)), but may also reflect a weaker bargaining position relative to the employer in the future and thus less ability to negotiate higher future wages.[5]

R and E are risk neutral. Let $V_i(w, A)$ be the utility function of R_i if she is a member of a firm. $V_i(w, A)$ includes the value of production, the wage payment, and the benefit gained from use of an NCA:

$$V_i(w, A) = \gamma(i)P - w + AB$$

[4]In this model, we do not allow for the inclusion of a nonsolicitation agreement (NSA). In practice, NSAs (which prohibit employees from soliciting ex-clients following separation from their former employer) are often bundled with NCAs, but also may be used with an NCA. In client-based low-wage industries, NSAs are often relatively ineffective at decreasing post-employment competition, as employees bound by an NSA are still free to serve ex-clients, as long as they do not actively solicit those clients. Especially with the proliferation of social media and advertising on the internet, an NSA on its own is relatively easy for employees to subvert, necessitating use of NCAs.

[5]Modeling B and C as constant across employers and employees is effectively a simplification of a compensating differentials model of a non-wage amenity (Rosen, 1986), in which costs and preferences over the amenity may be heterogeneous. We make this simplification for the sake of exposition to clarify the effects of frictions on transferability via the wage. We relax the assumption that B is constant across employers in Appendix A.5.2.

Any R who is not a member of a firm receives her outside option, π_R.

The utility function of an E if he is a member of a firm includes the wage payment and the cost, C, incurred by an E if his contract includes an NCA:

$$W(w, A) = w - AC$$

Any E who is not a member of a firm receives his outside option, π_E.

An equilibrium is a set of firms and a contract for each firm, $\{w, A\}$, such that all matches are stable (i.e., there does not exist an R and an E who may form a new firm with a contract that yields strictly greater utility to one member of the pair and weakly greater utility to the other member of the pair) and contracts are optimal (i.e., there does not exist a deviation contract for a firm that yields strictly greater utility to one member of the pair and weakly greater utility to the other member of the pair).

A.2 The Firm's Problem

First, we construct labor demand. The wage that an employer is willing to pay an employee depends on whether or not the contract includes an NCA. The willingness to pay of employer R_i under an optimal contract may be found by maximizing E's utility over all possible contracts (to rule out Pareto dominated contracts), subject to satisfying the limited transferability constraint and both agents' participation constraints, PCR and PCE:

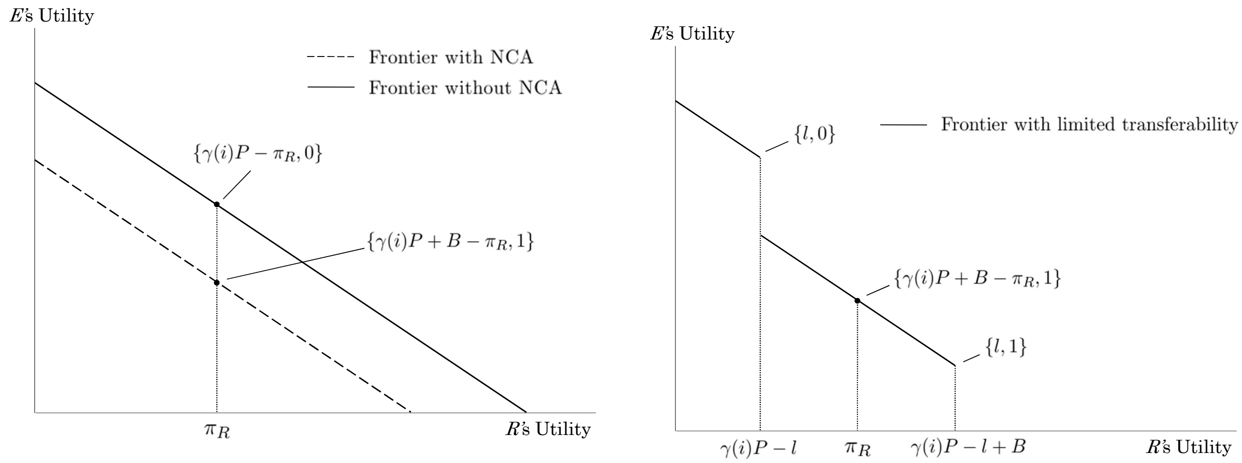
$$\max_{w \in \mathbb{R}, A \in \{0,1\}} w - AC$$

$$w \geq l \tag{LTC}$$

$$\gamma(i)P - w + AB \geq \pi_R \tag{PCR}$$

$$w - AC \geq \pi_E \tag{PCE}$$

Consider first a simplified problem which ignores the limited transferability constraint,



(a) With unlimited transferability of utility, R_i's participation constraint may be satisfied on the surplus-maximizing frontier. Here, $B < C$, so surplus-maximizing contracts do not include NCAs.

(b) With a transferability limitation, the Pareto frontier includes contracts with NCAs. A firm may need to use an NCA in order to satisfy R_i's participation constraint.

Figure A.1: Pareto frontiers when $B < C$, with and without utility transferability limitations.

(LTC). Assuming that (PCR) binds but (PCE) does not, substituting (PCR) into the maximand yields the reduced problem:

$$\max_{A \in \{0,1\}} \gamma(i)P + A(B - C) - \pi_R$$

The solution to this problem is $A = 0$ whenever $B < C$, and $A = 1$ whenever $B > C$. In other words, when utility is fully transferable via the wage (i.e., LTC does not bind), NCAs that maximize the pair's surplus are optimal, and NCAs that reduce the pair's surplus are not. The wage allocates the value of production and the benefit of an NCA to E, net of R_i's outside option: $w = \gamma(i)P + AB - \pi_R$.[6] The simplified problem (ignoring (LTC)) when $B < C$ is illustrated in Panel (a) of Figure A.1. In that example, the optimal contract that satisfies (PCR), $\{\gamma(i)P - \pi_R, 0\}$, lies on the frontier without an NCA, since $B < C$.

Now, consider the full problem with limited transferability, so that the wage cannot be

[6]Note that the assumption that (PCE) does not bind is equivalent to $\gamma(i)P + A(B - C) > \pi_E + \pi_R$: if PCE binds, there is no contract that R_i and E both prefer to simply receiving their outside options, and the maximization problem has no solution.

lower than l. If $l > \gamma(i)P - \pi_R$, the transferability constraint and R_i's participation constraint may be satisfied simultaneously only if $A = 1$, even when NCAs reduce the pair's surplus ($B < C$).

The solution to the complete problem is:

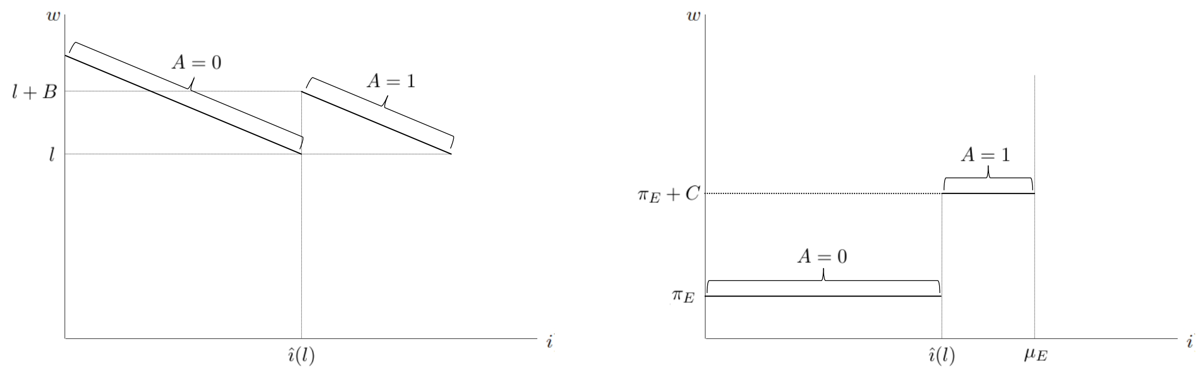
$$\{\gamma(i)P - \pi_R, 0\} \qquad \text{if } B < C \text{ and } l \leq \gamma(i)P - \pi_R \tag{1}$$

$$\{\gamma(i)P + B - \pi_R, 1\} \qquad \text{if } B > C \text{ or } l > \gamma(i)P - \pi_R. \tag{2}$$

Figure A.1 illustrates this problem for a particular firm when $B < C$. Panel (a) illustrates that, if there is no transferability constraint, the contract which maximizes E's utility subject to R's participation constraint is $\{\gamma(i)P - \pi_R, 0\}$, which lies on the surplus-maximizing Pareto frontier with no NCA. Panel (b) illustrates that, in the presence of a transferability constraint, l, the Pareto frontier becomes discontinuous: because the wage cannot fall below l, any contract with $w < l$ and $A = 0$ is unavailable. The exact location of the discontinuity is determined by firm i's productivity, $\gamma(i)$, and the magnitude of the transferability constraint, l. In Figure A.1, the firm's $\gamma(i)$ is such that only contracts that include $A = 1$ are available, since the most favorable contract for R_i with $A = 0$, $\{l, 0\}$, does not satisfy R_i's participation constraint. Thus, the contract must include an NCA to satisfy R_i's participation constraint, and the wage that maximizes E's utility is $\{\gamma(i)P + B - \pi_R\}$. The total surplus under this contract falls below that generated under the unconstrained optimal contract.

Given values for B, C, and l, Expressions 1 and 2 represent the inverse labor demand curve. When $B > C$, all contracts have $A = 1$, and the inverse demand curve is $D(i) = \gamma(i)P + B - \pi_R$. When $B < C$, the inverse labor demand curve has a discontinuity at $\hat{\imath}(l)$, given by $\gamma(\hat{\imath}(l))P - \pi_R = l$ (i.e., $R_{\hat{\imath}}$ is indifferent between the contract $\{l, 0\}$ and receiving her outside option). For $i \leq \hat{\imath}(l)$, inverse labor demand is $D(i) = \gamma(i)P - \pi_R$ with $A = 0$. For $i > \hat{\imath}(l)$, inverse labor demand is $D(i) = \gamma(i)P + B - \pi_R$ with $A = 1$.

Panel (a) of Figure A.2 shows the labor demand curve when $B < C$, with limited mone-



(a) The labor demand curve. The increase in willingness to pay at $\hat{\imath}(l)$ represents the benefit, B, associated with NCA use.

(b) The labor supply curve. The increase in willingness to accept at $\hat{\imath}(l)$ represents the cost, C, associated with NCA use.

Figure A.2: Labor demand and labor supply when $B < C$.

tary transferability of utility. The increase in willingness to pay at the discontinuity represents the value of an NCA to the employer, B.

The inverse labor supply curve, denoted by $S(i)$, is constructed analogously. The problem which characterizes the labor supply curve is given by:

$$\max_{w \in \mathbb{R}, A \in \{0,1\}} \gamma(i)P - w + AB$$

$$w \geq l \tag{LTC}$$

$$\gamma(i)P - w + AB \geq \pi_R \tag{PCR}$$

$$w - AC \geq \pi_E \tag{PCE}$$

Whenever (PCR) does not bind but (PCE) does, the solution to this problem is:

$$\{\pi_E, 0\} \text{ if } B < C \text{ and } l \leq \pi_E \tag{3}$$

$$\{\pi_E + C, 1\} \text{ if } B > C \text{ or } l > \pi_E \tag{4}$$

Labor supply is a horizontal line when $B > C$ at $S(i) = \pi_E + C$. When $B < C$, $S(i)$ has a discontinuity at $\hat{\imath}(l)$, jumping from $S(i) = \pi_E$ to $S(i) = \pi_E + C$. It is illustrated in Panel (b) of Figure A.2.

A.3 Characterization of Equilibrium

When $B > C$, all firms will use NCAs, since they are the unconstrained and constrained optimal contract for any firm, no matter the values of other parameters. Recall that μ_E and μ_R denote the measures of E and R in the labor market. The unconstrained market-clearing wage in this case, which we denote by $w^{B>C}$, is determined by the intersection of supply and demand:

$$w^{B>C} = \begin{cases} \gamma(\mu_E)P + B - \pi_R & \text{if } \mu_E < \mu_R \text{ and } D(\mu_E) > S(\mu_E) \\ \pi_E + C & \text{otherwise} \end{cases}$$

If the market-clearing wage is constrained ($w^{B>C} < l$), then the market contract is $\{l, 1\}$, and there will be a surplus of labor.

When $B < C$, the contract of the marginal firm in the labor market (hereafter denoted firm $\bar{\imath}$) will have $A = 1$ if $\bar{\imath} > \hat{\imath}(l)$: that is, if $R_{\bar{\imath}}$'s willingness to pay lies on the portion of the labor demand curve for which the firm's constrained optimal contract includes an NCA. Indeed, all R_i whose willingness to pay lies on the NCA portion of the labor demand curve (i.e., i such that $\hat{\imath}(l) < i \leq \bar{\imath}$) will use NCAs: they prefer their outside option to the contract $\{l, 0\}$, which is the most favorable allowable contract with $A = 0$. Denote the market wage in such contracts by w_1^*, which is set by firm $\bar{\imath}$.

Firms whose productivity is high enough to pay a wage equal to l with no NCA are not precluded from writing contracts without NCAs. However, the contract used by the marginal firm sets the market: that contract, $\{w_1^*, 1\}$, yields greater utility to any R than even the most favorable contract for an R with $A = 0$ (the contract $\{l, 0\}$). Otherwise, $\{l, 0\}$ would also be optimal for firms with $i > \hat{\imath}(l)$. This result implies that employers who would otherwise be willing to write surplus-maximizing contracts with no NCA will instead use surplus-reducing contracts with an NCA due to the law of one price (where "price" includes the totality of the contract). While use of NCAs with negative net benefit allows some pairs to form which would not be able to without NCAs, their use sets the market and induces suboptimal use by other pairs.

The proposition summarizing this result is simplified with the following assumptions:

Assumption 1. $\underline{\gamma}P < l + \pi_R$ *(i.e., $\hat{\imath}(l)$ exists)*

Assumption 2. $\gamma(\hat{\imath}(l))P + B - \pi_R > \pi_E + C$

The purpose of Assumptions 1 and 2 is to avoid trivial outcomes in which all firms' productivity is so high, or the cost of NCA use is so great, that no firms may optimally form which use NCAs. Assumption 1 says that there are some R_i for whom a contract with $A = 1$ would be optimal. Assumption 2 says that, at least for the firm that is indifferent between using $A = 0$ and $A = 1$, firm formation with an NCA yields surplus to the pair greater than each agent receiving their outside option.

Proposition A.1. *Under Assumptions 1 and 2, whenever $B < C$, all firms' equilibrium contracts have $A = 0$ if $\mu_E < \hat{\imath}(l)$. If $\mu_E > \hat{\imath}(l)$, all firms' equilibrium contracts have $A = 1$.*

Proof of Proposition A.1. When $\mu_E < \hat{\imath}(l)$, the intersection of $D(i)$ and $S(i)$ occurs at $i_0^* = \mu_E$ (since $D(i) > S(i)$ $\forall i < \hat{\imath}(l)$ by Assumption 2). Since $\mu_E < \hat{\imath}(l)$, the optimal contract for the marginal firm is $\{w_0^* \equiv \gamma(\mu_E) - \pi_R, 0\}$. No R_i for $i > \mu_E$ is willing to form a firm, and all R_i with $i < \mu_E$ are willing to form firms under that contract, since $\gamma(\cdot)$ is decreasing. Furthermore, the optimal contract for each firm with $i < \mu_E$ has $A = 0$. Therefore, no firm will deviate from the marginal firm's contract, all E are employed receiving the same utility, and no unmatched R can offer a better contract to an E. So, an equilibrium in which $A = 0$ in all contracts exists when $\mu_E < \hat{\imath}(l)$. Since the optimal contract for all $i \leq i_0^*$ has $A = 0$, equilibria with $A = 1$ in any contract do not exist.

When $\mu_R > \mu_E > \hat{\imath}(l)$, the intersection of $D(i)$ and $S(i)$ occurs at $i_1^* > \hat{\imath}(l)$: if $D(\mu_E) > S(\mu_E)$, then $i_1^* = \mu_E$ (all E are able to form firms). If $D(\mu_E) < S(\mu_E)$, then i_1^* solves $\gamma(i_1^*)P + B - \pi_R = \pi_E + C$ (which solution exists by Assumption 2). Since $i_1^* > \hat{\imath}(l)$, the marginal firm's contract is $\{w_1^* \equiv \gamma(i_1^*)P + B - \pi_R, 1\}$. For any $i \in (\hat{\imath}(l), \mu_E]$, firm i's optimal contract has $A = 1$, and competition drives the wage to w_1^*. However, for $i \leq \hat{\imath}(l)$, firm i's optimal contract has $A = 0$. Consider the most profitable contract for such a firm with $A = 0$: $\{l, 0\}$. That contract yields utility to R_i equal to $\gamma(i)P - l$. The marginal firm's contract yields utility to R_i equal to $\gamma(i)P - (\gamma(i_1^*)P + B - \pi_R) + B$. R_i prefers the contract $\{l, 0\}$ whenever:

$$\gamma(i)P - l > \gamma(i)P - (\gamma(i_1^*)P + B - \pi_R) + B$$

$$\gamma(i_1^*)P - \pi_R > l.$$

However, $l = \gamma(\hat{\imath}(l))P - \pi_R > \gamma(i_1^*)P - \pi_R$, since $i_1^* > \hat{\imath}(l)$. Therefore, there does not exist a contract with $A = 0$ that any R_i prefers to $\{w_1^*, 1\}$, and competition ensures that all firms use that contract. So, all equilibrium contracts have $A = 1$ when $\mu_R > \mu_E > \hat{\imath}(l)$.

Finally, when $\mu_E > \mu_R$, the logic of the preceding paragraph holds; however, the wage determined by the intersection of $D(i)$ and $S(i)$ may be lower than l if $\pi_E + C < \underline{\gamma}P + B - \pi_R < l$. In that case, the equilibrium market contract is $\{l, 1\}$, and the proof is nearly identical. □

Intuitively, Proposition A.1 states that, when transferability is limited and there are many E in the market, the marginal R is unwilling to hire an E without an NCA.[7] That firm sets the market, causing NCAs to be the optimal contract for all firms, even though the benefit of an NCA that accrues to the employer is smaller than the cost borne by the employee. Put another way, limitations on transferability make NCAs "cheaper" for R. R's cost of an NCA is the difference in the wages she must pay for a contract with versus without an NCA; this difference is less when a transferability limitation increases the wage paid without an NCA.

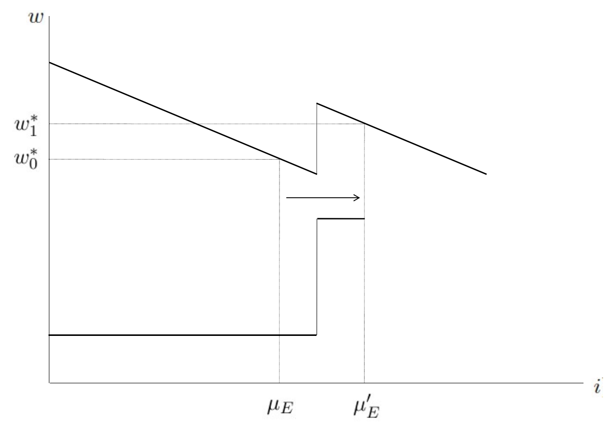
For some firms (namely, all $i \geq \hat{\imath}(l)$), pairwise surplus is still higher than it would be

[7] The absence of μ_R in Proposition A.1 is noteworthy, as one might imagine that the relative measure of employers should impact NCA use. While μ_R is not explicitly referenced in the proposition, we make two notes: first, $\hat{\imath}(l)$ will change as μ_R changes if one assumes that the relative distribution of productivities remains constant (i.e., that comparative statics involving μ_R scale up the relative distribution of productivities rather than holding $\hat{\imath}(l)$ constant). Second, to keep the model parsimonious, μ_R is assumed to be large, meaning that the market equilibrium occurs at $i < \mu_R$. One may drop this assumption and derive qualitatively identical results.

if NCAs were unavailable (in which case both E and R would get their outside option). For other firms (namely, $i < \hat{\imath}(l)$), pairwise surplus is *lower* than it would be if NCAs were unavailable. We note the similarity between this result and one contained in Basu (2003). Examining a ban on sexual harassment compared with a regime in which contracts which respectively allow or disallow harassment exist, Basu notes that such a ban "benefits those who would otherwise have chosen the no-harassment contract and also a number of those who would have chosen the harassment-allowed contract." This result is nuanced, so we illustrate with a representative example.

Suppose that $B < C$, $\pi_R = 0$, $P = 1$, and firms i_1 and i_2 have productivities $\gamma(i_1) = 10$ and $\gamma(i_2) = 6$. If $l = 8$, then the constrained optimal contract for i_1 has $A = 0$, and the constrained optimal contract for i_2 has $A = 1$. Suppose that i_3 is the marginal firm, where $\gamma(i_3) = 4$. In equilibrium, the market contract is $\{w = 4 + B, A = 1\}$. Employer i_1 earns $(10 + B) - (4 + B) = 6$, and employer i_2 earns $(6 + B) - (4 + B) = 2$. Employees at both firms earn $4 + B - C$, meaning that total surplus is $(10 + B - C)$ and $(6 + B - C)$ for firms i_1 and i_2, respectively.

Firm i_2 is better off in this situation than if NCAs were not allowed: in that case, there is no contract which satisfies the wage constraint ($w \geq l$) which would simultaneously satisfy i_2's participation constraint, so employer i_2 would earn $\pi_R = 0$, and her employee would not be employed. In other words, allowing NCAs in contracts allows firms to exist that would not otherwise, increasing utility for those employers and employees. However, if NCAs were not allowed, firm i_1 would still produce, as there are contracts without NCAs which satisfy employer i_1's participation constraint (for example, $\{l, 0\}$). Total surplus at that firm would be equal to its productivity, $\gamma(i_1) = 10$. That surplus is *greater* than the total surplus generated with NCAs $(10 + B - C)$, since $C > B$. Indeed, this is true for all firms with $i < \hat{\imath}(l)$: for each of these inframarginal firms with relatively high productivity, surplus is *decreased* by allowing NCAs in contracts. The deadweight loss at such inframarginal firms is exactly equal to the net cost of NCAs, $C - B$.



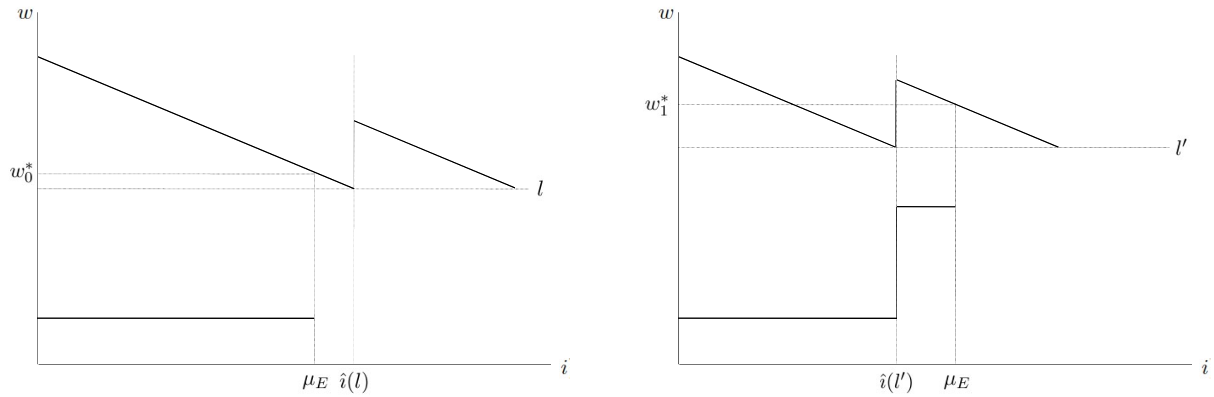
(a) A shift in labor supply from μ_E to μ'_E causes the marginal firm to be one for which NCAs are optimal. The optimal contract changes from $\{w_0^*, 0\}$ to $\{w_1^*, 1\}$.

Figure A.3: The effect of a change in labor supply.

A.4 Comparative Statics: Terms of Trade, Utility Transferability, and the Minimum Wage

Two immediate predictions arise from Proposition A.1. First, when NCAs reduce pairs' surplus ($B < C$), increases in labor supply (μ_E) will (weakly) increase the use of NCAs for a given l: NCAs will be used *only* when $\mu_E > \hat{\imath}(l)$. Holding all other parameters fixed, this inequality is satisfied more easily the larger the value of μ_E. This is illustrated in Figure A.3. An outward shift in labor supply causes the marginal firm to be one for which NCAs are optimal, resulting in an equilibrium in which all firms use NCAs. This result stands in contrast to the environment in which NCAs maximize pairs' surplus ($B > C$). In that case, NCAs are used regardless of the measure of labor supply.

Whether contracts have $A = 1$ in equilibrium is also a function of l, which is clear from the condition $\gamma(\mu_E)P - \pi_R < l$. Holding all else equal, a more binding utility transferability constraint (greater l) will induce NCA use (if $B < C$). This result is illustrated in Figure A.4. An increased transferability limitation causes the marginal firm to be one for which NCAs are optimal, resulting in an equilibrium with NCAs which reduce pairs' surplus. Again, this



(a) When l is low, the marginal firm is one for whom a contract with no NCA is optimal. The market contract is $\{w_0^*, 0\}$.

(b) When l increases to l', the marginal firm becomes one for whom a contract with an NCA is optimal. The market contract is $\{w_1^*, 1\}$.

Figure A.4: The effect of a change in l.

stands in contrast to the environment in which NCAs maximize pairs' surplus ($B > C$), in which case NCAs are used regardless of changes in the transferability of utility.

These observations are summarized in the predictions of Section II.

A.5 Model Extensions

We make note of two extensions to the model presented in this section, both of which apply directly to our empirical results. In the first extension, we consider the minimum wage as one outright constraint on monetary utility transferability. On the one hand, a greater minimum wage may provide more desirable employment opportunities in different labor markets (increasing π_E); on the other hand, it could decrease the probability that an individual is able to find a job (decreasing π_E). We discuss this extension in Appendix A.5.1. In the second extension, we consider a framework in which employer benefit of NCAs may be heterogeneous. We discuss this extension in Appendix A.5.2.

A.5.1 The Theoretical Impact of Changes in the Minimum Wage on NCA Use

One outright constraint on monetary utility transferability is a minimum wage. An increase in the minimum wage will increase NCA use insofar as it decreases transferability via the wage, as explained in Prediction 2. However, the minimum wage may also affect the terms of trade in the market by influencing an E's outside option, π_E. On the one hand, a greater minimum wage may provide more desirable employment opportunities in different labor markets (increasing π_E); on the other hand, it could decrease the probability that an individual is able to find a job (decreasing π_E). As increases in π_E act similarly to decreases in μ_E, an increase in the minimum wage that raises an employee's outside option will decrease NCA use. Therefore, for any increase in the minimum wage, the overall effect on NCA use will depend on the relative magnitudes of its effect on transferability and the outside option. Whenever the impact on transferability dominates the net impact on an employee's outside option, NCA use will increase.

Suppose that utility transferability and the employee's outside option are both functions of the minimum wage, m: $l(m)$ and $\pi_E(m)$. We assume that $l'(m) > 0$: increases in the minimum wage unambiguously decrease monetary utility transferability. When $B < C$, the condition that ensures that equilibrium contracts have $A = 1$ ($\gamma(\mu_E)P - \pi_R < l(m)$) is not a function of $\pi_E(m)$. Since $l'(m) > 0$ by assumption, increases in m allow this condition to be satisfied more easily: the willingness to pay of R_{μ_E} is more easily bound by l. Thus, increases in the minimum wage may only increase NCA use through this channel, which we call the Bindingness Effect (BE).

Changes in m also affect Assumption 2. If an increase in m causes a decrease in $\pi_E(m)$, the assumption will continue to hold unambigiously if m increases. However, if an increase in m causes an increase in $\pi_E(m)$ (such as, for example, if the employee may easily find a job in another industry that pays the minimum wage), the assumption may be violated if the corresponding increase in productivity of $\hat{\imath}(l(m))$ is not large enough. We call these two competing effects the Outside Option Effect and the Transferability Effect, respectively. A sufficient condition for increases in the minimum wage not to decrease NCA use is that the Transferability Effect (TE) dominates the Outside Option Effect (OOE):

Proposition A.2. *Suppose that there exists an equilibrium in which $B < C$ and $A = 1$ in* *all contracts when the minimum wage is m. If the minimum wage increases from m to $\tilde{m}$, in the new equilibrium, $A = 1$ in all contracts if the TE dominates the OOE: $l(\tilde{m}) - l(m) \geq \pi_E(\tilde{m}) - \pi_E(m)$.*

Proof of Proposition A.2. By Proposition A.1, $\mu_E > \hat{\imath}(l(m))$, since the equilibrium under m has $A = 1$ in all contracts. Since $l'(m) > 0$ and $\tilde{m} > m$, $l(\tilde{m}) > l(m)$, and therefore $\hat{\imath}(l(\tilde{m})) < \hat{\imath}(l(m))$. So, $\mu_E > \hat{\imath}(l(\tilde{m}))$. Thus, if Assumption 2 is satisfied under $\tilde{m}$ when the TE dominates the OOE, the equilibrium will have $A = 1$ in all contracts.

Assumption 2 under m states that $\gamma(\hat{\imath}(l(m)))P + B - \pi_R > \pi_E(m) + C$, which is equivalent to $l(m) + B > \pi_E(m) + C$ by the definition of $\hat{\imath}(l(m))$. Adding $l(\tilde{m}) - l(m)$ to the left hand side and adding $\pi_E(\tilde{m}) - \pi_E(m)$ to the right hand side preserves the inequality, since the TE dominates the OOE. Reducing, we are left with

$$l(\tilde{m}) + B > \pi_E(\tilde{m}) - C$$

$$\gamma(\hat{\imath}(l(\tilde{m}))) + B - \pi_R > \pi_E(\tilde{m}) - C,$$

which is Assumption 2 under $\tilde{m}$. Therefore, all contracts have $A = 1$ in equilibrium under $\tilde{m}$. □

The interpretation of Proposition A.2 is straightforward. As long as a one dollar increase in the minimum wage does not increase an employee's outside option by *more* than one dollar, NCA use will not decrease. If NCAs were not used prior to an increase, they may be used after if the conditions of Proposition A.1 become satisfied. Assumption 2 may become satisfied if the TE outweighs the OOE, or the BE may cause the inequality $\gamma(\mu_E) - \pi_R < l(m)$ to hold. We test Proposition A.2 in Section IV.B.3.

A.5.2 Heterogeneous Employer Benefit of NCAs

To this point, we assumed that the benefit of NCA use, B, was constant across employers. However, it is plausible that the benefits of NCA use vary across different types of employers;

it is thus constructive to assess how our model's predictions change allowing for heterogeneity in B. In Section IV.C, we empirically examine the role of an explicit source of heterogeneity in B: the capacity of employers to invest in the productivity of their workers. This section serves as a template for that analysis.

For simplicity, we consider two types of R. Let B^H and B^L (where $B^H > B^L$) be the exogenous values of NCAs to R who derive high and low benefit, respectively. We assume that an employer's level of B is independent of the productivity of its firm, γ. Let μ_E^H and μ_E^L be the endogenous measures of employees who ultimately form firms with H and L type Rs. Assuming all E match with Rs, it will be true that $\mu_E^L = \mu_E - \mu_E^H$. We have thus added one endogenous parameter to the model; the corresponding new equilibrium condition is that match stability now requires that each E will receive equal utility from matching with an H or L type R. With this new equilibrium condition, what remains to be shown is how heterogeneity in B affects the relationship between NCA use and the bindingness of wage constraints.

In some cases, heterogeneity in B cleanly follows the preceding analysis without heterogeneity. If $B^H > B^L > C$, NCAs will be used at all firms, independent of the values of l and μ_E. Wages will be identical for all workers (by the new equilibrium condition). Similarly, if $C > B^H > B^L$, NCA use will be identical across R. This is because $\hat{\imath}$ (the i such that the participation constraint of all $i > \hat{\imath}$ requires an NCA) is not defined by B. Thus, differences in NCA use across firms can only be due to one of μ_E^H and μ_E^L being less than $\hat{\imath}$ and one being greater. A simple thought experiment shows this cannot be the case. Suppose, for example, that $\mu_E^H < \hat{\imath}$ and $\mu_E^L > \hat{\imath}$. The utility of an E matched with an H type R will be $w^H > l$. The utility of an E matched with an L type R will be $w^L - C$, where $w^L < l + B^L$ (the greatest wage that would be paid before the marginal L type would prefer to switch to $A = 0$). Since $C > B_L$, the utility of an E matched with an L type will be less than that of an E matched with an H type. This violates the condition that E receives equal utility from matching with either type of R, so there will be no differential NCA use when $C > B^H > B^L$.[8]

The case that remains is when $B^H > C > B^L$. In this case, H types always use NCAs (following reasoning identical to when B is homogeneous), and firms with H types will achieve first-best levels of pairwise surplus independent of transferability limitations. On the other hand, NCA use among L types will be determined by the market: increased bindingness of transferability limitations induce greater NCA use. As in the case of homogeneous B and $B < C$, firms with B^L will not achieve first-best pairwise surplus if they use NCAs in equilibrium, including a subset of inframarginal firms for which contracts without an NCA are feasible and would result in greater pairwise surplus. Wages will adjust such that workers are indifferent between working at B^H or B^L firms: $w(B^H) + C = w(B^L)$. The details of these findings parallel the proof of Proposition A.1, with some additional technicalities.

It is straightforward that Rs with $B = B^H > C$ always choose $A = 1$: it is always a profitable deviation to include an NCA in the contract and compensate the worker exactly C.

For the logic contained in the proof of Proposition A.1 to hold for L type Rs when $C > B^L$ is heterogeneous, it must be shown that A's relationship with l and μ_E are the same as in the primary analysis.

Since $\hat{\imath}(l)$ is not determined by B, the role of l remains the same: when $\mu_E^L > \hat{\imath}(l)$ (as opposed to μ_E in Proposition A.1), $A = 1$ for all firms with B^L. However, μ_E^L is endogenous. The qualitative statement of Proposition A.1 is that high values of μ_E induce NCA use. Here, it is clear that high values of μ_E^L induce NCA use, so it need only be shown that μ_E and μ_E^L are positively related (i.e., increases in μ_E induce increases in μ_E^L). Once that is shown, the qualitative statement of Proposition A.1 holds in the case of heterogeneous B.

[8] It could be the case that there are differences in NCA use across employers when $C > B^H > B^L$ if we relax the assumption that B is independent of γ. Differences will only occur if higher productivity firms gain *less* benefit from NCAs than lower productivity firms. Consider the alternative (that higher productivity firms also get higher benefit from NCAs). Since the marginal firm is always the lowest productivity firm, higher productivity firms with higher benefit from NCAs would always follow the market-setting marginal firm (with low B) that uses NCAs. Therefore, if high productivity firms gain *greater* benefit from NCA use than low productivity firms, the analysis described above is unchanged.

Define $\mu_E^L(\mu_E)$ as the implicit function relating the equilibrium value of μ_E^L to the exogenous parameter μ_E, holding all else fixed. We seek to show, then, that $\frac{d\mu_E^L}{d\mu_E} > 0$.

We consider the two possible equilibria separately: first, when $A = 1$ for H types and $A = 0$ for L types, and second, when $A = 1$ for both types. First, consider the potential equilibrium in which H type firms use NCAs and L types do not. The equilibrium condition introduced in Section A.5.2 states that E must receive equal utility across R types. Let w^H be the wage paid by H types and w^L be the wage paid by L types. Then this condition states that $w^H - C = w^L$. Since w^H and w^L solve their respective firms' problems, they are given by labor demand, and this condition expands to:

$$\gamma(\mu_E^H)P + B^H - \pi_R - C = \gamma(\mu_E^L)P - \pi_R$$

$$\frac{B^H - C}{P} = \gamma(\mu_E^L) - \gamma(\mu_E^H)$$

$$\frac{B^H - C}{P} = \gamma(\mu_E^L) - \gamma(\mu_E - \mu_E^L), \tag{5}$$

where the last step follows because $\mu_E^H = \mu_E - \mu_E^L$. Equation 5 defines the equilibrium value of μ_E^L.

Implicitly differentiating with respect to μ_E yields:

$$\gamma'(\mu_E - \mu_E^L(\mu_E))\left(1 - \frac{d\mu_E^L}{d\mu_E}\right) = \gamma'(\mu_E^L(\mu_E))\frac{d\mu_E^L}{d\mu_E}$$

$$\frac{d\mu_E^L}{d\mu_E} = \frac{\gamma'(\mu_E - \mu_E^L(\mu_E))}{\gamma'(\mu_E^L(\mu_E)) + \gamma'(\mu_E - \mu_E^L(\mu_E))}$$

Since $\gamma'(\cdot) < 0$, $\frac{d\mu_E^L}{d\mu_E} > 0$.

In the second possible equilibrium (when $A = 1$ for L type Rs), Equation 5 becomes

$$\frac{B^H - B^L}{P} = \gamma(\mu_E^L) - \gamma(\mu_E - \mu_E^L),$$

and the proof is otherwise identical.

Since the equilibrium value of μ_E^L is positively related to μ_E, the qualitative predictions of Proposition A.1 hold for R with $B = B^L$.

Ultimately, this extension shows that how labor market conditions affect firms' NCA use depends on how much the firm benefits from using NCAs. As long as C falls in the range of employers' benefit, employers who benefit most from NCAs will use NCAs independent of labor market conditions. Employers who benefit the least will only use NCAs when wage constraints are more binding. This extension yields a natural empirical prediction that we test in Section IV.C.

A.6 Discussion: Assessing the Model's Explanatory Power

The empirical results in Sections IV and V all support our model's predictions that limitations to transferability via the wage drive NCA use among firms in which the net benefit of NCAs is negative. In this section we briefly consider whether factors outside of our model could instead be driving the relationships we observe in the data.

We considered the role of heterogeneity in employers' benefit of NCAs—theoretically in Appendix A.5.2 and empirically in Section IV.C—but it is also plausible that the *cost* of NCAs is heterogeneous across workers. Could such heterogeneity confound our model's empirical predictions? We argue the answer is no. Certainly, in the presence of heterogeneous C, shifts in μ_E could change the marginal worker's C. If $C > B$ for most inframarginal workers, but an outward shift in μ_E makes it more likely that the marginal worker has a low enough C such that his $C < B$, then an outward shift in μ_E could increase NCA use. This increase would not be because of wage constraints, but rather because the shift makes it more likely that surplus-enhancing NCAs can be written.

Taken seriously, this concern might cast doubt on one of the results found in Section IV.A: that an increase in the number of applicants for a position increases NCA use. However, it is largely inconsistent with the findings that higher unemployment and a higher minimum wage increase NCA use. In order for heterogeneous C to drive the unemployment result, it would need to be the case that the increase in unemployment is due to an increase in labor supply (without enough labor demand to meet it). If, instead, the increase in unemployment was due to a decline in labor demand (which it indeed was over the Great Recession, as discussed in Section IV.B), the opposite prediction would hold: that the marginal worker is more likely to have high C. Furthermore, heterogeneity in C has no bearing on our predictions regarding changes in l (the transferability constraint). If l increases, if anything it should be *less* likely that the marginal worker has a low C (since equilibrium employment, if anything, declines). Thus, we do not see heterogeneity in C as a threat to empirical tests of our model's predictions.

A distinct but related extension would be if C is *endogenous* to market conditions. For example, if we introduced frictions to make ours a search and matching model of the labor market, or if we introduced multiple periods to make ours a dynamic model, the terms of trade and the transferability constraint could directly affect workers' perceived costs of signing an NCA. First, consider the terms of trade. On one hand, lower terms of trade (due, for example, to higher unemployment) could mean that a worker finds it less likely that he could find a better-paying job through on-the-job-search, making it less costly to sign an NCA (and more likely that an NCA maximizes joint surplus). On the other hand, if the worker expects the terms of trade to improve in the future, then an NCA would be *more* costly when the terms of trade are low. Given extensive prior literature that workers leverage improvements in their outside option over the course of their tenure (**?**), the latter seems more likely. Thus, endogenizing C to the terms of trade would not yield a clear confound to our prediction about shifts in labor supply, and if anything would likely go *against* the relationship we observe. Second, consider the transferability constraint. Because increases in l might raise workers' value of employment in other labor markets (as explained in Appendix A.5.1), increases in l would if anything increase C, decreasing NCA use (going against our model's predictions). Thus, it is unlikely that endogenizing C could create empirical relationships that we would wrongly attribute to our model's predictions, and if anything it would create patterns that work *against* us finding relationships that our model predicts.

B Details About Sample Construction

B.1 Pipeline to Analysis Sample

As described in Section III, we estimate that roughly 705 salon owners to whom our survey invitation was sent clicked on the email with the survey link. 311 owners clicked on the link to begin the survey.

Table B.1 details the pipeline through which we ended up with a sample of 218 owners who completed the survey. Of the 311 that clicked on the link, 279 clicked past the initial consent page and began the survey. All but 8 of these individuals answered our first question: "For how many years have you been in the salon industry?" The mean response was 26 years and 27.4 years among those that did not and did complete the survey, respectively, and a t-test suggests these means are not statistically significantly different from each other ($p = .49$).

Of the 279 that began the survey, 245 (27 that did not complete the survey) clicked past the second page that described how the following questions would ask about some business aspects of their salon. Two key questions that were asked on this page were "How many stylists work in your salon" and "What was your salon's revenue in 2014?" Those that did not complete the survey have fewer stylists (3.56 vs. 7.18 for those that finished, $p = .04$), and have slightly less revenue.

Of the 245 that began answering business-related questions, 234 (16 that did not complete the survey) clicked past the page that revealed the following pages would ask questions about the owner's experience using various types of employment and hiring contracts (with no mention yet of questions regarding NCA use). Among these, the percent of respondents that hired stylists as employees (rather than independent contractors) was not statistically significantly different between those that did not and did complete the survey (44% and

48%, $p = .73$).

Finally, 224 (six that did not complete the survey) made it to the page that revealed that the following questions would deal with owners' use of NCAs. This was the first point at which respondents were told that they would be answering questions about NCAs, as it was not mentioned in the email invitation nor anywhere previously in the survey.

Thus, while our final sample of 218 completed respondents is certainly a selected sample, it does not appear to differ in a systematic way from those owners that began the survey but did not finish it, other than being larger in terms of number of stylists working. There also are at most 6 respondents who might have purposely chosen not to respond to avoid answering questions about NCAs.

B.2 Re-Weighting to Match the Population Distribution of Salons

While our survey contains salons in 139 counties in 40 states, the geographic distribution of our respondents does not reflect the population distribution of hair salons. To ensure our results reflect forces that affect the typical hair salon in the U.S., and not just the typical salon in our sample, we re-weight our observations so that our sample better reflects the distribution of the population of hair salons. We create a weight that is equal to the number of hair salons in a respondent's county as of 2013 (according to the County Business Patterns), divided by the number of salons in a respondent's county that responded to our survey. For example, we had seven respondents from Cook County, IL, and there are 1,404 salons in Cook County; each respondent located in this county gets a weight of 200.6.

In Table B.2, we recreate Table 2, except that our regressions weight each observations with the weight just described. The coefficient on *# Applicants* is slightly smaller than the baseline specification in Table 2, but the coefficient and statistical significance actually slightly *increase* for *Change in Local Unemployment Rate* and *Tipped Minimum Wage*.

Overall, these results illustrate that our estimates reflect effects that pertain to the general population of our industry under study, and not just to the distribution of respondents to our survey.

Table B.1: Pipeline to Analysis Sample

	N	N not completed	N completed	Mean, not completed	Mean, completed	p-value on difference in means
Clicked on email	311	93	218			
Began survey	279	61	218			
Years in beauty industry		56	215	26.04	27.43	0.49
Provided geographic information	270	52	218			
Began business questions	245	27	218			
Number of stylists working in salon		27	203	3.56	7.18	0.04
Salon annual revenue (000s)		25	208	284.00	381.13	0.24
Opened page on employment and hiring	234	16	218			
Emp-based salon		16	218	0.44	0.48	0.73
Opened page on NCAs	224	6	218			

Table B.2: Main Results, Weighting Observations to Better Reflect Population Distribution

	(1)	(2)	(3)	(4)	(5)
		DV=last hire signed NCA			
# applicants for last vacancy	0.0066			0.0065	0.0074
	(0.0044)			(0.0043)	(0.0048)
Change in local Unemployment Rate 2006-2012		0.057		0.033	0.016
		(0.023)**		(0.026)	(0.022)
Tipped Minimum Wage, 2014			0.042		0.039
			(0.016)**		(0.015)**
Bishara State NCA score, standardized	0.26	0.31	0.44	0.31	0.47
	(0.11)**	(0.11)***	(0.12)***	(0.10)***	(0.088)***
Observations	195	218	218	195	195
R^2	0.137	0.108	0.112	0.146	0.173
Mean Dep Var	0.303	0.298	0.298	0.303	0.303
Cluster	none	CZ	state	CZ	state

The dependent variable is a dummy equal to 1 if the most recently hired stylist signed a NCA.
Bishara score is a standardized measure of each state's enforceability of NCAs.
All regressions control for: Bishara score (a standardized measure of each state's enforceability of NCAs), the percent of a salon's stylists hired directly out of school, a dummy for employment-based salons, the owner's age, the number of stylists working in the salon, and the number of salons in a respondent's county.
Linear Probability Model. Robust SEs, clustered at the level designated in the footer, in parentheses.
***P<.01., **P<.05, *P<.1

C Further Details on Replication and Extension of Dube et al. (2016) and Meer and West (2016)

In this section, we provide more details of our replication and extension of the two studies of the employment effect of the minimum wage, discussed in Section V.

In our extension of Dube et al. (2016), we start with the regression:

$$y_{ipt} = \beta ln(MW_{s(i)t}) + \mathbf{\Gamma X_{it}} + \delta_i + \rho_{pt} + \epsilon_{it} \tag{6}$$

Here, y_{ipt} refers to log employment in county i that is part of pair p (with another cross-border contiguous county j) at time t. The minimum wage variable[9] is set at the level of the state, $s(i)$, and $\mathbf{X}$ includes a vector of time-varying controls. δ_i is a fixed effect for each county, and ρ_{pt} is a fixed effect for each pair-time. Thus, Equation 6 estimates the elasticity of employment with respect to the minimum wage (since both employment and the minimum wage are log-transformed), comparing adjacent border counties in the same time period, and purging the data of county-specific effects. Standard errors allow for two-way clustering by state, $s(i)$, and border-pair, p.[10]

Dube et al. (2016) measure quarterly employment using the Quarterly Workforce Indicators (QWI) from the Census Bureau, and they use state and federal changes to the minimum wage over 2000-2011 to identify changes to the minimum wage. They perform their analysis separately for teens and for restaurant workers, two groups considered in the literature to typically be bound by the minimum wage. We restrict attention to restaurant workers.[11]

[9] Following Dube et al. (2016), we use the standard (untipped) minimum wage in this section.

[10] We obtain standard errors that are slightly different from those reported in Dube et al. (2016). This difference arises because we use an updated procedure (the Stata command -reghdfe-) to estimate a regression with multiple fixed effects that allows for multi-way clustering, based on Correia et al. (2016).

[11] The restaurant industry is a ripe setting to test the effects of NCA enforceability, as recent evidence highlights that NCAs are common in this industry. The recent scandal over Jimmy Johns (a fast-food sandwich chain) using NCAs for minimum wage workers is one salient example. A website targeted to restaurant professionals has a post, dated 4/7/2018, describing why it is important for restaurant owners to include NCAs in employees' contracts (`https://pos.toasttab.com/blog/restaurant-employment-agreement`, accessed 2/1/2019).

To test Prediction 3, we examine whether the overall effect this study finds is moderated by states' enforceability of NCAs. In states in which NCAs are unenforceable (like California), they are likely a less valuable tool to transfer utility than in states where they are highly enforceable (like Florida).[12] We adapt Equation 6 the following way:

$$y_{ipt} = \beta_1 ln(MW_{s(i)t}) + \beta_2 ln(MW_{s(i)t}) \times Enforce_{s(i)} + \mathbf{\Gamma X_{it}} + \delta_i + \rho_{pt} + \epsilon_{it}$$

Enforce is the standardized state NCA enforceability score from Bishara (2010), described above[13] Here, the coefficient β_2 estimates the differential effect of a minimum wage increase for a state with the highest NCA enforceability relative to a state with the lowest enforceability; the coefficient β_1 estimates the effect of the minimum wage increase for a state with the lowest enforceability. Note that we do not include a main effect for *Enforce* because, since it is constant within counties, it is absorbed by the county fixed effects.

The second study that we replicate and extend is Meer and West (2016). As part of their analysis, Meer and West (2016) use a standard two-way fixed effects difference-in-difference model to estimate the effect of the minimum wage on employment. While both Meer and West (2016) and Dube et al. (2016) critique the two-way fixed effects method of estimating the employment effect of the minimum wage, it is a "classic" specification used in many papers throughout the literature; it thus serves as a means to ensure that the effects of NCA policy that we estimate are not specific to the elements of a particular study design.

[12] NCA enforceability could theoretically change the employment effect of the minimum wage for reasons other than allowing transferability of utility. However, plausible alternative explanations yield an opposite prediction to our own. For example, stricter NCA enforceability could mean workers that lose their job after a minimum wage increase stay non-employed for a longer duration because they are unable to take a new job that violates their prior NCA. However, this story implies that stricter enforceability leads to a *larger* effect of the minimum wage on employment, which is the opposite of our model's prediction.

[13] Note that there have been changes to NCA enforceability over the relevant time period. Hausman and Lavetti (2019) find 52 changes to NCA enforceability over the period 1991 to 2011. For simplicity, our estimates use the 2009 enforceability score. However, we obtain essentially identical estimates if we use the 1991 enforceability score.

Following Meer and West (2016), we start with the standard two-way fixed effects model:

$$ln(emp)_{it} = \beta_1 ln(MW)_{it} + \alpha_i + \tau_t \times \rho_r + \psi \mathbf{X_{it}} + \epsilon_{it} \tag{7}$$

We replicate the estimate in Column 3 of Table 2 in Meer and West (2016). The variable emp_{it} is annual employment in state i in year t and comes from the Business Dynamics Statistics. MW_{it} is the state minimum wage, and X_{it} is a set of state-level time-varying controls including log-population, the share aged 15–59, and log real gross state-product per capita. State fixed effects are represented by α_i, and $\tau_t \times \rho_r$ represents a fixed effect for each year by Census region.[14]

To estimate whether the employment effect of the minimum wage is heterogeneous based on NCA enforceability, we modify this equation as follows:

$$\begin{aligned} ln(emp)_{it} =& \beta_1 ln(MW)_{it} + \beta_2 ln(MW)_{it} \times Enforce_{it} + \alpha_i \\ &+ \tau_t \times \rho_r + \tau_t \times Enforce_t + \psi \mathbf{X_{it}} + \epsilon_{it} \end{aligned} \tag{8}$$

As with our analysis above, β_1 estimates the employment effect of the minimum wage in a state in which NCAs are the least enforceable, and β_2 estimates the differential effect for a state in which NCAs are most easily enforceable.

[14] The results that follow are essentially unchanged if we use any of the other specifications in Columns 1–4 of Table 2 in Meer and West (2016).

D Appendix Tables and Figures

Table D.1: State Tabulation

State	Number	State	Number
AL	5	MT	1
AZ	3	NC	3
CA	54	NE	1
CO	5	NH	1
CT	4	NJ	5
DC	1	NM	1
FL	15	NV	1
GA	3	NY	9
IA	3	OH	5
IL	19	OK	1
IN	7	OR	2
KS	2	PA	10
KY	2	RI	1
LA	2	SC	1
MA	4	SD	1
MD	5	TN	2
ME	2	TX	9
MI	3	VA	5
MN	4	WA	3
MO	6	WI	7
		Total	218

Table D.2: Characteristics of Employers that Did and Did Not Use NCA for Most Recent Hire

	(1) Last Hire NCA	(2) Last Hire No NCA	(3) Difference (1)-(2)
Num stylists working in salon	8.35	6.62	1.73
	(7.91)	(9.12)	
Salon 2014 annual revenue, 000s	376.12	380.23	-4.10
	(336.04)	(412.53)	
% of stylists hired out of school	51.97	38.24	13.73**
	(36.18)	(36.19)	
Appointment only	0.26	0.35	-0.08
	(0.44)	(0.48)	
Years in beauty industry	26.71	27.69	-0.98
	(14.68)	(12.69)	
Age of owner	49.61	51.49	-1.88
	(11.72)	(9.84)	
Emp-based salon	0.66	0.41	0.26***
	(0.48)	(0.49)	
Bishara State NCA score, standardized	0.71	0.58	0.13***
	(0.30)	(0.34)	
Line of Credit	0.62	0.45	0.16**
	(0.49)	(0.50)	
# applicants for last vacancy	9.98	5.41	4.57***
	(12.54)	(7.22)	
# applicants fewer than usual	0.31	0.31	0.00
	(0.47)	(0.46)	
# applicants same as usual	0.49	0.50	-0.01
	(0.50)	(0.50)	
# applicants more than usual	0.09	0.10	-0.01
	(0.29)	(0.31)	
Num beauty salons in county, 2013	352.75	405.69	-52.93
	(431.65)	(530.61)	
N	65	153	

Variable means with standard deviations in parentheses. Revenue, Number of Applicants, and Number of Salons in County topcoded at 99th percentile.

Table D.3: The Relationship Between Within-Owner Shifts in Labor Supply and Within-Owner Changes in NCA Use

	(1)	(2)
	DV=change in NCA use	
# applicants more than usual	0.12	0.12
	(0.083)	(0.094)
Observations	195	195
R^2	0.008	0.092
Mean Dep Var	0.036	0.036

The dependent variable is the difference between a dummy indicating whether an owner had its most recently hired stylist sign an NCA, and a dummy indicating whether the owner reported using NCAs prior to its most recent hire.
Number of applicants more is a dummy if the number of applicants the owner received for its most recent vacancy was more than it received for similar vacancies in the past.
All regressions control for: Bishara score (a standardized measure of each state's enforceability of NCAs), the percent of a salon's stylists hired directly out of school, a dummy for employment-based salons, the owner's age, the number of stylists working in the salon, and the number of salons in a respondent's county.
Linear Probability Model. Robust SEs in parentheses.
***P<.01., **P<.05, *P<.1

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