The Employment Effects of Non-compete Contracts: Job retention vs. Job creation

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Abstract

This paper studies the labor market effects of Non-Competition Agreements (NCAs) that constrain employee mobility, in a search model featuring random hiring and endogenous separation. As Non-competition clauses limit the job opportunities of the worker, an unemployed worker bound by NCAs has a lower job finding rate relative to the one unconstrained. Moreover, since NCAs encourage firm investment by lengthening job tenure, they are preferably chosen by firms and therefore induce the latter to open vacancies in the economy with a higher probability of signing NCAs. Hence, on the one hand, the average job finding rate increases with NCAs incidence through higher labor tightness. On the other hand, higher NCAs incidence raises the proportion of job seekers constrained by NCAs, making tough vacancy filling. Therefore the average job finding rate drops through decreasing labor tightness. The model calibrated to the US economy implies a decreasing job finding rate with NCAs incidence, consistent with evidence found in the US data. This fact appears as a trade-off for a lower job separation rate and higher firm investment in worker human capital implied by higher NCAs incidence. In equilibrium, the model predicts a higher unemployment rate associated with higher enforceable NCAs incidence in the economy. In addition, the paper shows that a restriction on the NCAs duration is welfare improving.

JEL Classification: J41, J24, J64

Keywords: Non-compete agreements, training, labor-market

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1 Introduction

There is a pronounced interest in a general reduction in competition among firms, shifting the balance of bargaining power toward employers (Furman and Orszag (2018)). Barriers to competition tend to reduce efficiency and lead to lower output, employment, and wage growth. Among competition impediments, Non-compete agreements (hereafter NCAs) in employment contracts and their labor market implications have become the focus of a heated controversy in the US media and political arena (Krueger and Ashenfelter (2018)). These contracts which prevent an employee from joining rival firms for a defined duration have spread in the U.S. labor market. Indeed, a survey conducted by Prescott et al. (2016) shows that NCAs bound about 20% of U.S. workers in 2014. Moreover, data from the National Longitudinal Survey of Youth reveal that about 17% of the active young population aged 33-34 were constrained by NCAs in 2017. Often justifiable for protecting firm investments (Shi et al. (2019); Garmaise (2011); Meccheri (2009); Long (2004)), NCAs are now surprisingly used for low-paid job[1]. The

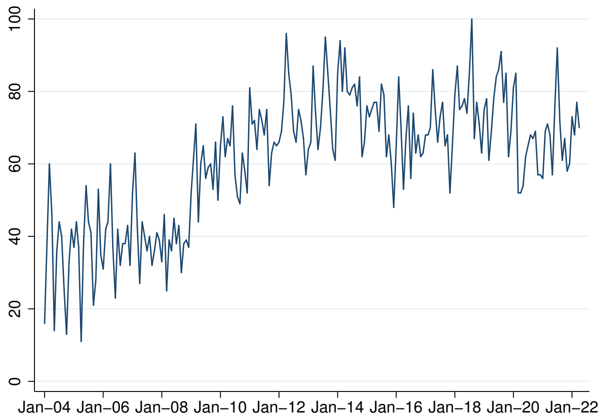


Figure 1: Google trend for the keyword 'Non compete agreement' in the US.

disagreement over the benefit of such contracts can be viewed through the call for NCAs reform by Obama's Administration in 2016[2] and also supported by Biden's one [3]. Similar debates exist in Austria and Canada with Ontario becoming the second

[1]Dave Jamieson, Jimmy John's making Low-Wage Workers Sign 'Oppressive' Noncompete Agreements, Huffington Post (Oct. 15, 2014) https://www.huffingtonpost.ca/entry/jimmy-johns-non-compete_n_5978180?ri18n=true

[2]Details at https://obamawhitehouse.archives.gov/sites/default/files/competition/noncompetes-calltoaction-final.pdf

[3]https://www.whitehouse.gov/briefing-room/statements-releases/2021/07/09/fact-sheet-executive-order-on-promoting-competition-in-the-american-economy/

jurisdiction in North-America to prohibit NCAs after California[4].

Despite this ongoing important debate, research on the equilibrium and welfare effects of NCAs contracts is only at an early stage. A reason is that detailed data on these labor contracts has only recently become available. The rare attempts on structural approach of understanding the NCAs equilibrium effects for informed policy design, focused particularly on managerial labor market (Shi et al. (2019)) or low-wage labor market (Potter et al. (2022)). This paper contributes to reconcile the existing works based on a random search and matching model and taking into account two important (different but complementary) dimensions of NCAs provisions : their incidence and enforceability. Our research is motivated by the significant correlations between NCAs incidence and aggregate labor market outcomes. Using data from the Longitudinal Employer-Household Dynamics (LEHD) and the Current Population Survey (CPS), I document that the transition rate from employment to unemployment is particularly low in U.S. states experiencing a high NCAs incidence. This relationship still holds at the national level across industries, suggesting that, on average, an employed worker experiences longer job tenure when she is more prone to sign non-compete agreements. More interestingly, the same pattern is observed for the transition rate from unemployment to employment, implying that, on average, job seekers are less likely to find jobs in an environment where most employment contracts signed include Non-compete clauses. Formally, I estimate that a ten percentage point increase in NCAs incidence significantly lowers the job-finding rate and the job separation to unemployment by 1.6 p.p and 0.25 p.p, respectively, ceteris paribus.

As robustness check, I take advantage of NCAs enforcement reform across States during the period 1992-2010 materialized in variation in State NCAs enforcement index (see Garmaise (2011)). Indeed, it is more likely that non-compete agreements are popular among companies with employees working in States where they are allowed. I mainly focus on Florida State with its change in NCAs enforcement in 1996 as a case study. Indeed, Florida's 1996 strengthening of NCAs enforcement offers an attractive case study compared to law changes in other states. Florida provides a close to the ideal site because (i) the legislation focused purely on restrictive covenants, notably NCAs, (ii) it was intended to strengthen enforcement in the state, and (iii) Florida

[4]see Ontario's Bill 27 on October 25, 2021

had a four-decade history with the laws governing non-competes, such that employers and employees were probably familiar with and accustomed to NCAs. The outcomes variables considered are the job destruction and job creation rates from the Business Statistics Dynamics provided by the U.S. Census Bureau. The analysis relies on the synthetic control method developed by Abadie et al. (2015) using the other States as a control group. As expected, the job flow rates drop after the reform. It suggests that higher enforceable NCAs contributes to reduce the labor market dynamism materialized by a fall in both job creation and destruction rates.

Motivated by these facts, I developed a job search model encompassing Non-compete contract signing at the hiring stage and in which firms optimally invest in worker human capital. In the model economy, the ex-ante homogeneous job seeker population becomes heterogeneous with respect to NCAs constraints after a transition from employment to unemployment. There is no on-the-job search [5]. The model mechanism is the following: As NCAs restrain the job opportunities of the worker, an unemployed worker bound by NCAs has a lower job finding rate relative to the one unconstrained. Moreover, since NCAs encourage firm investment by lengthening job tenure, they are attractive to firms and induce them to open vacancies in the economy with a higher probability of signing NCAs. Hence, on the one hand, the average job finding rate increases with NCAs incidence and enforceability through higher labor tightness. On the other hand, higher enforceable NCAs incidence increases the proportion of job seekers constrained by NCAs, which makes vacancy hard to fill. Therefore, the average job finding rate drops through decreasing labor tightness. The model calibrated to the U.S. economy implies a decreasing job finding rate with NCAs incidence, consistent with evidence found in data. This fact appears as a trade-off for a lower job separation rate and higher firm investment in worker human capital implied by higher NCAs incidence. In equilibrium, the model predicts a higher unemployment rate associated with higher enforceable NCAs incidence in the economy.
Moreover, the NCAs employment trade-off translates to the one between aggregate productivity enhancing and efficient level of unemployment rate, making the prediction of the efficiency of NCAs theoretically ambiguous. Our analysis suggests that a low level of NCAs incidence is desirable. The inefficiency arrives in our model economy

[5] Since our focus here is to explain the role of NCAs in the worker flow into and out of unemployment but not to explain the wage dynamics, the abstraction of on-the-job search is meaningful

mainly because too little job is created in high enforceable NCAs incidence environment. To reduce the inefficiency, we propose a cap on NCAs post-employment duration. One advantage of this policy is its simplicity and transparency (easily verifiable without cost for workers and firms)[6]. Results show that an average of NCAs duration capped at 6 months leads to a steady state welfare gains of about 0.8%. The gain is larger in a high NCAs enforcement regime.

This paper is complementary to the literature on the implication of NCAs in employment contracts both on the worker and firm sides. *On firm side* and in one hand, non-competes contracts encourage firms to invest in employee's human capital or training and hence facilitate innovation (Garmaise (2011); Meccheri (2009); Long (2004); Callahan (1985)). This paper contributes theoretically to this literature by showing numerically that NCAs partially help lessening the hold-up problem. However, unlike in Shi et al. (2019) considering Bertrand competition between three parties (Incumbent employer, employee, and new potential employer) a la Cahuc et al. (2006), this paper relies on the higher job tenure incentive generated by NCAs. On the other hand, NCAs may affect a firm's activities. In this sense, Starr et al. (2017), relying on the variation of NCAs enforcement intensity across U.S. states, found an ambiguous effect of NCAs on start-up activity. Two mechanisms are underlined. The first one refers to as a «screening effect »: Greater enforcement lowers the expected returns to spin-off activity by raising the probability of losing a lawsuit for violating the terms of a non-competition agreement. The second refers to the potential « investment protection effect » of NCAs that potentially stimulates start-up activity and employment growth. This paper embraces the same idea in the search and matching framework showing that the job creation relies on the training motive effect of NCAs (leading to higher job creation) and the proportion of job seekers constrained by NCAs (leading to lower job creation). First, as an empirical contribution, I show that the second effect dominates because the job-finding rate decreases in an environment of higher enforceable NCAs incidence. Second, the DMP model calibrated on the U.S. economy and relying on the mechanism above deliver qualitatively the same result. *On worker side*, Starr et al. (2019), using worker level data, argues that NCAs, by their chilling effect on worker mobility, slow wage dynamic in the labor msharket. This paper finds an ambiguous

[6]see Shi et al. (2019) for the same consideration

effect of enforceable NCAs incidence on wage due to the opposing effects on outside options and training in our DMP setup.

Since NCAs lead to a low separation rate and low probability to find a job, they generate two opposite effects on unemployment. To the best of my knowledge, this is the first paper to study the equilibrium effect of NCAs on the unemployment rate in the context of a search and matching model.

Finally, in terms of efficiency analysis of NCAs provisions, our work is closely related to Shi et al. (2019) and Potter et al. (2022). Our results aligned with the former, suggesting that a cap at NCAs duration is welfare enhancing whereas they are in opposition of the latter finding's in term of job creation effect of NCAs. We show that the trade-off of NCAs on employment leaned toward the negative side. Nevertheless, our findings have broader relevance comparatively.

The rest of the paper is organized as follows. Section 2 documents the relationship between the incidence of higher enforceable NCAs on aggregates job flows rates. Section 3 introduces the model. Section 4 provides a theoretical analysis of the effect of enforceable NCAs incidence on aggregates labor market outcomes. Section 5 presents the quantitative evaluation of the impact of higher NCAs incidence on job flows rates, investment, and equilibrium unemployment rate. Section 6 highlights the NCAs efficiency analysis following by a policy evaluation. Section 7 concludes.

2 Stylized facts

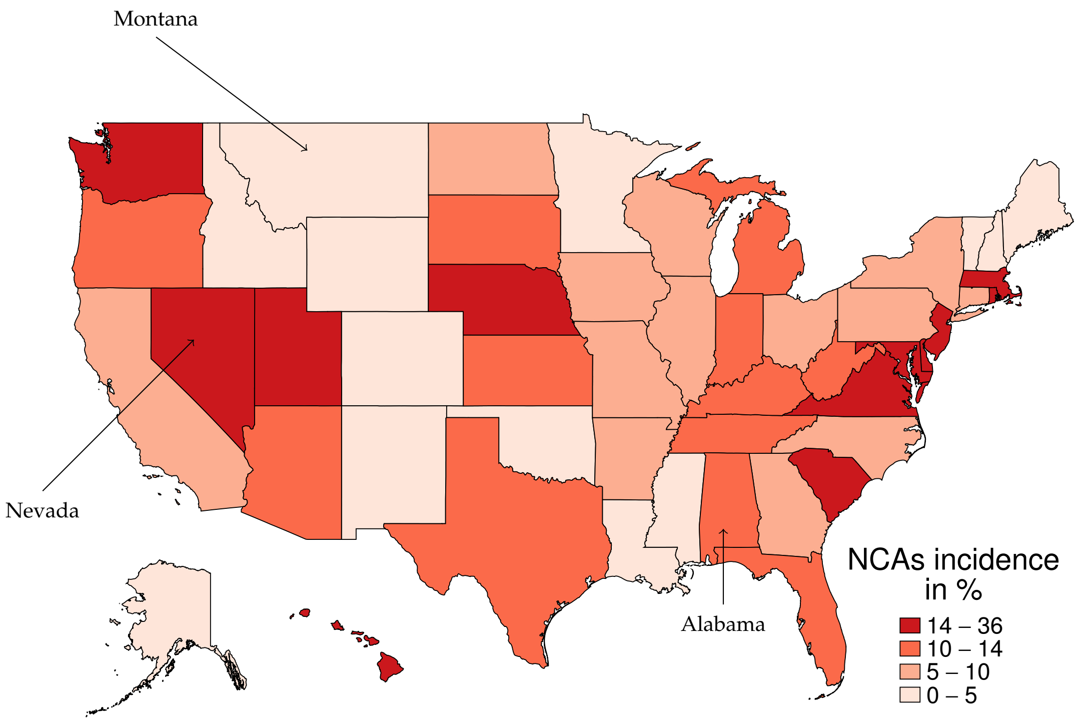
This section presents empirical evidence on the NCAs and their impact on the labor market. More precisely, we study the intertwined relationship between NCAs incidence and transition rates into and from employment.

Data on NCAs incidence come from the Non-compete survey in the US (Starr et al. (2019)). The survey was designed in 2014 to shed light on the use of NCAs in the US labor market. The data is representative of the US workforce and cover people aged between 18 to 75 who are either unemployed or employed in the private sector or a public healthcare system. It is, at this date, the only representative survey informing on the use of NCAs in the US. The final sample contains 11,505 respondents from all states, industries, occupations, and other demographic categories. I focus on the incidence of

NCAs, defined as the proportion of workers bound by an NCAs contract and measured at State level or industry level. The data report heterogeneity in the use of NCAs across States, industries, and education levels in the US. Particularly, figure 2 maps State level NCAs incidence in the US for the survey's year (2014). Darker shades of red encodes higher incidence. It highlights that States with NCAs incidence above 15% or below 5% can be found throughout the country. The cross-sectional standard deviation is 2.3 percentage points.

In addition to Non-compete survey data, I collect the NCAs enforceability index across

Figure 2: NCAs incidence across US States



States. The index scores the enforceability of the NCAs contracts based on legislation and case law. In other words, It measures, across states, the degree at which the Non-compete clauses effectively constraint worker who signed them, with a higher score indicating a strong NCAs enforcement. The NCAs enforceability index widely used in the literature comes from Bishara (2011)[7]. Nevertheless, I borrow the state-level weighted indices constructed by Starr (2019) and built on Bishara (2011) index for year

[7] Bishara (2011) looks at the following dimensions across jurisdictions: whether a State statute of general enforceability exists, the scope of employer's protectable interest, plaintiff's burden of proof, consideration provisions, modification of overly broad contracts, and enforceability upon firing.

2009 [8].

Data on the job flows rates come from the Longitudinal Employer-Household Dynamics (LEHD) program. I supplement those data with the Current Population Survey data to obtain at the micro-level, transition rates between unemployment and employment at a monthly based over time. I truncate the CPS data to the same period covered by the Non-compete survey. I depict the empirical evidence into two facts:

FACT 1: *On average, job separation rate decreases with NCAs incidence*

The panel (a) in Figure 3 shows a scatter plot of the proportion of workers bound by NCAs, named NCAs incidence (x-axis) and transition rate from employment to non-employment, (y-axis) across states and across industries in 2014. The plots show a decreasing pattern between the NCAs incidence and the job separation rate. The correlation coefficient is -0.51 with a standard error (s.e.) of 0.12 across States. This negative correlation is stronger across industries at the aggregate level (See panel (b)) with a correlation coefficient equals -0.65 and associated standard error of 0.20.

To formally test the relationship, I embed data on State-industry combination of NCAs incidence into the CPS data and exploit its panel dimension constructed as Shimer (2012). More precisely, I match individuals over two consecutive months in the CPS basic monthly files following Albert (2021) to compute job flow rates. As stressed before, NCAs incidence in State-industry combination data come from the Non-compete survey (Prescott et al. (2016))[9]. The exercise here is to understand how likely employed workers lose her job of transition to unemployment in a State-industry combination with a high incidence of NCAs.

I run the following linear probability specification:

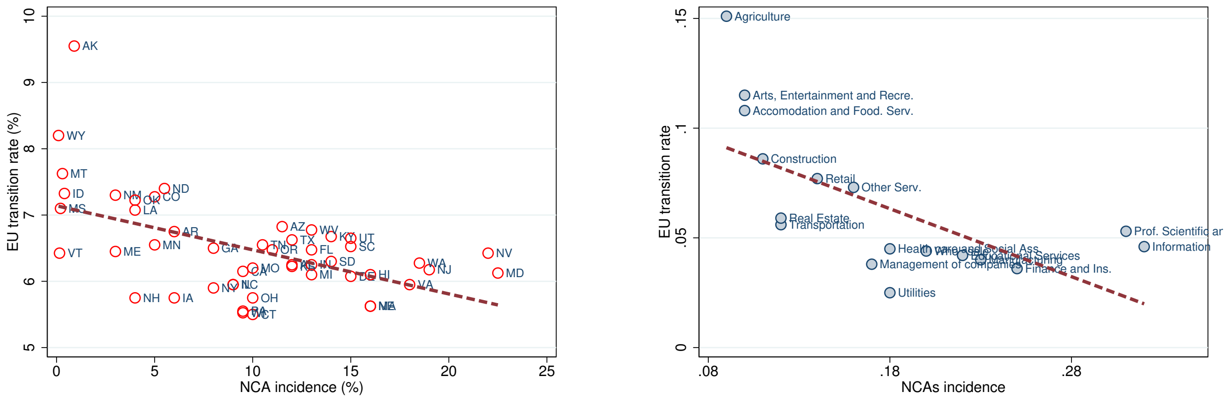
$$y_{isjot} = \alpha(\text{NCA incidence})_{sj} + X_i\beta + \eta_s + \varepsilon_{isjot} \tag{1}$$

where y_{isjot} is the outcome variable which is either the job separation event for the employed worker i in State s, industry j and occupation o happened in period t (a

[8] 2009 is the most recent year for which the index is constructed. Despite some recent changes in 2015 and 2016, which I view as non-significant, 2009 measures are a good proxy for the level of enforceability in 2014 (See Starr et al. (2019) for the same consideration)

[9] I thank Evan Starr for making these data available to me

Figure 3: NCAs incidence and job Separation rate in US, 2014



(a): States

(b): Industries

Notes: Panel (a) shows the relationships across States. Panel (b) highlights it across industries at 2-digit code using NAICS 2017. Across States, the correlation coefficient is -0.51 (s.e. 0.12) and -0.65 (s.e. 0.20) across industries. EU data come from LEHD, 2014 and NCAs incidence from Non-competes survey, 2014 (Starr et al. (2019)).

dummy variable equals 1 if EU transition occurs and 0 otherwise) or a job finding event for a job seeker. X includes worker demographics controls such as gender, race, education level, age, age squared and immigrant status. The specification also controls for State, industry and state by occupation fixed effects to ensure that any of those heterogeneity between worker explaining the transitions is a driving force. A period is a month, but I restrict the sample period years to 2012-2014 since the NCAs incidence measure comes from survey realized in 2014 [10]. Table 1 reports the regression results for the job separation rate. It shows that a ten percentage point increase in NCAs incidence (about one standard deviation in the State-industry NCAs incidence in our sample) lowers the job separation rate by 0.25 p.p, after controlling for State fixed effects and covariates. The result is statistically significant at 1% level. Columns 4 and 5 of the table 1 report that the negative and significant effect hold even after controlling for industry and State-occupation fixed effects.

However, what matters is not the incidence of NCAs per se but the incidence of enforceable NCAs. Hence, I interact the NCAs incidence with the index of NCAs enforcement across States. I normalized the index to California at 0 (lowest NCAs enforcement regime) and Florida at 1 (highest enforcement regime). Results are reported in table 4 in appendix A. It shows that the magnitude of the negative effect between NCAs incidence and the job separation rate is larger in higher-enforcement states.

[10] the results are robust to change of this period (only 2014 or 2013-2014)

Particularly, in a high-enforcement state like Florida, the magnitude of job separation decline amounts to 0.29 percentage point monthly comparative to a low-enforcement State like California. In sum, on average, an employed worker experiences longer job tenure when she is more prone to sign an enforceable Non-compete contract.

Table 1: NCAs incidence and job separation rate

	(1)	(2)	(3)	(4)	(5)
NCAs incidence	-0.026^{***}	-0.019^{***}	-0.025^{***}	-0.012^{***}	-0.006^{**}
	(0.0043)	(0.0038)	(0.0054)	(0.0021)	(0.0028)
Demographics	No	Yes	Yes	Yes	Yes
Year/state FE	No	No	Yes	Yes	Yes
State by occupation FE	No	No	No	Yes	Yes
Industry FE	No	No	No	No	Yes
N. Obs.	250876	250876	250876	250402	250402

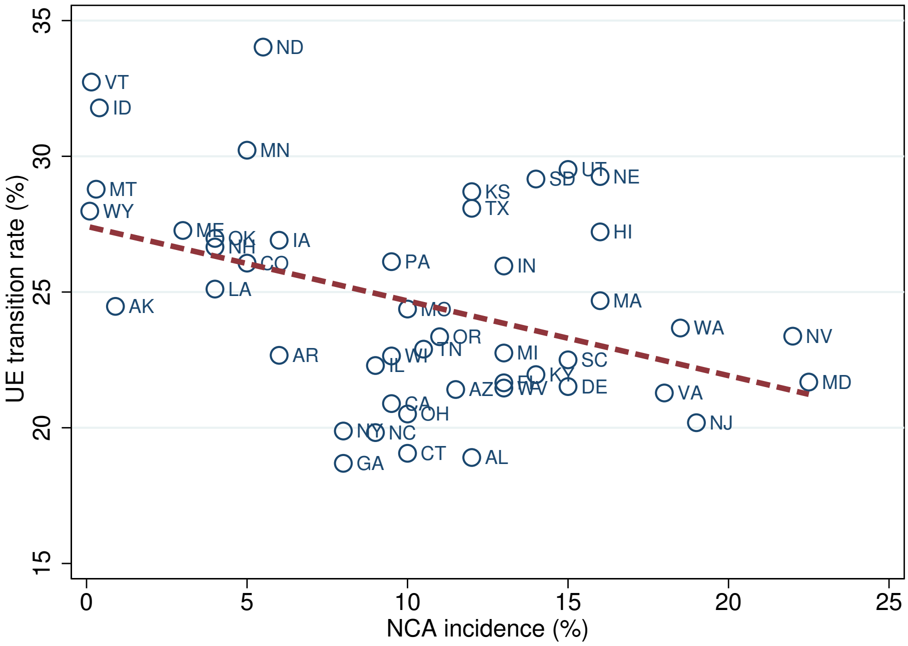
Note.- Dependent variable is the probability of a EU transition. Data come from the CPS monthly basic files 2012-2014. Demographic controls include *gender, race, age and age squared, education level and immigrant status*. Standard errors in parenthesis, clustered at state level.
$^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$

This fact is in line with previous studies (Shi et al. (2019), Starr et al. (2019)) and consistent with the nature and patterns of Non-compete agreements which are to impede worker mobility.

FACT 2: *On average, job finding rate declines with the NCAs incidence*

I next examine the relationship between job finding rate and NCAs incidence. Figure 4 shows a scatter plot of the job-finding rate against NCAs incidence across US states in 2014 using the panel dimension of CPS data as explained above. As we can see, NCAs incidence seems not only to affect job separation rate but also the rate at which job seekers find a job. The correlation coefficient is -0.48 with a standard error (s.e.) of 0.13 in raw data. The result suggests that job seekers in states with a high NCAs incidence have on average a low probability to find a job. I formally test the correlation as in fact 1, using the same specification as in equation 1 and controls. Table **??** reports the regression results. It shows that a ten percentage point increase in NCAs incidence (about one standard deviation in the State-industry NCAs incidence in our sample) lowers the

Figure 4: NCAs incidence and job finding rate across States, 2014



Note.-. Across States, the correlation coefficient is -0.48 (s.e. 0.13). UE data come from CPS, 2014 and NCAs incidence from Non-competes survey, 2014 (Starr et al. (2019)).

job finding rate by 1.6 p.p, after controlling for State fixed effects and covariates. The result is statistically significant at 1% level. The interaction with the strength of NCAs enforcement reveals in in table in appendix that the magnitude of the NCAs incidence is larger in higher-enforcement states. Particularly, in a high-enforcement state like Florida, the magnitude of job finding rate decline amounts to 1.55 percentage point monthly comparative to a low-enforcement State like California, after one standard deviation increase in NCAs incidence (about 10%). In sum, on average, job seekers are less likely to find a job in an environment where most employment contracts signed include Non-compete clauses. This fact is consistent with the theory that the incidence of NCAs contracts might inhibit the entry of new firms (See House (2016), Nunn (2016)).

Given that our NCAs incidence data is cross-sectional, one key concern from the previous results is the persistence over time of the findings presented above. To mitigate that issue, I study the change in the job creation rate and job destruction rate following an NCAs enforcement reform. To do so, I take advantage of the NCAs enforcement reform across States during the period 1992-2010 materialized in variation in State NCAs enforcement index (see Garmaise (2011)). Indeed, it is more likely that NCAs are popular among companies with employees working in States where they are allowed. I

Table 2: NCAs incidence and job finding rate

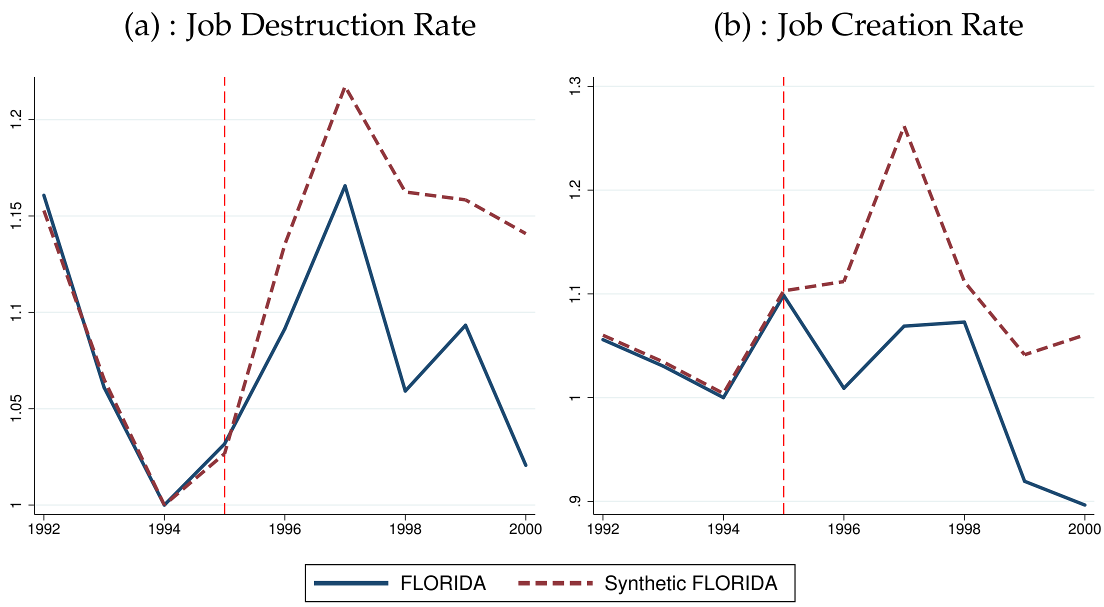
	(1)	(2)	(3)	(4)	(5)
NCAs incidence	-0.136^{***}	-0.122^{***}	-0.160^{***}	-0.093^{*}	-0.142^{*}
	(0.0376)	(0.0349)	(0.0321)	(0.0533)	(0.0845)
Demographics	No	Yes	Yes	Yes	Yes
Year/state FE	No	No	Yes	Yes	Yes
State by occupation FE	No	No	No	Yes	Yes
Industry FE	No	No	No	No	Yes
Observations	19141	19141	19141	18500	18500

Note.- Dependent variable is the probability of a EU transition. Data come from the CPS monthly basic files 2012-2014. Demographic controls include *gender, race, age and age squared, education level and immigrant status*. Standard errors in parenthesis, clustered at state level. $^{*}p<0.1$, $^{**}p<0.05$, $^{***}p<0.01$

mainly focus on Florida State with its change in NCAs enforcement in 1996 as a case study. A key change in the Florida's NCAs law was the introduction of a presumption of injury to a firm when a non-compete agreement is violated. Florida's 1996 strengthening of NCAs enforcement offers an attractive case study compared to law changes in other states. Indeed, Florida provides a close to ideal site because (i) the legislation focused purely on restrictive covenants, notably NCAs, (ii) it was clearly intended to strengthen enforcement in the state, and (iii) Florida had a four-decade history with the laws governing non-competes, such that employers and employees were probably familiar with and accustomed to NCAs.

By assumption, the Facts found above imply that conditional on unemployment rate, the job creation (JCR) and job destruction (JDR) rates would fall after the 1996 Florida's NCAs reform, making them more enforceable. I focus on the job creation rate from establishment births over the last 12 months or, clearly, the job creation from establishments with firm age equal to zero. The reason is that for those firms, it is more likely that they are in a growing stage and would like to hire, an incentive that the strengthening of NCAs might chill. For robustness check, I do the same exercise on high-growth firms which are predominantly young firms with 65% less than 10 years old according to Haltiwanger (2015). I consider firms aged 10 years or less and the result presented here still hold. The analysis uses data from the Business Statistics Dynamics provided by the U.S. Census Bureau. It relies on the synthetic control method developed by Abadie et al.

Figure 5: NCAs enforcement reform in Florida, effect on job flow rates



(2015) using the others States as a control group. The synthetic control method is well known and requires little description. The idea is to find a combination of comparison units (here, the other States except Florida) named synthetic unit that better reproduces the characteristics of the interest unit (here, Florida) in terms of the outcomes (here, job flows rates) predictors before the reform. Synthetic controls are more suitable when the units of analysis are aggregate entities such as counties, States, region, countries and are attractive because of their simple interpretability and transparent nature. Figure 5 shows the results obtained after normalizing values relative to the 1994 value. An essential advantage of normalizing the values is that I can account for the time-invariant difference between Florida and other states (see Kang and Fleming (2020)). As expected, we can see that the job flow rates decreased following the reform, and the effect lasted some years after. I carried out placebo tests asking whether the results could be driven entirely by some randomness. In other words, How often would we obtain results of this magnitude if we had chosen a state at random for the study instead of Florida. Hence, placebo tests repeat the analysis using States alternately in the control group and ask whether the conjectured effect on the job flow rates is present or not and whether the magnitude is as large as the one found with Florida.

Figure 13 in appendix A shows the distribution of estimated job flows rates gaps for states in control group that comes from the iterative procedure. Result shows that the estimated gap for Florida during the 1996-2000 period is unusually large relative to the distribution of the gaps for the states in the control group.

3 Model

In this section, I develop a theoretical framework to account for the aforementioned facts. The model helps to understand the possible mechanism underlining the declining labor market dynamism generated by the usage of NCAs. It also offers a framework to analyze their implications in terms of unemployment rate, productivity and welfare.

3.1 Environment

The model I employ is a modified version of the search and matching model in the spirit of Mortensen and Pissarides (1994). Time is continuous and horizon infinite. There is a continuum of ex-ante identical workers of measure one, infinitely lived and risk-neutral. They derive utility from consumption and maximize the present discounted value of their utility. On the other side of the market, there is a larger continuum of risk-neutral firms with the same discount rate β as workers. The labor market is frictional. There exists a constant return to scale matching technology $M = m(u, v)$, with the unemployment rate u and the vacancy rate v as inputs. The labor market tightness $\theta = v/u$ is a sufficient statistic for the job finding and vacancy filing rates. A vacancy is matched to a worker during a period with probability $q = m(\frac{1}{\theta}, 1)$. A worker finds a job with probability $f = \theta q(\theta)$. Once matched, a pair firm-worker (a job) operates under a NCAs contract with probability ϕ. Non competes agreements contract status $b = 0, 1$ determine the set of feasible contracts. Working with NCAs contract sets $b = 1$ and restricts the worker post-employment mobility. In this environment, firms offer training to the employed worker that enhances the match productivity at cost $C(i)$. Training is match-specific, and the match productivity is $p + i$ where $p > 0$ denotes the common productivity, assumed exogenous. Furthermore, an employed worker is subject to an i.i.d idiosyncratic preference shock ε that alters her decision of continuing the match leading to endogenous job separation. In addition, the match could be dissolved at exogenous rate δ. The preference shock is only observable by the employee. There is no on-the-job search, and then the job-to-job transition is through an unemployment spell.

3.2 Employment and unemployment values

Workers are either employed or unemployed and searching for a job. Due to match separation, workers are of four types: employed bound by NCAs, employed unbound by NCAs, unemployed bound by NCAs, and unemployed free of NCAs. The timing of events and of decisions is as follows: First, a firm with a vacant job match with a worker and then randomly decides to assign or not an NCAs contract to the worker. Once the contract is assigned, the firm decides how much to invest in worker's firm-specific skills conditional on the type of contact. The firm and worker then bargain the wage. Subsequently, production takes place, and profit is shared. Second, employed worker observes the preference level ε and decide whether to quit or continue the match which implies an endogenous separation rate. If she quits but was under NCAs contract before job separation, she becomes unemployed, and the NCAs are binding one period ahead with probability χ. If the match continues, the worker is subject to the same NCAs status, and there is no contract renegotiation. Furthermore, all matches are exogenously destroyed with per-period probability δ. The problem of employed workers is defined by a continuation decision :

$$W^c(b,i,\varepsilon) = \max\Big\{\underbrace{W(b,i)+\varepsilon}_{\text{stay}}, \underbrace{U(b)}_{\text{quit}}\Big\} \tag{2}$$

Where $U(b)$ is the value of quit, equivalently the value of being unemployed with NCAs status b (with the associated optimal quit policy $x(b,i,\varepsilon) \in \{0,1\}$)
The value of being employed is, then, given by :

$$W(b,i) = w(b,i) + \beta\Big\{\delta U(b) + (1-\delta)\mathbb{E}_\varepsilon W^c(b,i,\varepsilon)\Big\} \tag{3}$$

As shown later, there exists a threshold for preference shock $\bar{\varepsilon}(b,i)$ under which employee decides to quit. The expectation in equation (3) is only taken over preference shock because, as long as the match continues, employed worker in state (b,i) remains in this state.

Unemployed worker received unemployment benefit z while is searching for a job.

Assuming that in expectation, worker bound by NCAs starts with $\bar{i}_1$ and the unbound one with $\bar{i}_0$, the value of unemployed worker unconstrained by NCAs is given by :

$$U(0) = z + \beta\Big\{f(\theta)[\phi\, W(1,\bar{i}_1) + (1-\phi)\, W(0,\bar{i}_0)] + [1-f(\theta)]U(0)\Big\} \tag{4}$$

Conditional on finding a job, the unbound unemployed worker is employed with NCAs with probability ϕ and is free of NCAs with counter probability. The path of NCAs constrained unemployed worker is however slightly different and separates into two cases depending on whether the non-compete clause turns out to be enforceable or not. Unemployed value of NCAs constraint worker $U(1)$ satisfies:

$$U(1) = z+\beta(1-\chi)\Big\{f(\theta)[\phi\, W(1,\bar{i}_1)+(1-\phi)\, W(0,\bar{i}_0)]+[1-f(\theta)]U(0)\Big\}+\beta\chi\mathbb{E}[U(b')] \tag{5}$$

Where b' stands for next period NCAs status. Since the NCAs constraints last a finite period of time, there is a law of motion for NCAs status in post-employment period (unemployed spell). I assume that the unemployed worker bound by NCAs becomes unconstrained next period with probability μ. Hence, NCAs unemployment status b' remains 1 with probability $1-\mu$ and becomes 0 with counter probability. This probability is assumed exogenous and will be recover later from the average duration of NCAs. χ stands for the NCAs enforcement probability and accounts here for the tightness of NCAs constraint. The higher is χ, the more stringent are the NCAs. Nevertheless, as one might think, the enforcement probability χ must be endogenously linked to the NCAs relaxing constraints probability μ since the latter is related to NCAs restrictions duration and that it is generally considered easy in many states to enforce a non-compete clause with reasonable duration. However, I choose to exogenous χ and link μ to the average NCAs duration across States. Hence, I can account for factors related to NCAs enforcement other than their duration.

Note that the training level of a typical firm has no impact on the worker's fallback position $U(0)$ or $U(1)$, which depends on the equilibrium level of training. In other words, the training level corresponds to the best response by a firm to the symmetric equilibrium profile of strategies where all firms choose either $\bar{i}_0$ and $\bar{i}_1$. The equilibrium is indeed defined by $i(b) = \bar{i}_b$, but $\bar{i}_b$ thereby $U(b)$ are taken as given when the firm chooses its optimal training level.

3.3 Job creation

Let V denote the value of expected profit from a vacant job . In the present framework, firms are assumed to post vacancy that might be filled by NCAs job with probability ϕ and by No NCAs job with probability $1-\phi$. Moreover, each type of implicit vacancy involves training the employee by the amount i at cost $C(i)$.
The value of expected profit of a vacant job V in the economy is given by:

$$V = -\kappa + \beta \max_{i(0),i(1)} \left\{ q(\theta) \left[\tilde{\eta} \left\{ \phi[J(1,i(1)) - C(i(1))] + (1-\phi)[J(0,i(0)) - C(i(0))] + (1-\tilde{\eta})V \right\} \right] + [1-q(\theta)]V \right\} \tag{6}$$

Where

$$\tilde{\eta} = \eta + (1-\chi)(1-\eta)$$

stands for the probability that the match is allowed, in the sense that once randomly meet, NCAs constraints do not distort the match to be successful. η represents the endogenous probability to meet unemployed worker unconstrained by NCAs. $J(b,i)$ is the value of filled job with NCAs status $b = 0,1$ and training i. The explanation of the vacant job bellman equation 6 is standard. The vacancy posting requires a flow cost of recruiting κ and with probability $q(\theta)$, the vacancy encounter an unemployed worker either bound by NCAs or free of NCAs. Once the match is successful, which happens with probability $\tilde{\eta}$, the vacancy is filled with NCAs contract at rate ϕ and without NCAs at counter rate $(1-\tilde{\eta})$ or remains vacant otherwise.

The free entry condition of supplying vacant job is $V = 0$ and implies job creation condition:

$$\frac{\kappa}{\beta q(\theta)} = \max_{i(0),i(1)} \tilde{\eta} \left\{ \phi[J(1,i(1)) - C(i(1))] + (1-\phi)[J(0,i(0)) - C(i(0))] \right\} \tag{7}$$

This optimization problem from the job creation condition directly implies that the optimal training investment is described by:

$$i(b) = \text{argmax} \left\{ J(b,i) - C(i) \right\}$$

Let $w(b,i)$ be the wage from an occupied job with worker of NCAs status b and training intensity i. The value of filled job with NCAs status $b = 0,1$ and training i, $J(b,i)$ satisfies:

$$J(b,i) = p + i - w(b,i) + \beta\Big\{\delta V + (1-\delta)[(1 - G(\bar{\varepsilon}(b,i)))J(b,i) + G(\bar{\varepsilon}(b,i))V]\Big\} \quad (8)$$

Firm's instantaneous payoff consists of production after training minus wage paid. A match is exogenously severed with probability δ and with counter probability endogenously blown up with quit probability $G(\bar{\varepsilon}(b,i))$. In that case, the job becomes vacant next period and firm receives V. From now and later on, denote $\tilde{G}(\bar{\varepsilon}(b,i)) = (1-\delta)\, G(\bar{\varepsilon}(b,i)) + \delta$, the job separation rate.

NCAs and firm's investment choice. As training is firm-sponsoring and incurs a cost $C(i)$, firm will choose training level that maximize the net value of filled job $J(b,i) - C(i)$, given unemployment rate, labor market tightness and unemployment value. Hence, training is set so that the marginal benefit of filled a vacancy with a pair (b,i) equals the marginal cost of training. that is :

$$\frac{\partial J(b,i)}{\partial i} = C'(i) \quad (9)$$

Using Job filled value equation optimal investment condition can be rewritten as

$$C'(i) = \underbrace{\frac{1}{1-\beta(1-\tilde{G}(\bar{\varepsilon}(b,i))}}_{\text{Average match duration}} \left[\underbrace{1 - \frac{\partial w(b,i)}{\partial i}}_{\text{Direct marginal profit}} \overbrace{-\beta \frac{\partial \tilde{G}(\bar{\varepsilon}(b,i))}{\partial i} J(b,i)}^{\text{Expected marginal benefit from } \Delta \text{ in quit proba.}} \right] \quad (10)$$

An increase of one unit of training intensity incurs a marginal cost of $C'(i)$ and generates a marginal benefit which corresponds to the RHS of Eq.(10). The return to training can be decomposed in two terms: (i) training raises productivity and wages through rent sharing, which gives rise to a direct return to training, but in addition, training also makes the employment relationships more stable; (ii) the more productive the match, the less easily it is destroyed (in this case worker is less likely to quit). Hence, the second effect correspond to a return to job stability.

Notice that the separation rate $\tilde{G}(\bar{\varepsilon}(b,i))$ only depends on training intensity i through wage $w(b,i)$. Hence, if wages were independent of training then the marginal benefit of training will only depend on the average match duration. Thus, higher training intensity will be associated to job type with high match duration. As showing later, this result holds after wage adjustment making meaningful the role played by the wage in our setting.

3.4 Wage barganing

I follow search and matching literature and assumed that wages are determined by Nash Bargaining. Consider a firm-worker match currently associated with the pair (b,i) such that it generates a positive surplus. Nash Bargaining implies that the wage, $w(b,i)$, solves :

$$(1-\rho)\left(W(b,i)-U(b)\right)=\rho\left(J(b,i)-V\right) \tag{11}$$

where $\rho \in [0,1]$ denotes the worker's exogenous bargaining power. Bargaining outcomes then yields a share ρ of the total surplus of the job $S(b,i)$ to the worker and a share $1-\rho$ to firm. The surplus sharing rule reads :

$$W(b,i)-U(b)=\rho S(b,i)=-\bar{\varepsilon}(b,i) \quad ; \quad J(b,i)-V=(1-\rho)S(b,i) \tag{12}$$

Using employed worker value function, filled job value together with optimal condition (11), it is straightforward to show that wage curve is given by :

$$w(b,i)=\rho(p+i)+(1-\rho)\left[(1-\beta)U(b)-\beta\,(1-\delta)\underbrace{\int_{-\rho S(b,i)}\varepsilon dG(\varepsilon)}_{\gamma(b,i)}\right] \tag{13}$$

As standard, the wage is a weighted average of the match productivity and reservation wage. However, here, the standard reservation wage $(1-\beta)U(b)$ as in Mortensen and Pissarides (1994) is distorted by the nuisance quantity $\gamma(b,i)$. This quantity is the average value of preference shock received by the worker. On average, a positive preference shock implies an increase in the utility of working and a decrease in its opportunity cost. Therefore, the reservation wage decreases. Given training level i and assuming that worker bound or unbound by NCAs has the same outside option value U, worker with high probability of retention or stay will receive higher wage. All in all, bargained wage of each worker type depends on the level of training received, the separation rate associated and on how much NCAs impact the outside option of the worker.

Using the value functions and surplus sharing rule, it is straightforward to show (See appendix), that the total surplus of job (b,i) satisfies:

$$S(b,i) = p + i + \beta\left[1 - \tilde{G}(-\rho S(b,i))\right]S(b,i) - (1-\beta)U(b) + \beta(1-\delta)\int_{-\rho S(b,i)} \varepsilon dG(\varepsilon) \tag{14}$$

where:

$$(1-\beta)U(0) = z + \beta f\left[\phi\rho S(1,i(1)) + (1-\phi)\rho S(0,i(0)) + \phi\Delta U\right] \tag{15}$$

$$(1-\beta)U(1) = z + \beta\left[f\rho(1-\chi)\mathbb{E}[S(b,i(b))] + [f(1-\chi)\phi - (1-\mu)(1-\chi) - \mu]\Delta U\right] \tag{16}$$

$$(1-\beta)\Delta U = \beta\left[-f\chi\rho\mathbb{E}[S(b,i(b))] - [f\phi\chi + (1-\chi)(1-\mu) + \mu]\Delta U\right] \tag{17}$$

and where $\Delta U = U(1) - U(0)$. I set $\bar{i}_b = i(b)$ as unique symmetric equilibrium, since all firm solve the same investment problem (See also Acemoglu and Pischke (1999)). From equation (17), it follows that employed workers constrained by NCAs has lower outside option than their peers unbound by NCAs. This result is stressed in Lemma 1.

Lemma 1 *Assuming that both types of job exist in equilibrium (positive match surpluses) then employed workers constrained by NCAs have lower outside option than their peers unbound by NCAs, that is :* $U(1) < U(0)$.

Proof: See Appendix B.1

The result in lemma 1 is quite intuitive. Since, NCAs limit the opportunities of NCAs worker outside her match, the probability to find job upon separation is lower than the one for NCAs unconstrained worker.

Equilibrium. A stationary equilibrium consists of policy functions $i(b)$, $\bar{\varepsilon}(b, i(b))$, value functions $W(b, i(b))$, $U(b)$, $J(b, i(b))$, $S(b, i(b))$ and wage function $w(b, i(b))$, labor market tightness θ and unemployment rate such that :

(i) The value functions solve (3) to (8)

(ii) Wage is given by (13)

(iii) Training policy function satisfies (10)

(iv) Free entry (7) pins down labor tightness

(v) Quit decision policy function satisfies $\bar{\varepsilon}(b, i(b)) = -\rho S(b, i(b))$ and

(vi) Unemployment rate u is derived from law of motion of each type of unemployment $u(0)$ and $u(1)$ which read :

$$\Big[\mu + (1-\chi) f(\theta)\Big] u(1) = \phi\,(1-u)\tilde{G}(\bar{\varepsilon}(1, i(1))) \tag{18}$$

$$u(0)\, f(\theta) = \mu\, u(1) + (1-\phi)\,(1-u)\tilde{G}(\bar{\varepsilon}(0, i(0))) \tag{19}$$

Since $u = u(0) + u(1)$, we get:

$$u = \frac{\lambda\Big[\mu + (1-\chi) f\Big] + f\phi\chi\tilde{G}(\bar{\varepsilon}(1, i(1)))}{f\phi\chi\tilde{G}(\bar{\varepsilon}(1, i(1))) + \Big[\mu + (1-\chi) f\Big](f+\lambda)} \tag{20}$$

where $\lambda = (1-\phi)\,\tilde{G}(\bar{\varepsilon}(0, i(0))) + \phi\,\tilde{G}(\bar{\varepsilon}(1, i(1)))\ ;\ f = f(\theta)$

From this expression, we see that unemployment rate is increasing in the job destruction rates for the various types of jobs contract and a decreasing function of the exit rate from unemployment $f(\theta)$. Finally, when $\phi = 0$ (economy without NCAs), we get the familiar expression $u = \dfrac{\lambda}{\lambda + f}$.

The endogenous fraction of unemployed workers constrained by NCAs $(1-\eta)$ is given by:

$$1 - \eta = \frac{u(1)}{u} = \frac{\phi\tilde{G}(\bar{\varepsilon}(1, i(1)))}{\mu + (1-\chi) f}\,\frac{1-u}{u} \tag{21}$$

which closes the model.

4 Qualitative insights

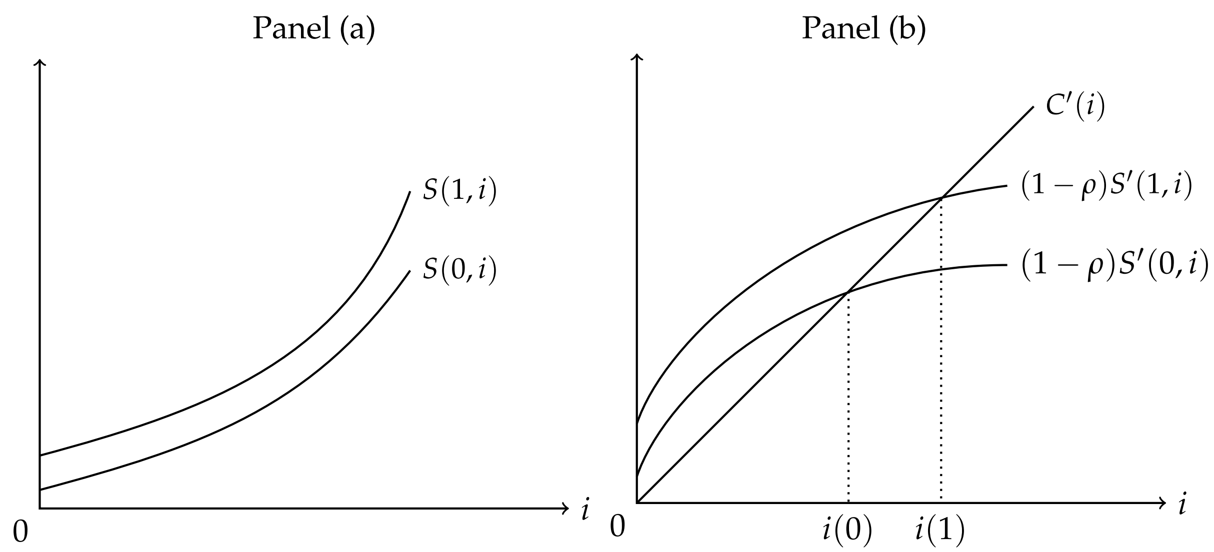
Before turning to a quantitative analysis, I provide some qualitative insights in the baseline model. I abstract from unemployment to focus on how NCAs interact with training, separation rate and labor tightness.

Proposition 1 *Conditional on training i, NCAs match surplus is higher than No NCAs match surplus. That is :*

$$S(i,1) - S(i,0) \mid_i > 0$$

The proof is in appendix B.2. Proposition 1 states that if both types of workers (NCAs and No NCAs) received the same level of training, the match surplus would be higher in NCAs job than No NCAs job for any level of training. The reason is that holding training constant across job types, the only difference between their surpluses comes from the outside options values.

Figure 6



Hence, as surplus decreasing in the outside value, from lemma 1, NCAs surplus is higher. Panel (a) in figure 6 illustrates this result. As a consequence, NCAs worker receives higher training and experiences lower separation rate, a result highlighted in the proposition 2 above.

Proposition 2 *NCAs worker receives higher training and experiences lower separation rate*

The proof of proposition 2 is straightforward (see appendix B.3) and the result is intuitive. The analysis of proposition 1 suggests that conditional on training, NCAs worker experiences lower separation than No NCAs worker. Hence, conditional on training level i, NCAs match duration is higher. Therefore the marginal benefit of investment is higher for NCAs job [11]. This result is illustrated in panel (b) of figure 6. The result implies, between others, that the optimal training policy is decreasing in outside value of workers. This is consistent with Acemoglu and Pischke (1998) finding that a lower probability that the worker meets a new employer increases the value of human capital to the incumbent firm [12].

NCAs and equilibrium labor tightness. Let us analysis the effect of the increase in the policy instrument χ, which is the NCAs enforcement probability, on job creation decision. From free entry condition (equation 7), we can see that the impact of tightening in NCAs enforcement on job creation depends on its net effect on the expected profit of filling a vacancy. As the optimal training is higher with NCAs, the incidence of higher enforcement NCAs increases the expected profit of filling a vacancy and therefore firms will be keener to open more vacancy, increasing the labor tightness. However, the incidence of higher enforcement NCAs influences negatively the marginal benefit of filling a vacancy in two ways: (*i*) directly through $\tilde{\eta}$ and (*ii*) indirectly (a general equilibrium effect) through η, the probability to meet unemployed worker unconstrained by NCAs. This negative effects counteract the positive training motive effect, lowering labor tightness and may dominate. Intuitively, a tightening in NCAs enforcement will be accompanied by a spread of highly enforceable NCAs among unemployed worker. Hence, it becomes awkward for firms to fill a vacancy, lessening the expected profit of filling vacancy.

5 Quantitative analysis

In this section, I calibrate the model and analyze the equilibrium effect of Non-competition agreements in steady state. The parameters are set to match a set of moments describing

[11] I show that the marginal benefit is increasing in the match surplus and only depends on the latter (sufficient statistic in the model) (see appendix).

[12] Although, there is no on the job search in this model, the new employer contact rate stands here for the probability to find a job.

the dynamics of the US labor market prior to the 2009 recession.

5.1 Calibration

5.1.1 Parameters set externally

The model period is a month. Thus, I set the discount rate $\beta = 0.9967$, so that the model implies a steady-state annualized real interest rate of about 4%. The matching function is assumed to be Cobb-Douglas: $m(u, v) = A\, u^{\alpha} v^{1-\alpha}$. As standard in search literature, I choose a conservative value for the elasticity $\alpha = 0.5$. The bargaining power ρ is set equal to α to ensure that the Hosios condition is fulfilled in the benchmark economy (with NCAs). In the benchmark economy, the exogenous probability for a worker to be bound by NCAs is set to $\phi = 0.20$ in line with Starr et al. (2019) from 2014's Non-compete survey in US. Also, like in Shi et al. (2019) I use an average duration of NCAs restricted period of 1.6 years consistent to data. Hence, I calibrate the probability of being unconstrained by NCAs after separation to $\mu = 0.052$. The instantaneous return of unemployment, z, is equal to 40% of the productivity p, which value is normalized to one, consistently with Shimer (2005). I target a monthly job-finding rate of 0.45, which is the average value using data in Shimer (2012) for my targeted period prior the great recession (2000-2007) and consistently with Pries and Rogerson (2019). Using Federal Reserve Bank data, I find an average value of labor market tightness of 0.52 over the period targeted. This value of θ yields an efficiency parameter A equals to 0.6364 together with the targeted monthly job finding rate.

5.1.2 Internal calibrated parameters

I assume $C(i) = c\, i^2$ as the functional form for the training cost function that is increasing and convex in training intensity i. I jointly estimate the parameters κ, c, σ, respectively the per unit cost of vacancy, the training cost parameter and the preference shock distribution standard deviation. I assume a normal distribution for the preference shock with mean m and standard deviation σ. I normalize the mean m to zero and calibrate the standard deviation so as to match the average separation rate. Shimer (2005) computes an average separation rate of 0.036 using The current Population Survey (CPS) data and Bils et al. (2011) found a value of 0.02 from the Survey and

Income Participation Program (SIPP) data over the targeted period. Therefore, I target an average monthly separation rate of 0.027 which the average value reported by those authors. This imply a steady state value of unemployment rate of 0.06 which maps to the value in data over the period. The vacancy cost κ is recovered from free entry condition given a value of tightness of 0.52. Finally, the training cost parameter is cali-

Table 3: Calibrated parameters

Parameters	Name	Value	Reason
Predetermined			
β	Discount rate	0.9967	Interest rate=4%
ρ	Bargaining power	0.5	(Leduc & Liu, 2019)
ϕ	fraction of bound worker	0.20	Starr, 2018
μ	Proba. of being unconstrained	0.052	1.6 years of NCAs
χ	NCAs enforcement Probability	0.7	Starr, 2016 NCA index
z	Employment benefit	0.40	Shimer, 2005
p	Common productivity	1	Normalization
m	Preference shock mean	0	Normalization
A	Matching efficiency	0.6364	Job finding probability
Estimated			
κ	vacancy cost	0.58	$\theta = 0.52$ and $V = 0$
c	Training cost parameter	143.5	$i^{\star}(1)/i^{\star}(0) = 1.28$
σ	Preference shock std.	0.51	avg. sep. rate = 0.027

brated by targeting the ratio of average hours dedicated to training for NCAs job versus No NCAs job. This ratio stands here for the value of training intensity received by NCAs worker relative to the one received by the No NCAs worker. Using data from the 1997's National Longitudinal Youth Survey, I compute that on average NCAs worker receives 18 hours of training per week during training session while the No NCAs worker receives 14 hours per week training intensity. This implies a ratio of 1.28 for training intensity of NCAs job relative to the No NCAs job. The benchmark calibrated value of enforcement probability χ is set to 0.7. This value corresponds to the mean of the NCAs enforceability index developed by Bishara (2011) and improved by Prescott et al. (2016). The index is normalized with values between 0 and 1. The calibrated value is also consistent with Shi et al. (2019) who find an enforcement probability of 0.4 in a low-enforcement regime like California. With a value of full-enforcement regime like Florida equals 1, the calibrated value appears to be the average-enforcement regime's value.

The resulting calibrated and estimated parameters are presented in table 3.

5.2 Accounting for the stylized facts

I now assess the model's ability to account for the facts 1 and 2 outlined in Section 2. To do so, I simulate the model to generate artificial data comparable with the data used in the empirical analysis of Section 2.

Fact 1. I examine whether the model can account for the negative cross-sectional

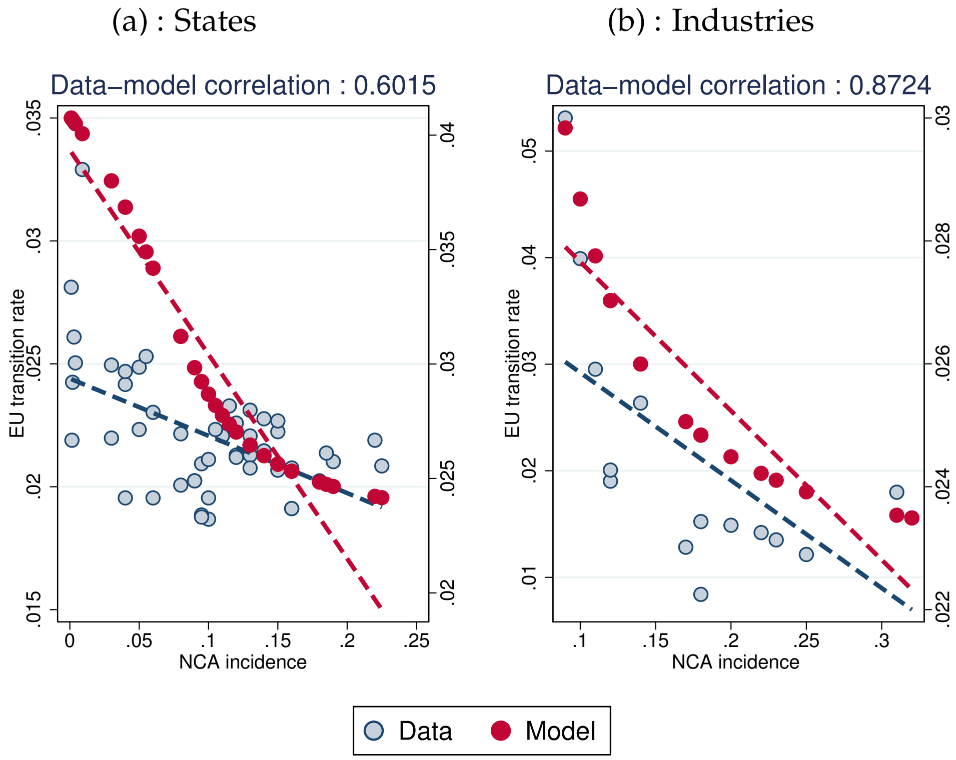


Figure 7: NCAs incidence and job separation rate : Data vs. Model

association between the incidence of NCAs and the job separation rate on average. Specifically, I replicate the cross-section relationships between both variables across States and Industries according to figure 3. To do so, I vary the parameter ϕ in order to get the same sequence of NCAs incidence across States and Industries as observed in the data. Figure 7 shows that this exercise makes the model predict a significant negative correlation between the NCAs incidence and the job separation rate. As we can see, the model's ability to account for the overall a magnitude of cross-sectional correlation is quite remarkable especially across industries with a data-model correlation of 0.87.

Fact 2. Second, I argue that the model is also consistent with the negative cross-sectional association the incidence of NCAs and the job finding rate observed in the data. To examine this fact through the lens of our model, I proceed in a way analogous to the way I proceed for the fact 1. Figure 8 shows a scatter plot in which each dot represents a States, with the x-axis and y-axis respectively measuring the proportion of worker constrained by NCAs and the probability to transition to employment from non-employment. The figure shows that State displaying significant increases NCAs incidence also displays large drop in the job finding rate, consistent with fact 2. Of course, job finding rate in the data are also driven by factors other than the prevalence or the use of NCAs studied in the paper. Hence, the correlation observed in the data in Figure 4 is not as tight as the model counterpart in Figure 8.

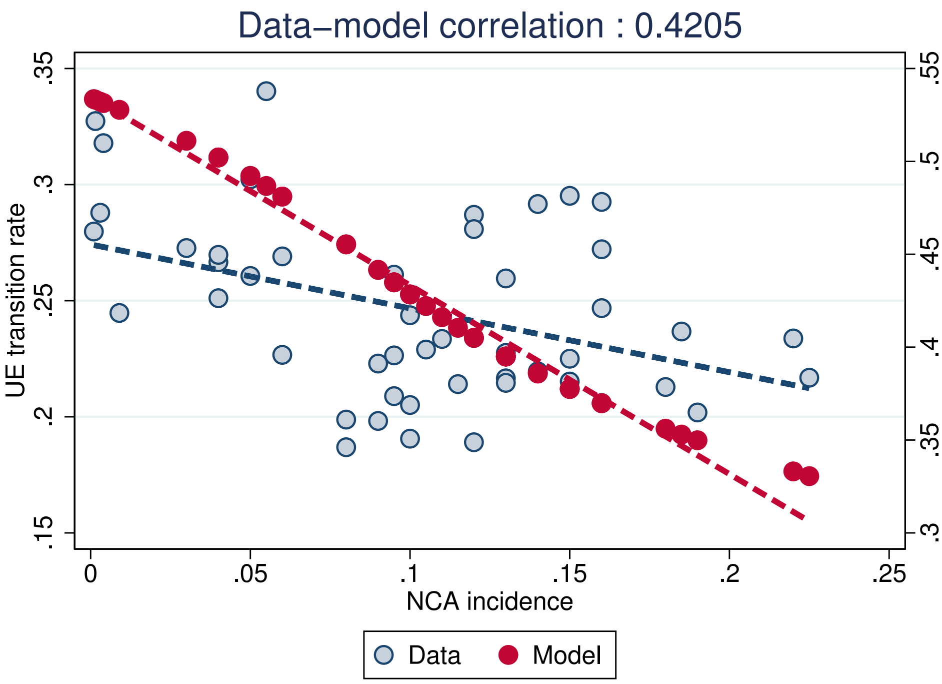


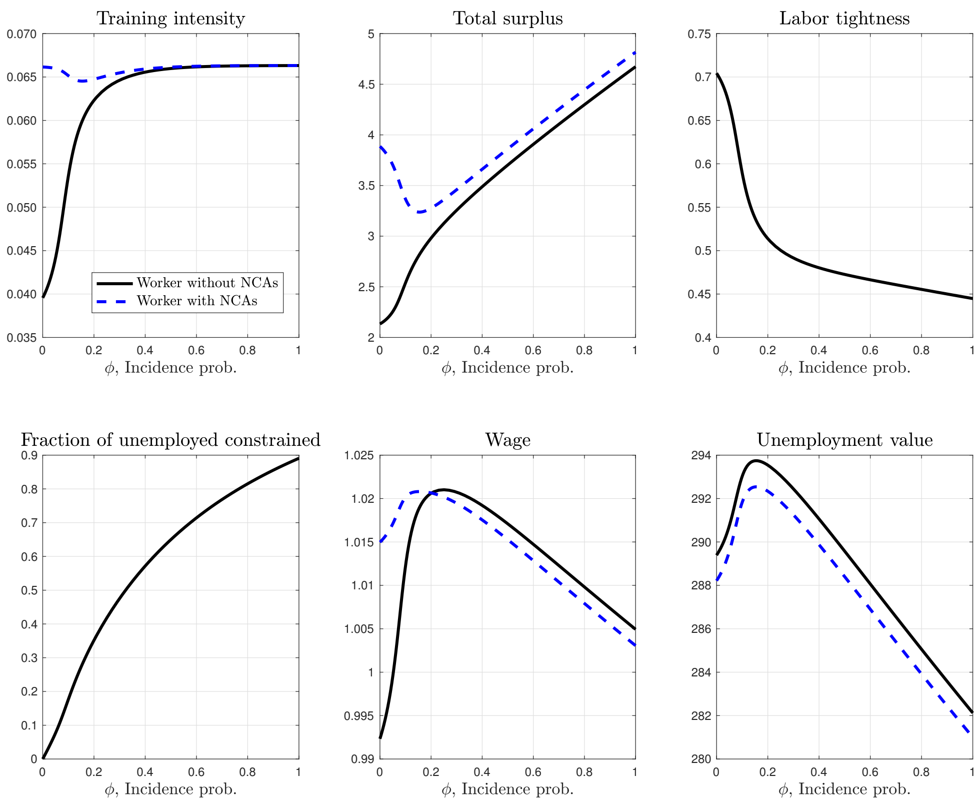
Figure 8: NCAs incidence and job finding rate : Data vs. Model

5.3 The Effects of Non-Compete Agreements incidence

With the estimated model at hand, I start by describing the decentralized equilibrium in figure 9. Hence, I simulate the model with various level of the NCAs incidence ϕ. The results indicate that training intensity rises as the NCAs incidence increases while the job separation rate drops. These observations are explained by the rise in the match surpluses of each type of job, due to the resulting downward pressure on the outside options, as the NCAs incidence increases. More specifically, NCAs worker receives higher training intensity and experiences lower job separation rate in line with Proposition 2. The low separation rate for a worker with NCAs results from a combination of two effects going in the same direction: the drop in both the separation initiated by the worker (a quit) and the one initiated by the employer (nil here because not explicitly modeled). Intuitively, as the outside options of worker decline due to the NCAs signed, the latter has less willing to quit. The decline in the quit rate encourages the employer to invest in the worker's human capital. As a result, it is less likely that the employer lays off the worker. Thus, the employer could extract the maximum possible of its investment.

Results also suggest that not only the outside option value of NCAs worker decline

Figure 9: Comparative Statics with respect to NCAs incidence proportion - ϕ



Note. All parameters except ϕ are fixed at their benchmark values

as the NCAs incidence increases, the NCAs unconstrained worker's one drops too, a result somewhat surprising. Nevertheless, It suggests that NCAs incidence exerts negative externality on the unconstrained worker. The rationale behind this effect can be analyzed through two channels simultaneously at play. The first channel comes from the potential decline of labor market tightness that decreases the probability of finding a job. The second channel derives from the fact that there is a positive probability that the NCAs unbound worker becomes constrained in the near future. This situation contributes to lessening the present value of unconstrained unemployed worker. This pattern is consistent with the empirical finding in Starr et al. (2019) who examine the mobility constraint externalities of NCAs. Starr et al. (2019) find that in the US States with a higher incidence of enforceable NCAs, workers, including those unbound by NCAs, receive fewer job offers.

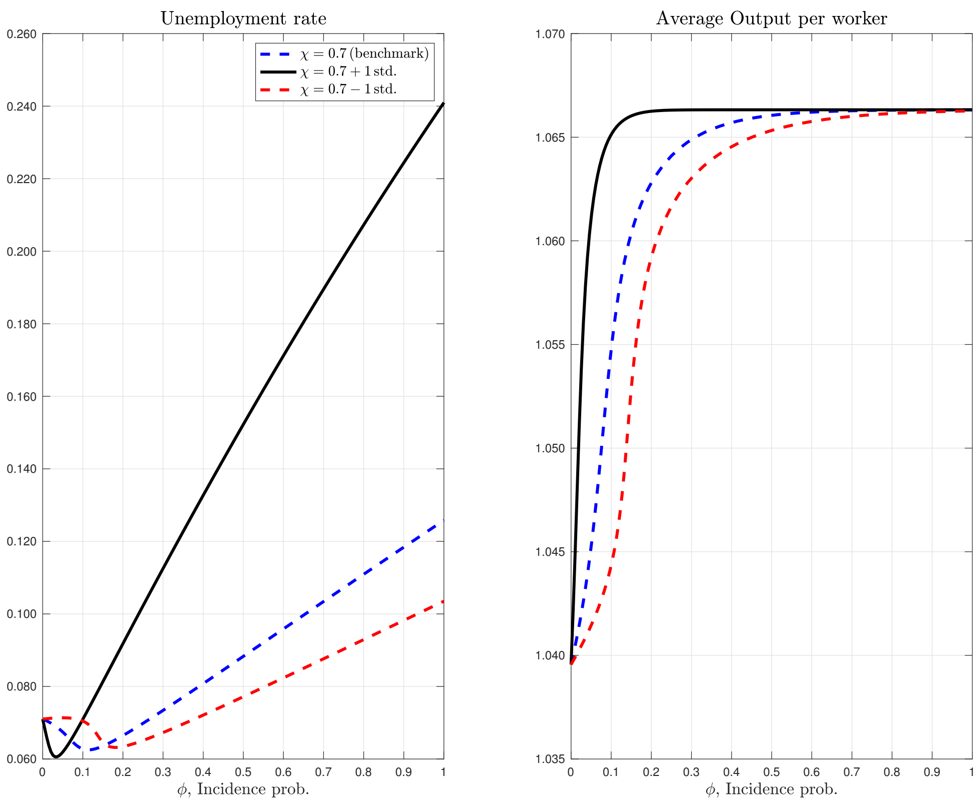
Speaking of earnings, NCAs worker receives lower wage than a worker without NCAs when the NCAs incidence is high. What determine the wage profile in our setting are the training intensity and the unemployment value of the worker through Nash bargaining. Since the outside option value decreases when NCAs incidence is high, the wage pass-through effect is negative. The positive training effect of higher NCAs on wage helps reducing the negative effect of the outside options, but the adjustment is not enough to increase the wage for the NCAs worker when NCAs incidence is sufficiently high. Indeed, as the results make apparent, when the probability to sign NCAs is high, there is no significant difference between NCAs worker and No NCAs worker in term of human capital investment.

Finally, training motive and the composition of job seekers relative to NCAs constraint are two opposing forces determining the NCAs effect on job creation. Results show a decreasing pattern of labor tightness. The declining pattern observed for labor market tightness is the result of the general equilibrium effect of job seekers composition relative to NCAs constraint that appears to be dominant here. Indeed, the proportion of job seekers constrained by NCAs increases as NCAs incidence rises, and thus it becomes awkward for firms to fill a vacancy. As a result, firms post fewer vacancies pushing downward the tightness of the labor market.

On average, the model implies a declining pattern of job finding rate and separation rate with NCAs incidence as shown in Figure 9 suggesting that the incidence of NCAs lowers labor turnover. Given this, the effect on unemployment rate is ambiguous. Unemployment rises if job flows into unemployment falls by proportionally less than job flows out of unemployment. The model predicts a U-shaped curve for unemployment rate suggesting that higher NCAs incidence (with a threshold of about 10%) has a positive impact on the rate of unemployment (See figure 10. Additionally, Given a sufficient higher level of NCAs incidence, an increase in the enforceability of NCAs amplifies the effect on the unemployment rate. This suggests that it is not the NCAs incidence or their enforceability degree per se that is harmful to employment, but the combination of both.

Furthermore, figure 10 shows the positive effect of the NCAs incidence on the productivity through the associated higher firm specific investment. Hence the use of the NCAs generates a trade-off between enhancing productivity and attaining an efficient level of the equilibrium unemployment rate. I now turn to the welfare effects induced by NCAs.

Figure 10: Effects of NCAs incidence on unemployment rate and productivity



Note. In each plot, the blue curve shows the effect of the increase in the NCAs incidence when the enforcement probability is equal it benchmark value, $\chi = 0.7$. The black and red dashed curves show the same effect when enforcement probability increases by $+/-$ one standard deviation value as in data (≈ 0.23). All other parameters are set as in Table 3

6 Welfare analysis

In this section, I quantitatively investigate the welfare effects of NCAs. In line with Charlot and Malherbet (2013), I consider that the planner chooses the job separation threshold, the labor market tightness θ and training intensity with respect to each type of employment contract. Formally, the planner maximizes social welfare, defined as the sum of the discounted stream of aggregate output net of search and training costs,

$$\max_{\theta,\varepsilon(b),i(0),i(1)} \int_0^\infty e^{-rt}\left\{Y + uz - \theta u\kappa - \tilde{\eta}\theta q(\theta)u\left[\phi C(i(1)) + (1-\phi)C(i(0))\right]\right\}dt$$

Aggregate output Y is the sum of outputs for each type of job (With and without NCAs), i.e. $Y = Y^0 + Y^1$ which, at any moment in time t evolve according to:

$$\dot{Y}^1 = \tilde{\eta}\theta q(\theta)u\phi[p + i(1)] - \tilde{G}(\varepsilon(1, i(1))Y^1 \tag{22}$$

$$\dot{Y}^0 = \tilde{\eta}\theta q(\theta)u(1-\phi)[p + i(0)] - \tilde{G}(\varepsilon(1, i(0))Y^0 \tag{23}$$

At any moment in time, the unemployed, conditional to encounter an allowed match with probability $\tilde{\eta}$ can be hired on either NCAs contract at rate $\phi\theta q(\theta)$ or a job without NCAs contract with probability $(1-\phi)\theta q(\theta)$ and produce respectively $p + i(1)$ and $p + i(0)$. In the same time, a proportion $\tilde{G}(\varepsilon(b, i(b))\,, b = 0, 1$ of job of type b is destroyed.

The welfare properties of the decentralized economy are studied in two steps. As a first step, I study the welfare properties of a laissez-faire economy, i.e. an economy where a probability ϕ of signing NCAs is one ($\phi = 1$) and the NCAs duration is sufficiently large (μ=0) but there is a probability $\chi \in (0, 1)$ that NCAs are enforced. Such economy ressembles to a one with a strong bargaining power of employers. I show that an economy of this type is inefficient even if the hold-up problem is meaningless (higher firm investment). The inefficiency arrives in this economy because there is too little job creation. In the second step, I show that a cap in the NCAs duration is welfare-improving. The focus here on the capping non-compete duration as policy evaluation is for comparison with the literature (See. Shi et al. (2019)).

6.1 The inefficiency of the laissez-faire economy

I first study the welfare properties of the laissez-faire equilibrium where $(\phi, \mu) = (1, 0)$. The result presented here also holds in a general case where $(\phi, \mu) \in (0, 1)$. Thus, the case $(\phi, \mu) = (1, 0)$ is reported for ease of presentation. Furthermore, I restrict myself to the case where $\beta \longrightarrow 1$. Hence, the objective of the planner becomes static and writes:

$$\max_{\theta, \varepsilon(1), i(1)} \tilde{\eta}\theta q(\theta) u \left\{ \frac{p + i(1)}{\tilde{G}(\varepsilon(1, i(1))} - C(i(1)) \right\} + uz - \theta u \kappa \tag{24}$$

the maximization problem is subject to the same constraint on labor market flows as the decentralized economy (20 and 21). Let ε^s, θ^s and i^s denote the values of the endogenous variables chosen by the social planner.

Proposition 3 (*Efficient job creation.*) *The values ε^s, θ^s and i^s solve:*

$$\frac{\kappa}{q(\theta^s)} + \frac{\tilde{\eta}\,\kappa\,\psi\,\theta^s}{\tilde{G}(\varepsilon^s)} + \tilde{\eta}(1-\psi)C(i^s) = \tilde{\eta}(1-\psi)\frac{p + i^s - z}{\tilde{G}(\varepsilon^s)} \tag{25}$$

where $\psi = -\theta^s \frac{q'(\theta^s)}{q(\theta^s}$, the opposite of the elasticity of the matching function with respect to unemployment. These values can be directly compared to those obtained in the laissez-faire equilibrium.

Let ε^*, θ^* and i^* denote the equilibrium values of the key endogenous variables.

Proposition 4 (*Job creation in the laissez-faire economy.*) *The values ε^*, θ^* and i^* solve:*

$$\frac{\kappa}{q(\theta^*)} + \frac{\tilde{\eta}\,\kappa\,\rho\,\theta^*}{\tilde{G}(\varepsilon^*)}\frac{1}{1-\chi(1-\theta^* q(\theta^*)} + A\tilde{\eta}\,C(i^*) = \tilde{\eta}(1-\rho)\frac{p + i^* - z}{\tilde{G}(\varepsilon^*)} \tag{26}$$

where, $A = 1 + \dfrac{\rho\,(1-\chi)\theta^* q(\theta^*)}{\{1 - \chi[1 - \theta^* q(\theta^*)]\}\tilde{G}(\varepsilon^*)}$

The comparison of job creation condition in the equilibrium and centralized outcomes yields a necessary condition. For a given training intensity and job destruction rate, a necessary condition for the equilibrium to be constrained efficient is that the well-known Hosios-Diamond-Pissarides (HDP) condition $\rho = \psi$ holds. However, this condition is not sufficient here. It is easy to see that $\theta^* < \theta^s$ under HDP and given a training intensity and a job destruction rate. To achieve efficiency, a second order condition is that the bargaining power of the worker ρ must be set to zero ($\rho = 0$). This result is similar to the one obtained in Acemoglu and Shimer (1999) that study the efficiency of the search and matching model under the presence of match-specific investments. While, the result appears in their paper for the hold-up problem, here it holds in the presence of incidence of NCAs which help lessening the holp-up problem but generates too little job creation.

Note that the inefficient job creation cannot be solved by giving all the bargaining power to the employer ($\rho = 0$), otherwise workers do not get any return to the training that increases the productivity. Hence, by doing so, it depresses wages and creates excessive entry of firms.

This being said, I turn to the welfare effects of capping NCAs duration. The exercise is to understand to which degree this policy helps improving the welfare.

6.2 Policy evaluation: Capping NCAs duration

Giving that there can be little job creation, there may be room for improving welfare by capping the NCAs duration. We are interested here in quantifying the effects.

Using the calibrated model, I compute the welfare gains pertain to the equilibrium allocation. Figure 11 depicts the result in the panel (a). As we can see, a low level of NCAs incidence is desirable as it would help the economy benefit from the higher productivity and low job destruction without being too harmful for job creation. The desirable level of NCAs incidence is lower than the equilibrium benchmark value of 20%. The model predicts a desirable level of 15.38% .

Next, I investigate how the optimum changes when there is a cap on NCAs duration, i.e. when the probability to loosening the NCAs constraints in the near future μ rises. Results in panel (b) of figure 11 show that a cap on NCAs duration improves the welfare. The welfare gains are 0.3 percent and 0.8 percent when the NCAs duration is capped at one year and six months respectively from it benchmark value of 1.6 years.

Furthermore, the welfare gains observed is accompanied by a rise of the level of NCAs incidence. We could, therefore seek to determine the level of NCAs duration, consistent to the benchmark level of NCAs incidence which equals 20%, that is able to restore the maximum of welfare given the benchmark values of enforcement probability and NCAs duration of 1.6 years. The exercise shows that the equivalent NCAs duration

Figure 11: Welfare effects of NCAs

(a) : Optimum (b) : Effect of capping NCAs duration

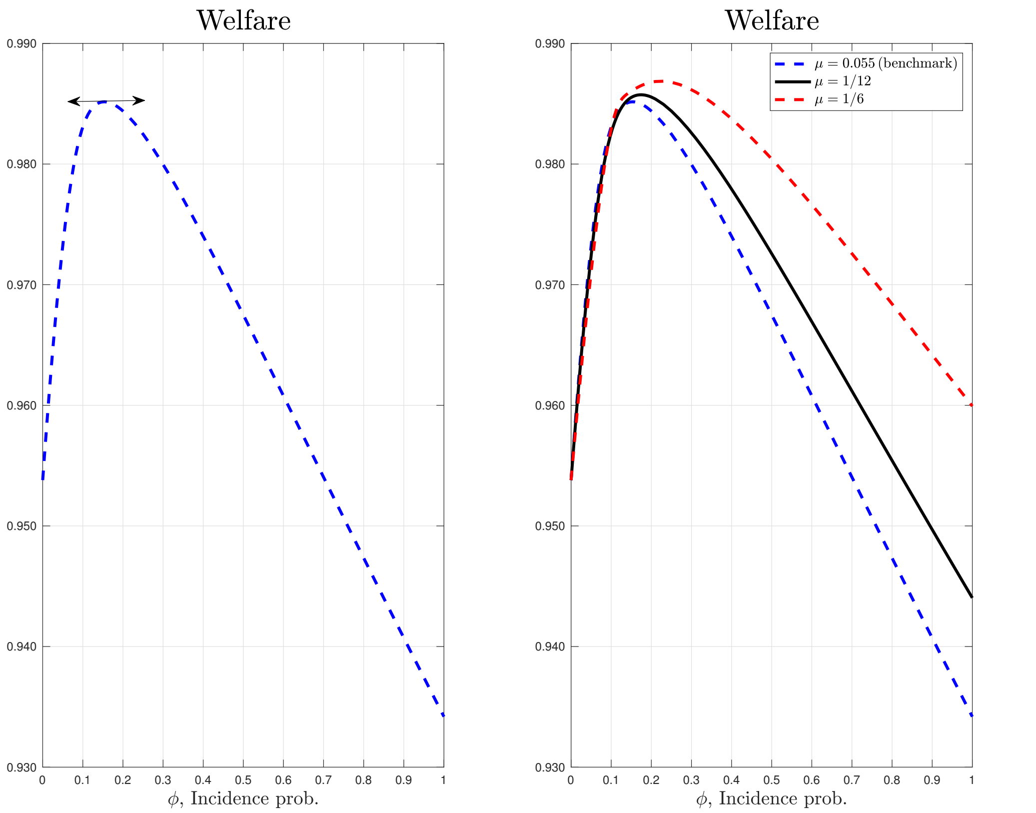
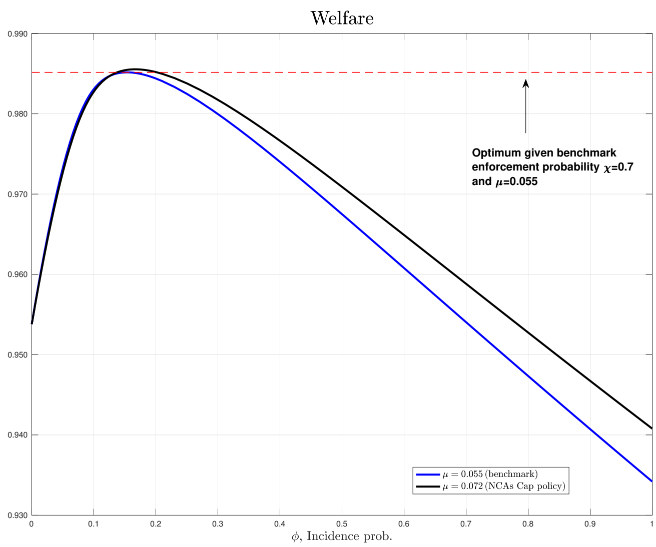


Figure 12: Welfare effects of NCAs and equivalent NCAs duration cap policy



should be cap at 1.16 years (1/0.072) instead of 1.6 years as in the benchmark (see figure 12). Capping the NCAs duration at 1.16 years, everything else equals, would help improving welfare by about 0.1% of the benchmark economy with an average enforcement regime. These results are consistent with Shi et al. (2019). The paper found that in a full-enforcement regime $\chi = 1$, the optimal cap (0.6 years) results in welfare gains of 4.8%, relative to the laissez-faire equilibrium outcome. In a low-enforcement regime $\chi = 0.4$ that resembles California, the optimal cap results in welfare gains of 0.5%. The key difference is that, while their paper study the effects of NCAs in the managerial labor market (high skill labor), here our results have a broader relevance.

7 Conclusion

Non-competition contracts influence labor market outcomes by increasing job search frictions. This paper studies the equilibrium employment effects of the incidence of NCAs contracts. It documents that an increased incidence of enforceable NCAs is associated with a decline in labor market dynamism. Both job creation and destruction rates fall, generating an ambiguous effect on the unemployment rate in equilibrium. The model calibrated to US data predicts a higher unemployment rate, suggesting that the negative job creation effect dominates. The result can also be interpreted as unemployment mismatch implications of NCAs in the sense that workers with a sector-specific human capital endowment but constrained by NCAs, are waiting in unemployment during their non-competition restriction period. This situation may generate a dispersion in the probability of finding a job across sectors leading to inefficiency.

Finally, I show that a restriction on the non-compete duration is welfare improving. This restriction helps the economy benefit from the higher productivity and low job destruction without being too harmful for the job creation.

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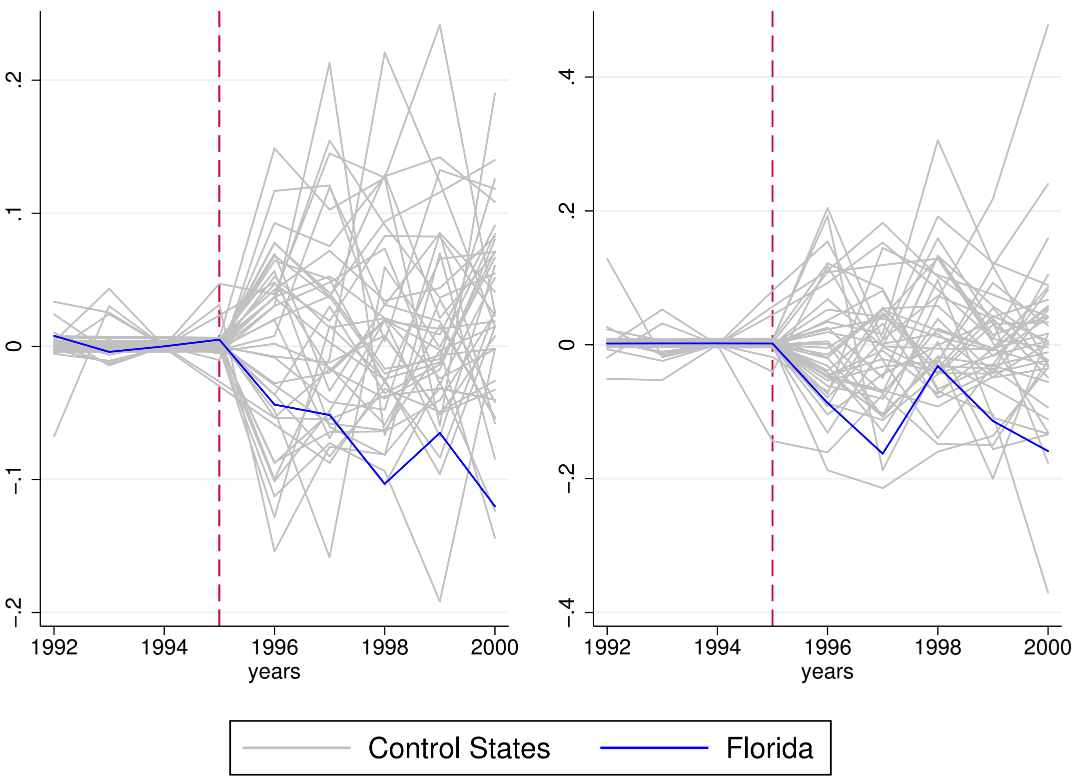
A Tables and Figures

Figure 13: Placebo test

(a) : Job Destruction Rate Gap

(b) : Job Creation Rate Gap



-Notes: The gray lines represent the gap associated with each of the 46 runs (states included in the control group) of the placebo test. the blue line denotes the estimated gap for Florida

Table 4: NCAs incidence and employment transition rates

Dependent var.	Job losing (Y/N)		Job finding (Y/N)	
	(1)	(2)	(3)	(4)
NCAs inc. × Enforceability		-0.029^{***}		-0.155^{***}
		(0.0000)		(0.0005)
Controls.	Yes	Yes	Yes	Yes
Year/state FE	Yes	Yes	Yes	Yes
N. Obs	250,876	250,876	19,141	19,141

Note.- Standard errors in parenthesis, clustered at state level.$*_{p<0.1}$, $**_{p<0.05}$, $***_{p<0.01}$

Table 5: Targeted moments

Moments	Data	Model
labor tightness	0.52	0.56
Separation rate	0.027	0.027
$i^\star(1)/i^\star(0)$	1.28	1.21

B Proofs

B.1 Proof of Lemma 1

Recall that from equations (4) and (5) we have:

$$U(0) = z + \beta\Big\{f(\theta)[\phi\, W(1,\bar{i}_1) + (1-\phi)\, W(0,\bar{i}_0)] + [1-f(\theta)]U(0)\Big\} \tag{27}$$

$$U(1) = z + \beta(1-\chi)\Big\{f(\theta)[\phi\, W(1,\bar{i}_1) + (1-\phi)\, W(0,\bar{i}_0)] + [1-f(\theta)]U(0)\Big\} + \beta\chi\mathbb{E}[U(b')]$$

Replacing $U(0)$ in $U(1)$ expression yields:

$$U(1) = z + (1-\chi)[U(0)-z] + \beta\chi[\mu U(0) + (1-\mu)U(1)] \tag{28}$$

Rearranging equation (28) to obtain:

$$(1-\beta)U(0) = z + \big[\beta(1-\mu) - \frac{1}{\chi}\big]\Delta U \tag{29}$$

Where $\Delta U = U(1) - U(0)$.
Now, using equation (27) we obtain:

$$(1-\beta)U(0) = z + \beta f(\theta)\Big[\phi\, W(1,\bar{i}_1) + (1-\phi)\, W(0,\bar{i}_0) - U(0)\Big] \tag{30}$$

Hence, by using Nash bargaining conditions: $W(1,\bar{i}_1) - U(1) = \rho S(1,\bar{i}_1)$ and $W(0,\bar{i}_0) - U(0) = \rho S(0,\bar{i}_o)$, we can rewrite (30) as:

$$(1-\beta)U(0) = z + \beta f(\theta)\Big\{\rho\Big[\phi S(1,\bar{i}_1) + (1-\phi)S(0,\bar{i}_0)\Big] + \phi\Delta U\Big\} \tag{31}$$

Subtracting terms at each side of equations 29 and 31 yields:

$$\Big[-1 + \chi\beta[1-\mu-\phi f(\theta)]\Big]\Delta U = \chi\beta f(\theta)\rho\Big[\phi S(1,\bar{i}_1) + (1-\phi)S(0,\bar{i}_0)\Big] \tag{32}$$

There are two cases:

- Case 1 : $1-\mu-\phi f(\theta) \leq 0$

In this case we have $\Big[-1+\chi\beta[1-\mu-\phi f(\theta)]\Big] < 0$ and assuming that both types of jobs exist in equilibrium $S(1,\bar{i}_1) > 0$ and $S(0,\bar{i}_0) > 0$ meaning positive surpluses, then (32) yields $\Delta U < 0$, that is $U(1) < U(0)$

- Case 2 : $1-\mu-\phi f(\theta) > 0$

In this case we have $0 < 1-\mu-\phi f(\theta) < 1$, since $\mu+\phi f(\theta) > 0$. Hence $0 < \chi\beta[1-\mu-\phi f(\theta)] < \chi\beta < 1$. Finally $-1 < \Big[-1+\chi\beta[1-\mu-\phi f(\theta)]\Big] < 0$. Again, assuming that both types of jobs exist in equilibrium $S(1,\bar{i}_1) > 0$ and $S(0,\bar{i}_0) > 0$ meaning positive surpluses, then (32) yields $\Delta U < 0$, that is $U(1) < U(0)$. Notice that if NCAs contract are unenforceable ($\chi = 0$) then $U(0) = U(1)$, that is NCAs constrained and unconstrained workers have the same outside option value.
In all cases, we have $U(1) < U(0)$, so long as $\chi > 0$.

B.2 Proof of Proposition 1

From equation (3), we have:

$$W(b,i) = w(b,i) + \beta\Big\{\delta U(b) + (1-\delta)\mathbb{E}_\varepsilon \max\left\{W(b,i)+\varepsilon, U(b)\right\}\Big\} \tag{33}$$

But,

$$\max\Big\{W(b,i)+\varepsilon, U(b)\Big\} = \begin{cases} W(b,i)+\varepsilon & \text{if } \varepsilon \geq \bar{\varepsilon}(b,i) \\ U(b) & \text{otherwise} \end{cases}$$

where $\bar{\varepsilon}(b,i) = U(b) - W(b,i)$. Hence, rewriting equation (32) reads:

$$W(b,i) = w(b,i) + \beta\Big\{\delta U(b) + (1-\delta)(1-G(\bar{\varepsilon}(b,i)))\mathbb{E}_\varepsilon\big[W(b,i)+\varepsilon|\varepsilon > \bar{\varepsilon}(b,i)\big] + (1-\delta)U(b)G(\bar{\varepsilon}(b,i))\Big\}$$

That is:

$$W(b,i) = w(b,i) + \beta\Big\{U(b)\tilde{G}(\bar{\varepsilon}(b,i)) + (1-\delta)(1-G(\bar{\varepsilon}(b,i)))W(b,i) + (1-\delta)\int_{\bar{\varepsilon}(b,i)} \varepsilon dG(\varepsilon)\Big\} \tag{34}$$

where $\tilde{G}(\bar{\varepsilon}(b,i)) = (1-\delta)\,G(\bar{\varepsilon}(b,i)) + \delta$. Now reorganizing and using $\bar{\varepsilon}(b,i) = U(b) - W(b,i)$ yields:

$$(1-\beta)W(b,i) = w(b,i) + \beta\left[(1-\delta)\,G(\bar{\varepsilon}(b,i)) + \delta\right]\bar{\varepsilon}(b,i) + \beta(1-\delta)\int_{\bar{\varepsilon}(b,i)} \varepsilon dG(\varepsilon) \tag{35}$$

Furthermore, from equation (8), we have:

$$J(b,i) = p + i - w(b,i) + \beta\Big\{\delta V + (1-\delta)[(1-G(\bar{\varepsilon}(b,i)))J(b,i) + G(\bar{\varepsilon}(b,i))V]\Big\} \tag{36}$$

With free-entry condition (V=0) and rearrangement, we obtain:

$$(1-\beta)J(b,i) = p + i - w(b,i) - \beta\left[(1-\delta)\,G(\bar{\varepsilon}(b,i)) + \delta\right] J(b,i) \tag{37}$$

Total surplus: $S(b,i) = W(b,i) + J(b,i) - U(b)$ and $\bar{\varepsilon}(b,i) = U(b) - W(b,i)$. Hence, by summing up equations (35) and (37) and subtracting $(1-\beta)U(b)$ reads:

$$(1-\beta)S(b,i) = p + i + \beta\left[(1-\delta)\,G(\bar{\varepsilon}(b,i)) + \delta\right]\bar{\varepsilon}(b,i) + \beta(1-\delta)\int_{\bar{\varepsilon}(b,i)} \varepsilon dG(\varepsilon) \tag{38}$$

$$-\beta\left[(1-\delta)\,G(\bar{\varepsilon}(b,i)) + \delta\right] J(b,i) - (1-\beta)U(b) \tag{39}$$

Using Nash bargaining: $W(b,i) - U(b) = \rho S(b,i)$ and $J(b,i) = (1-\rho)S(b,i)$. Therefore :

$$(1-\beta)S(b,i) = p + i - \beta\left[(1-\delta)\,G(-\rho S(b,i)) + \delta\right] S(b,i) - (1-\beta)U(b) \tag{40}$$

$$+\beta(1-\delta)\int_{-\rho S(b,i)} \varepsilon dG(\varepsilon) \tag{41}$$

Hence Total surplus $S(b,i)$ for $b = 0,1$ satisfies equation 41 and depends on training intensity i and NCAs job status b. From equation 41, conditional on training intensity i, the only difference between the NCAs total match surplus and the one without NCAs comes form difference in the outside option value U of both types of job. Since $U(1) < U(0)$ as shown in Lemma 1, the proposition 1 holds.

B.3 Proof of Proposition 2

Given Aggregate variables, η, u and θ, Firm's optimal investment $(i^\star(0), i^\star(1))$ for NCAs job and job without NCAs respectively solve:

$$(1-\rho)S'(0, i^\star(0)) = C'(i^\star(0)) \tag{42}$$

$$(1-\rho)S'(1, i^\star(1)) = C'(i^\star(1)) \tag{43}$$

Differentiate (41) for $b = 0,1$ give:

$$(1-\beta)S'(b,i) = 1 - \beta\left[(1-\delta)\,G(-\rho S(b,i)) + \delta\right] S'(b,i) + \tag{44}$$

$$\beta\,(1-\delta)\rho(1-\rho)S'(b,i)S(b,i)\frac{\partial G}{\partial \varepsilon}(-\rho S(b,i)) \tag{45}$$

I guess and verify that $\frac{\partial G}{\partial \varepsilon}(-\rho S(b,i)) = 0$ and therefore we obtain:

$$S'(b,i) = \frac{1}{1 - \beta[1 - \tilde{G}(-\rho S(b,i))]} \tag{46}$$

where $\tilde{G}(-\rho S(b,i)) = (1-\delta)\, G(-\rho S(b,i)) + \delta$. Optimal investment condition becomes for $b = 0, 1$:

$$\underbrace{\frac{1-\rho}{1-\beta[1-\tilde{G}(-\rho S(b,i))]}}_{\text{Marginal benefit}} = \underbrace{C'(i)}_{\text{Marginal cost}} \tag{47}$$

Using proposition 1, conditional on training, the marginal benefit of investing in NCAs job is higher relative to the job without NCAs. Hence NCAs worker receives higher training. Finally, total match surplus is higher with NCAs job. Since separation rate is decreasing function of match surplus, therefore NCAs worker experiences lower separation rate.