Exploding Offers: Adverse Selection and Stealing

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Review of Integrative Business & Economics Research

ABSTRACT
I study adverse selection and stealing workers when making exploding offers. I show that lower ranking firms can steal workers from higher ranking firms by making exploding offers. When competitive pressure is high, workers receive zero wage exploding offers and all workers are weakly worse off.

Keywords: early contracting, exploding offer.

1. INTRODUCTION

There are two types of exploding offers. The classic exploding offer refers to early contracting between workers and firms before uncertainty of worker quality is fully realized; another type refers to offers by the firm to lock down worker commitment before workers' search process is completed. The main difference between the two comes form the information held by the worker - worker has as the same limited information as firms in the first case and holds better information than firms in the second case.

The first type exploding offers are well studied under the context of early contracting between professional students and employers years before graduation. Such form of early contracting are causes of market unraveling which leads to suboptimal ex-post matching. This is seen in Li & Rosen (1998), Li & Suen (2000), Suen(2000) and Halaburda (2010). Li & Rosen(1988) proposed that this form of early contracting serves as an insurance mechanism between high quality workers and low quality firm before workers' quality uncertainty is realized. High quality worker is insured against future unemployment and low quality firm managed to hire a high quality worker that would not have been possible ex-post. In this case, \textbf{ex-post} matching efficiency is traded for \textbf{ex-ante} insurance benefits. One firm's incentive to contract early induces others to compete by also making exploding offers. When early contracting is common, the loss of matching efficiency and lack of investment incentive becomes a problem. Examples include the judicial clerkship and medicine graduates in the USA (Roth Niederle 2009). Centralized market is often proposed as a solution in markets plagued with such form of exploding offers. The medical graduate goes into a program called the "National Resident Matching Program" which performs a centralized matching between graduates and hospitals. The program has achieve considerable success and considered a success story for centralized matching markets.

A centralized system is often not a feasible solution in many markets, such as the general employment market. In fact, the type of exploding offers in regular employment market falls into the second type, where the job seeker has better self quality information than

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

prospective employers. For example, upon graduation, a candidate's relevant abilities has already been realized and the candidate knows more about their own ability than prospective employers. This introduces the problem of adverse selection in the insurance mechanism. While the employer is trying to recruit high quality workers, they also worry that only the low quality workers would accept the offer. The candidate judges the trade off between a taking a mediocre offer and waiting for a good offer risking potential no-offer. Many career counseling considered exploding offers as "exploitative" and worry about unintended bad selection (Huffington). Experimental studies suggest that workers that accepted the offers are likely to develop negative feelings and have lower morales. (Lau et al 2014)

The goal of this paper is to set up a best case scenario for exploding offers to enhance welfare and improve ex-post efficiency. I identify the problem of "falling through the cracks" as documented by Cole et al. (2010), medium ranking schools would decline interview with seemingly high quality candidates, because they appear "ungettable" and the candidate might end up with no offers when the high ranking school find them insufficiently qualified. Hence the candidates get caught in the \textit{cracks} of being simultaneously "too good" and "not good enough". Roth, Niederle (2009) suggested that "exploding offers have the potentially positive effect of combating congestion by increasing the number of offers a firm can make". There is an obvious loss of ex-post matching efficiency here that can be used to demonstrate how the exploding offers can provide relief to. Specifically, I investigate whether lower ranking firms can "steal" high quality candidates and whether that benefits workers.

2. MODEL

I modify the two sided asymmetric information framework from Avery Levin (2009) by removing horizontal preferences and replaced with two sided vertical quality in Li Suen (2000) insurance. This allows us to study an environment with information asymmetry along with strong competition between firms. Firms have limited information about the job candidates, but the job candidates know their own quality. I consider competition between firms in established small markets, so capacity constraint is non-binding, no aggregate uncertainty and individual uncertainty is realized but not fully revealed to all parties.

2.1 Players

Job candidates are characterized by {t_1,t_2} in [0,1]^2. Two firms A,B are in the market and they value candidates differently.

$$\begin{aligned}\pi_A &= v_A - w_A \\ &= a(t_1 t_2 - \phi_A) - w_a \\ \pi_B &= v_B - w_B \\ &= t_1 t_2 - \phi_B - w_B\end{aligned}$$

where $a > 1, \phi_A > \phi_B$

Fig 1. Firms Payoff

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The firms only care about the product of types $t=t_1t_2$ and not their individual values t_1,t_2. Multiplicative specification mirrors the Cobb-Douglas production function with complementary characteristics. Firm A is the 'better firm' who has higher efficiency $a>1$, but is more selective in the candidate they pick $\phi_A>\phi_B$. Firm B while being less efficient, is willing hire more broadly. This paves way for a assortative matching result, where the lower types matches with Firm B and higher type matches with Firm A. I will say that the workers with $v_A(t)>v_B(t)$ *belongs* to Firm A and those with $v_B(t)>v_A(t)$ *belongs* to Firm B.

Job candidates has a mean-variance utility, so they prefer higher expected wages μ but discounts each unit of uncertainty (measured in standard deviation) σ^2 by β. I assume that cost of application is low, so job candidates applies to both firms. Candidates know their t_1 accurately, but only receive a noisy signal $s=t_2+e$ ($e\sim U[-\epsilon,+\epsilon]$)about their true quality. Candidates has an outside option with value normalized to zero.

$$u = \mu - 3\beta\sigma^2$$

Fig 2. Candidate Payoff

2.2 Timing

No Exploding Offer:

period 1. Firms observes t_1, they choose to pay c to interview candidates or exit the game.

period 2. Firms that interviewed candidates can make offers to worker. Candidate accepts the best offer, receives γ of the surplus and firm keeps $1-\gamma$ of the surplus.

With Exploding Offer:

period 1. Firms observes t_1, they choose to pay c to interview candidates, pay c' to make an exploding offer or exit the game. Exploding offers binding commitments, and firms that chose to make exploding offers cannot interview candidates.

period 2. Firms that interviewed candidates can make offers to worker. Candidate accepts the best offer, receives γ of the surplus and firm keeps $1-\gamma$ of the surplus.

In this setup, t_1 can be interpreted as the observed quality of the candidate, candidates with higher the observed quality can achieve higher actual quality. This makes them more likely to be $v_A>v_B$. Firms has to make a decision after only knowing the observed quality t_1, so if the firms interviews the candidate and discover good quality an offer is made, if else they makes no offer. In period 2, the Firm that can generate higher surplus is contracted with the candidate. The candidate receives γ and the firm receives $1-\gamma$ of total output as per simple Nash bargaining. In this period, if only one firm interviewed, candidates accepts the firm's contract if offered; if both firm interviewed, candidates that *belongs* to Firm A $v_A>v_B$ contracts with Firm A, candidates that *belongs* to Firm B $v_B> v_A$ contracts with Firm B. Since the players do not make any meaningful decisions in period 2, all the future equilibriums will only reference period 1 choices, knowing the players will follow directions in period 2.

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In case of multiple equilibrium, I borrow the *robust sort equilibrium* from Chade Lewis Smith (2014). The idea is that if both my left and right neighbors acts one way, then I also choose to act the same way. In a one dimensional setup, this leads to an easy equilibrium configuration where all player in a range will choose an the same equilibrium action. Instead of applying the refinement to individuals, I apply it to firm decisions when faced with candidates of different observed quality, so firm will choose the same action for some given t_1 range.

3. One Firm Equilibrium

Consider if Firm B is the only firm in the market. By backward induction, we know that if the Firm B searches after observing t_1, candidates who v_B(t)=t_1t_2-\phi_B>0 will receive \gamma of the value as wage. The expected profits for firm B to search is,

$$
\begin{aligned}
E[\pi_B] =& (1-\gamma)\int_{\frac{\phi_B}{t_1}}^{1} t_1 t_2 - \phi_B dt_2 \\
=& (1-\gamma)\frac{(t_1-\gamma)^2}{2t_1} - c
\end{aligned}
$$

Fig 3. One Firm B payoff

Proposition 1: One Firm Equilibrium

There exist t_1^{B1} s.t. Firm B interviews candidates t_1, if t_1^{B1}< t_1

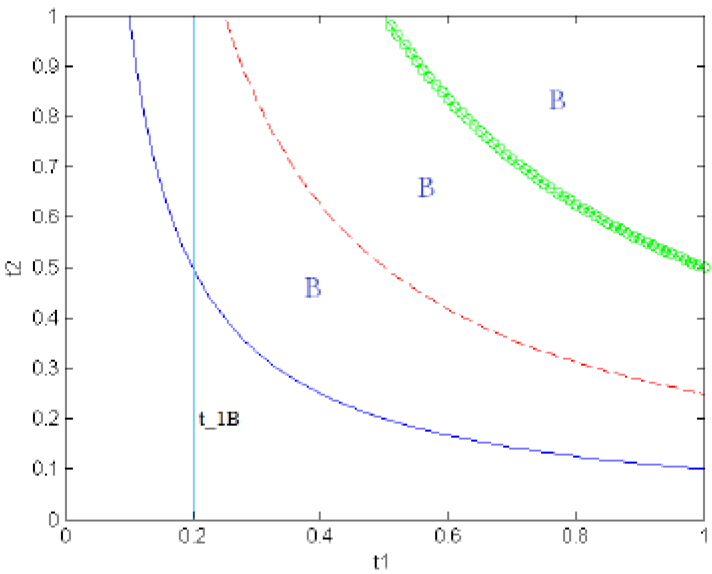

Fig 4. One Firm Equilibrium

The value is strictly increasing wrt t_1 for all t_1>\phi_B, so there exist a cutoff t_1^{B1} such that firm B always searches for any t_1 >t_1^{B1} and no search otherwise. As observed quality improves, Firm B is more likely to fetch a high quality candidate, so the expected value given t_1 is strictly increasing and Firm continues to search.

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4. Two Firm Equilibrium

Now Firm A and B are both active in the market. By backward induction we first compute the expected profit from entering search in period 1.

Only A

$$\begin{aligned} E[\pi_A^{only}] =&(1-\gamma)\int_{\frac{\phi}{t_1}}^{1} a(t_1t_2-\phi_A)dt_2 - c \\ =&(1-\gamma)a\frac{(t_1-\phi_A)^2}{2t_1} - c \end{aligned}$$

Only B

$$\begin{aligned} E[\pi_B^{only}] =&(1-\gamma)\int_{\frac{\gamma}{t_1}}^{1} t_1t_2-\phi_B dt_2 - c \\ =&(1-\gamma)\frac{(t_1-\phi_B)^2}{2t_1} - c \end{aligned}$$

A B Both

$$\begin{aligned} E[\pi_A^{both}] =&(1-\gamma)\int_{\frac{a\phi_A-\phi_B}{t_1(a-1)}}^{1} a(t_1t_2-\phi_A)dt_2 - c \\ =&\frac{a(1-\gamma)}{2t_1}\left[(t_1-\phi_A)^2 - \left(\frac{\phi_A-\phi_B}{a-1}\right)^2\right] - c \\ E[\pi_B^{both}] =&(1-\gamma)\int_{\frac{\gamma}{t_1}}^{\frac{a\phi_A-\phi_B}{t_1(a-1)}} t_1t_2-\phi_B dt_2 - c \\ =&(1-\gamma)\frac{1}{2t_1}\left(\frac{a(\phi_A-\phi_B)}{(a-1)}\right)^2 - c \end{aligned}$$

Fig 5. 2 Firm Payoffs

Note that E[\pi_A^{only}], E[\pi_B^{only}], E[\pi_A^{both}] are all increasing wrt to t_1 and only E[\pi_B^{both}] decreases wrt t_1. This means that when the firms are competing, Firm A will start to edge out on Firm B as t_1 increases, because the higher observed quality candidates are likely to be realized a high actual quality candidates that will choose Firm A over Firm B.

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Proposition 2: Two Firm No Exploding Offer Equilibirum. *There exist* $\overline{t_1^B}, \overline{t_1^A}, \underline{t_1^B}, \underline{t_1^A}$, *such that,*

1) Firm A interviews candidates t_1, *if* $\underline{t_1^A} \leq t_1 \leq \overline{t_1^A}$;

2) Firm B interviews candidates t_1, *if* $\underline{t_1^B} \leq t_1 \leq \overline{t_1^B}$;

3) $\underline{t_1^B} \leq \underline{t_1^A} \leq \overline{t_1^B} \leq \overline{t_1^A} = 1$

Fig 6. Prop 2

When Firm A is also in the market, Firm B stops interviewing candidates after t_1 gets too high. This is Firm B forfeiting interviewing the "ungettable" candidates described in Coles et al (2010) survey, the possibility of eventually hiring the candidate is so low that it is not worth the interview cost. Note that since Firm B hires more broadly given any t_1, there are some candidates with low t_2 that will "fall through the cracks" since Firm A does not make offers to them, they are marked with a "X" in the fig 6. Firm B's strategic avoidance of high t_1 candidates causes some "worthy" candidates to be sub-optimally matched with Firm A or not matched at all. This paves way for possible improvement when exploding offer becomes an alternative to interviewing.

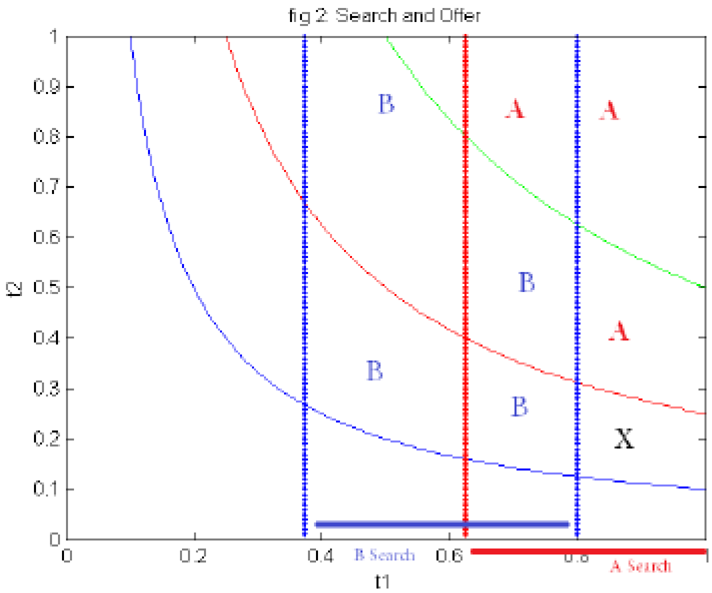

Fig 7 2 Firm Interview Equilibrium

4.1 Welfare

Total welfare generated is the sum of value of output minus total interview cost invested. When B joins the market, for any given t_1 the lower types t_2 is sorted with Firm B that generates higher output.

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$$
\begin{aligned}
W_A^{solo} =& a\frac{(t_1-\phi_A)^2}{2t_1} - c \\
W_A^{both} =& \frac{a}{2t_1}[(t_1-\phi_A)^2 - (\frac{\phi_A-\phi_B}{a-1})^2] - c \\
W_B^{both} =& \frac{1}{2t_1}\left(\frac{a(\phi_A-\phi_B)}{a-1}\right)^2 - c \\
W_{total}^{both} =& \frac{a}{2t_1}(t_1-\phi_A)^2 - \frac{a^2-a}{2t_1}\left(\frac{\phi_A-\phi_B}{a-1}\right)^2 - 2c
\end{aligned}
$$

Fig 8. 2 Firm Welfare

Since firms do not reap the full benefit of the interview actions, it is likely that there is a discrepancy between the social optimal action and actual private action. Compare the socially optimal point of exit and private exit decision by Firm B.

Social Efficient No-Interview

$$
\begin{aligned}
W_{total}^{both} >& W_A^{solo} \\
(\phi_A-\phi_B)^2\frac{a}{(a-1)} >& 2t_1c
\end{aligned}
$$

Firm B Private No-Interview Decision

$$
\begin{aligned}
\pi_B^{both} >& c \\
(\phi_A-\phi_B)^2(1-\gamma)\left(\frac{a}{(a-1)}\right)^2 >& 2t_1c
\end{aligned}
$$

Fig 9. Private decision and welfare optimizing decision

Proposition 3: Strategic Avoidance. *Comparing Firm B's private decision and socially optimal decision to interview:*
When $a\gamma > 1$, $\exists\ t_1$ s.t. Firm B inefficiently offer no interview;
When $a\gamma < 1$, $\exists\ t_1$ s.t. Firm B inefficiently offers too many interviews;
When $a\gamma = 1$, Firm B's private decision is socially optimal.

Fig 10. Prop 3

The term a\gamma represents the upward pressure on wages created by competition, created by the competing Firm A's higher production a and the bargaining power by the candidate \gamma. So when the competitive pressure is strong, Firm B will quit the market inefficiently early, because too a big part of the output is given away; when competitive pressure is low, Firm B will stay in the market inefficiently long since it can benefit from earning big share of output but does not produce enough to be socially efficient.

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In the case of "inefficient offering too many interviews", the brunt of welfare loss is borne by Firm A. In fig 2, note that when only Firm A is interviewing, the firm can hire some lower quality candidates that \textit{belongs} to Firm B, if Firm B also searches, Firm A loses those candidates. Candidates gain as they receive more offers and better offers when both firms are active. So there is little to worry about in this case as only the firm with superior position is hurt.

In the case of "inefficient offering no interview", the brunt of welfare loss is borne by the candidates. Similar logic as the last case, Firm A manages to hire more lower quality candidates, but candidates that would have been hired by Firm B either get lower wages or no offer at at. Candidates are being hurt by Firm B's strategic avoidance, this sets up a case where exploding can potentially make a positive impact.

5. Exploding Offer

Now I consider the case when firms can making exploding offers as an alternative to interview and offer.

Definition: Exploding Offer is a wage offer w that is independent of unobservable t_2 which the candidates has to make a committing decision before finding out offers from the other firm.

Definition: Stealing Candidates When one firm makes an exploding offer such that a candidate that *belonging* to the other firm will accept in favor of waiting for an offer.

Exploding offer is a fixed wage offer w, which candidates will receive regardless of their actual quality. The major difference with the interview process is that it by-passes the negotiating process. Real world exploding offers are often short windowed, allowing little amount of time to negotiate or make through decision. I investigate whether Firm B can steal candidates from Firm A while benefiting the candidates in general. Exploding offers have to be attractive to high quality candidates which pushes up the wage offer, so candidates benefit, but the adverse selection problem keep wages from going too high. Note that candidates are not fully aware of their own t_2, so the decision is made keeping in mind they are taking a risk. In this paper, I consider the case of candidates knowing rather accurately their true t_2, ie. small \epsilon, but firms does not know anything about t_2 aside from their prior. This contrasts the case of Li Suen (2000) where they considered workers and firm being equally ignorant on the realized true quality.

Profit of Firm i making an exploding offer while the other firm search:

$$\pi_i^{exploding} = \int_0^Q Pr(Accept(w)|t)v_i(t)dF(t|Q) - \int_0^Q Pr(Accept(w)|t)wdF(t|Q)$$

Fig11. Exploding offer profit

Every candidate receives a signal s(t_2)~ t_2+e which they use to decide their optimal choice,

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Definition 3: Highest Acceptance Signal. *Given any offer w, $s(w)$ denotes the highest signal that the workers received and would still accept the offer.*
$s(w) = sup\{s \in S = T + e | w \geq u(wait|s)\}$
Fig 12. Highest acceptance signal.

This means s(w) can be expressed as follow,

$$Pr(Accept(w)|t) = Pr(e < s(w) - t|t) = \begin{cases} 1 & if s(w) - t > \epsilon \\ \frac{s(w)-t+\epsilon}{2\epsilon} & if \epsilon \leq s(w) - t > -\epsilon \\ 0 & if -\epsilon > s(w) - tx \end{cases}$$

Fig 13. s(w)

The firm's problem becomes the choice of wage to attract highest quality worker,

$$\pi_i^{exploding} = \int_{s(w)-\epsilon}^{s(w)+\epsilon} v_i(t) \left[\frac{s(w) - t + \epsilon}{2\epsilon}\right] dF + \int_{\phi_B}^{s(w)-\epsilon} v_i(t)\ dF - \int_{s(w)-\epsilon}^{s(w)+\epsilon} w \left[\frac{s(w) - t + \epsilon}{2\epsilon}\right] dF - \int_0^{s(w)-\epsilon} w\ dF$$

Fig 14. Exploding Offer Profits 2

First, note that exploding wages attract all candidate below a certain t_2, since the good types are willing to wait and only the bad types accept. Secondly, note the discrepancy of the lower bound between the positive and negative terms, offers are made without knowing the true quality of workers, so there is alway a chance the offer would hire a "useless" candidate.

FOC

$$w^* = \begin{cases} \frac{(1-a\gamma)[\phi_A + \beta a\gamma\epsilon^2] - \phi_B}{(2-\frac{1}{a\gamma})} & if \quad > 0 \\ 0 & otherwise \end{cases}$$

$$s(w^*) = \frac{a\gamma\phi_A - \phi_B + \beta(a\gamma\epsilon)^2}{2a\gamma - 1}$$

SOC

$$a\gamma > \frac{1}{2}$$

Fig 15. FOC/SOC

Lemma 1. Positive Wage Offer
Necessary condition for Firm B to offer positive exploding offer requires: (1-a\gamma)>0

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Lemma 1 says that Firm B can only make a good offer when the competitive pressure is low. Sufficient condition requires that Firm A exclude many low quality candidates (high \phi_A) and candidates having high aversion towards uncertainty(high \beta). The optimal exploding offer is increasing in Firm A's exclusivity \phi_A, candidate uncertainty \epsilon and risk aversion \beta. As Firm A hires more exclusively, Firm B faces a lower competition in the medium value t_2, so Firm B can be more aggressive in trying to steal candidates. When candidate faces more uncertainty or more risk averse, then the value of making exploding offer increases allow Firm B to be more aggressive. The second-order condition a\gamma>1/2 ensures the existence of interior solution, violation of the condition implies that Firm B either makes an offer that all candidates accept or reject, which is well studied in Li Suen (2000) and not the focus of this paper. If we consider Firm A making exploding offer and Firm B going through the interview process, the SOC is more easily violate, but I am not interested in this case as only Firm B strategically avoiding interviews that causes welfare loss. Also, I assume the error in judgment \epsilon is small so only candidates near the cutoff has a chance to make the 'wrong' decision.

Define t^* as the minimal t s.t. v_A> v_B,

Proposition 5 : Steal Condition. *Steal is successful when ϵ is large enough.*

$$s(w^*) \geq t^*$$
$$(a-1)[\beta(a\gamma\epsilon)^2 + (2a\gamma - 1)\epsilon] \geq a\,[(a\gamma + a - 1)\phi_A - (2\gamma - 1)\phi_B]$$

Fig 16. Prop 5

Note the RHS is always greater than zero and LHS is increasing in \epsilon. The steal condition requires that \epsilon to be large enough for the steal to be successful. Contrasting the insurance explanation for exploding offers, when Firm B makes exploding offers to candidates, the only chance of good quality candidates to accept is for them to make mistakes. This means the candidates that belongs to Firm A never gets lured away from Firm B unless they make a mistake.

Corollary 1: Steal Candidates
Firm B cannot make competitive offers good enough to attract high quality workers without candidates making mistakes.

The good news is Firm B **can** steal candidates, bad news is that Firm B only steals when there is a **mistake** made by candidates.

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Propostion 6: Exploding Equilibirum. *Assuming c>c', Firm B switches to making exploding offers instead of exiting the market in some high* t_1,

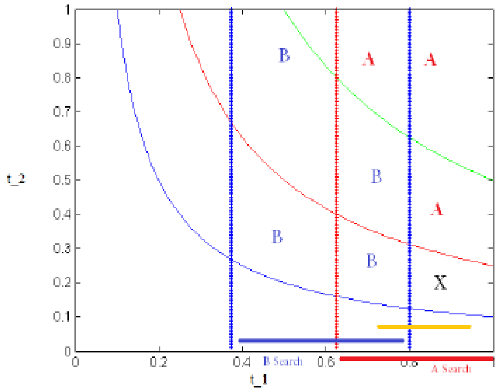

Fig 17. Prop 6

This is good news for welfare, as now Firm B makes offers instead of exiting the market. Note that exploding offer is made as an alternative to the interview-offer process, partly because of the lower cost, partly because of the newfound ability to control wage offer. The region of t_1 that Firm B would choose to offer is dependent on parameter assumptions, instead, I consider qualitative change to welfare when Firm B chooses to make exploding offers.

5.1 Welfare

Remember when competitive pressure is high a\gamma>1, Firm B exhibits "inefficient avoidance"; when competitive pressure is low a\gamma<1, Firm B exhibits "inefficient competition". I compare the benefit generated in Firm B's private decision to make exploding offers.

Inefficient Competition $a\gamma < 1$

$$w^* = \frac{(1-a\gamma)[\phi_A + \beta a\gamma\epsilon^2] - \phi_B}{(2-\frac{1}{a\gamma})}$$

$$s(w^*) = \frac{a\gamma\phi_A - \phi_B + \beta(a\gamma\epsilon)^2}{2a\gamma - 1}$$

Fig 18. Inefficient Competition

Exploding offers are made in range of t_1 where interview was and was not offered. Compared to the case when Firm B offered interviews, exploding offers comes with a positive wage because of the low competitive pressure, so the lowest quality candidates receives a positive wage offer instead of not receiving offers. However, for the mid quality candidates, the exploding offer can be better or worse than their original interview offers, so it is unclear whether Firm A loses or gains candidates. Allocative efficiency weakly goes down, as candidates make mistakes. Compared to the case when firm B makes no offer, positive wage is an improvement for candidates who were "falling through the cracks" and v_B=0 zero value candidates. Firm A loses candidates in the lower end of its hiring limit.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

Overall, the welfare change is unclear and Firm B paid for zero value candidate with positive wage.

Inefficient Avoidance $a\gamma > 1$

$$\begin{aligned} w^* &= 0 \\ s(w^*) &= \phi_A + \beta a \gamma \epsilon^2 \end{aligned}$$

Fig 19. Inefficient Avoidance

Exploding offers are made in range of t_1 where interview was and was not offered. Since competitive pressure is high, Firm B cannot offer a high enough wage to attract good candidates without paying for low worth candidates, so the wage is forced down to zero. Compared to the case when firm B offered interviews, Firm A gains some medium quality candidates but the candidates are worse off as they receive lower wage from Firm A, other candidates below Firm A's qualification t_1t_2<\phi_A but above Firm B's qualification t_1t_2>\phi_B are also worse off as they are now receive a zero wage offer instead of a positive wage offer. Compared to the case when Firm B does not offer interviews, Firm A and candidates experiences no change. Overall, candidates are weakly worse off, Firm A loses nothing, Firm B weakly gains positive worth candidates at no cost.

This means the Firm B pockets all the potential benefits by taking candidates with positive worth at zero price that Firm A is not interested in. The high competitive pressure condition that caused the problem of "inefficient avoidance" and "falling through cracks", forces the exploding offer wage to zero and none of the benefits from increased output goes to the candidates.

6. Conclusion

I showed that exploding offers have the potential for lower ranking firms to steal candidates from higher ranking firms. If the competitive pressure is low, exploding offer is an alternative way to increase offers and low quality candidates gain positive wage offers, while mid/high quality candidate can be better or worse off. If competitive pressure is high, exploding offer cannot provide a positive wage to candidates because of adverse selection problem, candidates are weakly worse off as a result.

There is no evidence that suggests exploding offer can benefit candidates in the market especially in the case of "inefficient avoidance" which we are worried about. Roth Niederle's (2009) conjecture that exploding offers can increase offers is confirmed, but it did not result in welfare gain or candidate benefit.

Managerial implications of this study would be to advise against making exploding offers. As long as there is lingering doubt in the actual quality of the candidate, the chance of stealing a good worker is not worth the risk of hiring sub par one. Also, successful stealing depends on a "mistake" made by the worker so there are chances of selecting mistake prone candidates. Job candidates should be wary in accepting such offers, since the offer is only the right choice if the candidate is of bad quality. Undoubtedly, this does create big problems and small benefits for less experienced candidates, but whether the practice of exploding offers should be banned or regulated requires more scrutiny. Alternative ways of

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sharing output and dynamic version of the game that allows recontracting between the two party can channel benefits from exploding offers to the workers, thus allowing the candidates to also benefit from the practice.

7. Appendix

Prop 2.

$\underline{t_1^B}$:

$$E[\pi_B^{only}] > 0$$
$$(1-\gamma)\frac{(t_1-\phi_B)^2}{2t_1} - c > 0$$

$\underline{t_1^A}$:

$$E[\pi_A^{both}] > 0$$
$$\frac{a(1-\gamma)}{2t_1}\left[(t_1-\phi_A)^2 - \left(\frac{\phi_A-\phi_B}{a-1}\right)^2\right] - c > 0$$

$\overline{t_1^B}$:

$$E[\pi_B^{both}] > 0$$
$$(1-\gamma)\frac{1}{2t_1}\left(\frac{a(\phi_A-\phi_B)}{(a-1)}\right)^2 - c > 0$$

Fig 20. Appendix

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