Wage Fairness in a Subcontracted Labor Market*

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Abstract: Labor market subcontracting is a global phenomenon. This paper presents a theory of wage fairness in a subcontracted labor market, where workers confront multi-party employment relationships and deep wage inequities between regular and subcontractor-mediated hires. We show that subcontracting derives its appeal from a downward revision of workers' fair wage demand when producers delegate employment decisions down the supply chain. Furthermore, subcontracting creates a holdup problem, resulting in wages that workers deem unfair, along with adverse worker morale consequences in equilibrium. These insights reveal the efficiency costs of subcontracting as an employer strategy to redress workers' demand for fair wages.

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"[T]he evidence of fissuring creates a great puzzle to labor economics and social science more broadly. We need a new "fissured market" model that goes beyond standard analysis, new measures of wage determinants in the existing framework, or some judicious mixture of the two." Freeman (2014).

1 Introduction

Why do employers who practice wage fairness to bolster the morale of their own workers nonetheless employ subcontractors who pay unfair wages? The seminal insight of the fair wage-effort hypothesis (Akerlof and Yellen 1988, 1990) holds that workers' fair wage preference and the prospect of low morale and worker reprisal jointly compel profit maximizing employers to pay fair wages to their own workers. This hypothesis has inspired a large empirical literature demonstrating the relevance of wage fairness in the lab and in the field (Fehr and Schmidt 1999; Verhoogen, Burks and Carpenter 2004; Amiti and Davis 2012, Breza, Kaur and Shamdasini 2018). The co-existence of fair and unfair wages for the same work by similar workers, according to this hypothesis, is fundamentally inconsistent with profit maximizing behavior.

In recent years, the advantages that fair wages supposedly confer have been called into question as labor markets worldwide have become increasingly fissured (Weil 2014; Freeman 2014). Often, the typical labor contract no longer resembles the single employer-single worker relationship depicted in canonical labor market models. Instead, multiple organizations are involved in layers of subcontracted hiring and wage contract relationships (Bernhardt 2014; ILO 2015). Subcontracted workers, henceforth contract workers, perform work for client employers, but they are direct employees of subcontractors. Contract workers routinely receive less pay than other regular workers directly hired by employers (Dube and Kaplan 2010; Goldschmidt and Schmieder 2017; Basu, Chau and Soundararajan 2018). The contract wage penalty is non-trivial, and by some estimates the penalty can be as high as 60% in developing countries, and 34% in developed countries (ILO 2015). Such wage inequities have led to concerns about the erosion of worker morale among contract workers (Panagariya 2004), and outright work disruption due to strikes and labor disputes.[1]

[1] For example, labor disputes related to contract labor have triggered strikes in motor vehicle production

Worldwide, workers directly affected by fissuring drastically outnumber those involved in strikes and labor disputes. For example, in India the coexistence of regular and contract workers in the same establishment is common, and contract employment accounts for over 65% of the man days hired in Indian manufacturing in the last decade where subcontractors are deployed (Ramaswamy 2013; Soundararajan 2015).[2] Katz and Krueger (2016) documents drastic increases in the share of non-traditional work arrangements such as contract work in total employment in the U.S. from 10.7% to 15.8% between 2005 and 2015, and close to half of this increase was due to temporary and contract work. Goldschmidt and Schmieder (2017) uses administrative data on the universe of workers and firms in Germany to demonstrate a recent sharp rise in subcontracting in business service, food, cleaning and security service occupations.

In addition to widespread wage inequities, an essential feature of the subcontracted workplace is the emergence of employment intermediaries. One example of such intermediaries is staffing agencies. India for example has seen a more than ten-fold increase from about 1,000 nation-wide to 12,000 between 1998-2005 according to the Economic Census of India 1998 and 2005 (Bertrand et al. 2017). The U.S. has likewise witnessed a similar surge in staffing and employment agencies (Bernhardt 2014). Yet the staffing industry is but the tip of the iceberg. Janitorial services is a notable example (e.g. Abraham and Taylor 1996), where over 850,000 subcontracting establishments in 2015 employed 1.8 million workers in the U.S (Hinkley et al. 2016). Employers benefit from keen competition between subcontractors (Weil 2014). But subcontractors are not just fly-by-night operators who enjoy free entry (Bernhardt 2014). Table 1 presents data from the U.S. Census (2007) on select industries where contract employment is reportedly common (Gochfeld and Mohr 2007, ILO 2015, Katz and Krueger 2016, Appelbaum 2017). The four(eight)-firm concentration ratios range from 10.5% (14%) in janitorial service to 37% (53.2%) in waste treatment and disposal. Employment per establishment likewise vary considerably, ranging from 17.5 in janitorial service to 95.3 in temporary help service.

in India (Seghal 2012; Gulati 2012), among airport workers in the United States (Burdo 2016). The issue has also triggered mass general strikes in Greece (Kitsantonis 2017).

[2]Likewise in many low income country labor markets (ILO 2015), the importance of subcontractors have been growing. Over 50% of the knitwear factories in Bangladesh, for example, uses contract labor (Chan 2013).

The salient features of the fissured labor markets are thus two-fold: (i) wage inequities between regular and contract workers and (ii) the emergence of subcontracting intermediaries with various degrees of entry barriers. This paper develops the basic analytics of a subcontracted labor market in the presence of a fair wage-effort relationship with these two salient features in mind. Our objective is to examine the determinants and the welfare properties of such a labor market equilibrium.

The fair wage-effort hypothesis is first and foremost about a fair division of a worker's contribution to firm revenue. In a regular work contract, the regular fair wage accomplishes the task by stipulating a sharing rule that divides the value of a worker's effort between worker and the direct employer. In a subcontracted labor market, workers do the same work but now confront the subcontractor as employer. Thus the fair wage for contract work will need to account for the value of a worker's effort from the perspective of a subcontractor. As long as subcontractors are unable to claim the full share of the value of the worker's effort the way a direct employer can, the delegation of hiring and wage authorities down the supply chain can depress the (contract) fair wage.[3] As a first consequence of the contractual duality between regular and contract workers, we show that the fair wage for contract work can indeed be distorted downwards, symptomatic of a less favorable rent sharing environment for workers. Importantly, observations and empirical studies that demonstrate a similar sharp reduction in subcontracted workers' ability to share rents with employers relative to regular workers are available notably in the U.S. (Appelbaum 2017, Weil 2017) as well as in Germany (Goldsmith and Schmieder 2017). Our model is the first attempt at rationalizing these findings in a fair wage framework.

Next, we show that with but one exception – a zero-cost subcontracting industry – there is no guarantee that contract workers will even receive the contract fair wage. We show that this important departure from the standard fair wage model prediction is the result of a subcontracting holdup: As subcontractors are not the direct residual claimants of workers' effort, they do not correctly internalize the productivity implications of paying the fair wage. Meanwhile, client employers do not set wages, but instead set

[3] In our model, we allow the contract fair wage to flexibly incorporate rent sharing between the subcontractor, the direct employer and the worker.

a subcontractor price. Since there is no credible assurance that high price automatically translates into high wage and high morale among contract workers (Rajeev 2009; Weil 2014), a low morale-low effort equilibrium thus ensues. Importantly, when employers harbor rational expectations, these effort consequences feed back into the client employers' decision-making calculus, and in turn justify the payment of low subcontractor price to begin with.

In a nutshell, we show that whenever multi-party employment distorts the fair wage downwards, profit maximizing employers may prefer subcontracting to take advantage of a more favorable rent sharing relationship. We find that this preference per se does not spell efficiency losses, but only in a special case where subcontracting is operation cost- and entry cost-free. Anything short will give rise to a subcontracting holdup, and the non-payment of the contract fair wage. Efficiency losses now arise when workers do not utilize their full productive potential as a result of low morale in equilibrium. These observations provide the basic analytics of a subcontracted labor market. The robustness of these observations are checked in four extensions, to include endogenous social opportunity cost of labor, endogenous labor supply, alternative fair wage specifications, and other existing forms of labor market distortions.

This paper speaks to the broader literature on the determinants and implication of the subcontracting of work. Existing studies have incorporated subcontracting as a response to a need for flexibility and specialized skills (Abraham and Taylor 1996), high wages due to labor market regulations (Boeri 2011), efficiency concerns (Basu, Chau and Soundararajan 2018), and cross-country wage cost differences (Feenstra and Hanson 2006, Grossman and Rossi-Hansberg 2008, Chaurey 2015). The coexistence of regular and contract work has been shown to raise profits when subcontractor bargaining power is endogenous and rises with output (Stenbacka and Tombak 2012), and when competition among subcontractors and input suppliers lowers cost (Shy and Stenbacka 2003) for example. This paper contributes to this burgeoning literature by establishing the role of fair wage preference in bolstering producer's desire to engage in subcontracting.

The growing importance of subcontracting has also inspired studies on within-establishments wage inequality (Barth et al 2016). The key findings so far are that the status of a contract worker delivers a wage penalty (Ahsan and Pagés 2007), even after accounting for worker and firm level characteristics (Goldsmith and Schmieder 2017). Freeman (2014) refers to this growing wage inequality within establishments as a "great puzzle" that cannot be easily understood using basic labor market models. In this context, this paper reconciles the puzzle by showing that a two-tiered wage structure of fair and unfair wages within the same establishment can be rationalized as a result of a holdup problem endemic to the institution of subcontracting.

The rest of this paper is organized as follows. In Section 2, we present the model of fair wage and subcontracts. In Section 3, we examine the fair wage equilibrium, the conditions for co-existence of regular and contract work, and the welfare properties of such an equilibrium. Section 4 concludes and discusses extensions.

2 A Model of Fair Wage and Subcontracts

Consider a small open economy home to a workforce of size $\mathcal{L}$. There are two traded commodities: (i) a homogeneous good, with production and consumption quantities respectively x^o and c^o, and (ii) a differentiated good, consisting of a continuum of unique varieties $k \in [0,1]$. Within this range of varieties, a subset $i \in [0,n]$ represents varieties that are produced and consumed domestically at quantities x_i and c_i respectively, while $j \in (n,1]$ represent imported varieties at quantity c_j. Consumer preferences are given by:

$$U = \alpha \ln c^o + (1-\alpha) \ln \left(\int_0^1 (c_k)^\rho \, dk \right)^{\frac{1}{\rho}}$$

where $\alpha \in (0,1)$ is a consumption share parameter, and $1/(1-\rho) > 0$ denotes the elasticity of substitution between varieties. Let Y denote the level of world income that all producers take into account as they gauge total demand for the varieties they produce. The demand function $x_k(p_k, P, Y)$ facing the producer of variety $k \in [0,1]$ is

$$x_k(p_k, P, Y) = (1-\alpha) Y \left(\frac{p_k}{P} \right)^{\frac{1}{\rho - 1}}$$

where P denotes a price index of the differentiated goods

$$P = \left(\int_0^1 p_k^{\frac{\rho}{\rho-1}} \, dk \right)^{\rho - 1}.$$

Henceforth, we take the homogeneous good as the numeraire. Units are expressed in such a way that one unit of output of any variety $k \in [0,1]$ requires 1 effective unit of labor input, and one unit of the homogeneous good requires $1/w^o$ units of effective labor input. We assume that labor market in the homogeneous goods sector is competitive, where anyone who needs a job can find one at wage w^o. w^o thus denotes the reservation wage for any worker contemplating employment in the differentiated goods sector.

2.1 The Regular Fair Wage in a Single-employer Relationship

The fair wage-effort hypothesis (Akerlof and Yellen 1990) posits that if wage payment does not meet the level workers deem fair, $\bar{w}$, henceforth the fair wage, worker reprisal in the form of a proportionate reduction in effort occurs:

$$e(w) = \min\{\frac{w}{\bar{w}}, 1\}. \tag{1}$$

As in Akerlof and Yellen (1990), the fair wage is given by the weighted average of the value of the marginal value product of a worker at full effort, p_k, and the wage the workers can expect if she opts out of the fair wage contract, w^o respectively.[4]

$$\bar{w} = \beta p_k + (1-\beta) w^o \tag{2}$$

where $\beta \in [0,1]$ is a fairness preference parameter indicating workers' desire for pay commensurate with productivity p_k.[5]

2.2 A Fair Wage Equilibrium with Regular Work

A fair wage equilibrium with regular work is given by a wage and price pair (w_k, p_k) for each variety $k \in [0,n]$, and an allocation of workers between the differentiated and homogeneous goods sector such that each producer maximizes profits by choice of (w_k, p_k) taking as given world demand Y and the world price index P:

$$\pi_k(w_k, p_k, P, Y) = \left(p_k - \frac{w_k}{e(w_k)}\right) x(p_k, P, Y), \tag{3}$$

[4]In Section 4, we consider alternative specification of the fair wage as well as the opt out wage.

[5]In the homogeneous goods sector, marginal product pricing guarantees that all workers provide full effort.

subject to the fair wage-effort relationship in (1), and a fair regular wage given by

$$\bar{w}_k = \beta p_k + (1-\beta)w^o. \tag{4}$$

Equilibrium allocation of workers between employment in the homogeneous (L^o) and regular employment in the differentiated (L_r) goods sector follows:

$$L_r + L^o \equiv \int_0^n x(p_k, P, Y)dk + L^o = \mathcal{L}. \tag{5}$$

From (1), the prospect of worker reprisal in the event $w_k < \bar{w}_k$ implies that the effective wage cost per unit labor is equal to the fair wage itself $w_k/e(w_k) = \bar{w}_k$. This is the seminal Akerlof and Yellen (1990) insight – paying regular workers the fair wage is profit maximizing. Wage fairness among regular workers in the differentiated goods sector also gives rise to a segmented labor market where high wage workers are employed in a sector where employment is rationed. To see this:

$$p_k^* = argmax_{p_k}(p_k - \bar{w}_k)x(p_k, P, Y) = argmax_{p_k}(1-\beta)(p_k - w^o)x(p_k, P, Y) = \frac{w^o}{\rho}. \tag{6}$$

Paying the fair wage reduces employers profits to a share $(1-\beta)$ of the total profits with as shown in (6). Other than this distributional change, employers continue to tack on the profit maximizing markup $p_k/w^o = 1/\rho > 1$. By definition of the fair wage in (2), this implies that the fair wage $\bar{w}_k$ is itself is a markup over the reservation wage:

$$\bar{w}_k = (1+\theta)w^o, \quad \theta \equiv \beta(1-\rho)/\rho. \tag{7}$$

The equilibrium fair wage thus extracts β share of the monopoly rent since:

$$\frac{p_k - w^o}{w^o} = \frac{1-\rho}{\rho} > \frac{\beta(1-\rho)}{\rho} = \frac{\bar{w}_k - w^o}{w^o}.$$

The corresponding number of jobs available in the high wage differentiated goods sector is rationed and based on demand conditions, $nx(\frac{w^o}{\rho}, P, Y)$. The equilibrium price index P depends of course on technologies and reservation wages in the rest of the world. We assume a small country environment where the price index P as well as total world income Y are given internationally.[6]

[6] In footnote (10), we discuss the implications of dispensing with the small country assumption that P is constant.

Proposition 1. *In a fair wage equilibrium with only regular employment, all workers in the differentiated goods sector are paid the fair wage, $\bar{w}_k = w^o(1+\theta) > w^o$, which includes an employer-to-worker transfer of β fraction of monopoly rent, $\theta = \beta(1-\rho)/\rho$.*

2.3 The Contract Fair Wage in a Multi-party Employment Relationship

Let L_r and L_c denote regular and contract employment in the differentiated goods sector. Consider the entry of subcontractors who act on behalf of producers to make employ offers to job seekers not otherwise regularly employed in the differentiated sector $(\mathcal{L} - L_r)$. Subcontractors engage in two types of contracts: (i) with producers as a supplier of contract labor at price p_c, and (ii) with job seekers to satisfy contract labor demand at wage w_c. To incorporate the cost of recruiting workers in a transparent way, let $\delta \in [0,1]$ denote the fraction of revenue forgone for each worker the subcontractor attempts to recruit. δ is our parameter for entry cost, evaluated at a per worker recruited basis.

Within a multi-party employment relationship, we specify the contract fair wage to flexibly account for both the value of the contract worker to the subcontractor $p_c(1-\delta)$, and the value of the contract worker to the producer at full effort, p_k. The weight $\gamma \in [0,1]$ indicates the relative importance associated with the subcontractor value $p_c(1-\delta)$:[7]

$$\bar{w}_c = \beta[\gamma p_c(1-\delta) + (1-\gamma)p_k] + (1-\beta)w^o. \tag{8}$$

The effort levels respectively of contract and regular workers continue to depend on any wage shortfalls relative to the contract-specific fair wages:

$$e_c = \min\{\frac{w_c}{\bar{w}_c}, 1\}, \quad e_k = \min\{\frac{w_k}{\bar{w}_k}, 1\}. \tag{9}$$

From (2) and (8), contract worker's fair wage demand is strictly less that of regular workers if and only if $p_c(1-\delta) < p_k$ and $\gamma > 0$. Effectively, the fair wage as perceived by contract workers is distorted downwards whenever the subcontractor does not claim the full marginal product of a worker at full effort: $p_k - p_c(1-\delta) > 0$. But will contract workers be paid the contract fair wage? We turn this next by inspecting the contract between

[7]Since subcontractors are smaller in scale typically (Table 1), one may argue that β may be reduced when workers are inequality averse with respect to the income of the employer (Fehr and Schmidt 1999). While we refrain from modeling such considerations explicitly here, such a change will only strengthen our findings below.

producers and subcontractors, and the contract between subcontractors and workers.

Contracting between Producers and Subcontractors

Subcontracting delegates direct control over wages to subcontractors. Rajeev (2009) and Weil (2014) suggest that employers are often unaware and otherwise unable to credibly dictate the contract wage. From (9), producers cannot precisely predict the effort contribution of any given contract worker without precise information about the wage that the worker receives. Instead, they resort to assessing the wage and effort characteristics of the average contract worker in rational expectation $\bar{e}_c$, and make a uniform payment p_c to each subcontractor taking this expectation as given.

The profit maximization problem of a producer of variety k is thus

$$\max_{p_k, s}(p_k - s\bar{w}_k - (1-s)p_c/\bar{e}_c)x(p_k, P, Y) \tag{10}$$

where s is the share of work accomplished by regular workers. Maximizing profits with respect to s, producers are indifferent between regular and contract workers if and only if the effective costs per unit effort are the same $\bar{w}_k = p_c/\bar{e}_c$:

$$\frac{p_c}{\bar{e}_c} = \bar{w}_k. \tag{11}$$

Given (11), producers engage in exactly the same markup pricing as in (6), and set $p_k = w^o/\rho$.

Contracting between Workers and Subcontractors

As discussed earlier, the typical subcontracting market features a large number of subcontractors facing various degrees of barriers to entry depending on industry. Their sheer number has meant that some subcontractors violate labor standard regulations as enforcement is difficult (ILO 2015). Likewise, job seekers face a daunting challenge sifting through potentially numerous contract offers (Weil 2014).

We thus choose to explicitly model the contract wage distribution in the presence of search friction. Let there be M endogenenous number of subcontracted wage offers. We consider a setting in which contract job seekers and subcontractor with wage offers are matched at random. The number of such matches each job seeker encounters ($z = 0, 1, 2, ...$) is determined by a draw from a Poisson distribution with parameter $\lambda = M/(\mathcal{L} - L_r)$, or, $\Pr(z;\ \lambda) = e^{-\lambda}\lambda^z/z!$, where $\mathcal{L} - L_r$ denotes the total number of potential job seekers. By incorporating search friction in this way, the lack of direct producer control over contract worker wages becomes salient, for subcontractors may offer a dispersed set of both low and high wages and still ensure positive uptake to their wage offers. In turn, producers may be faced with a dispersed range of effort levels in equilibrium.

Let $F(w_c)$ denote the cumulative distribution function of all contract wage offers w_c. $F(w_c)$ is endogenous, and will be determined in the sequel. Since the likelihood that a job seeker is met with $z = 0, 1, 2, ...$ offers is given by $\Pr(z;\ \lambda) = e^{-\lambda}\lambda^z/z!$, the corresponding cumulative distribution of the maximal offer received is (Mortensen 2003):

$$H(w_c) \equiv \sum_{z=0}^{\infty} \frac{e^{-\lambda}\lambda^z F(w_c)^z}{z!} = e^{-\lambda(1-F(w_c))}. \tag{12}$$

$H(w_c)$ gives the probability that the best offer that a worker receives is less than w_c. $H(w_c)$ thus gives the likelihood of consummating a match with a job seeker. The subcontractor profit maximization problem is:

$$\pi_c(w_c, p_c) = \max_{w_c} H(w_c)(p_c - w_c) - p_c\delta. \tag{13}$$

$\delta \geq 0$ denotes the cost of creating a job vacancy expressed in terms of the share of labor input forgone.

The set of feasible contract wages ranges from a minimum of $w_c^- \equiv w^o$ since contract wage can be no less than the fall back option, to a maximum at $w_c^+ \equiv p_c(1-\delta)$ for any contract wage beyond this will fail to turn a profit with certainty. In between w_c^- and w_c^+, an increase in the contract wage increases the likelihood that a matched worker accepts the wage offer $H(w_c) = e^{-\lambda(1-F(w_c))}$, but the profit margin $p_c - w_c$ shrinks. In equilibrium with free entry of subcontractors, $\pi_c(w_c, p_c) = 0$ for all $w_c \in [w^o, p_c(1-\delta)]$, the contract wage distribution is given by:[8]

$$H(w_c) = \frac{\delta}{1 - w_c/p_c}. \tag{14}$$

[8] The implied wage offer distribution is $F(w_c) = 1 - \frac{1}{\lambda}\ln\left(\frac{\delta}{1-w_c/p_c}\right)$ where the arrival rate $\lambda = M_c/(\mathcal{L} - L_r)$ is given by $\lambda = \ln(1 - w^o/p_c)$ since no wage offer should be less than the reservation wage, or, $F(w^o) = 0$.

It can be checked that $H(w_c^+) = 1$ evaluated at the maximum contract wage, w_c^+. Meanwhile, $1 - H(w_c^-) = 1 - \frac{\delta}{1-w^o/p_c}$ denotes the probability that a job seeker will encounter at least one viable contract wage offer.[9] Thus, total contract employment as well as total employment in the homogeneous goods sector are given respectively by

$$L_c(p_c) = \left(1 - \frac{\delta}{1 - w^o/p_c)}\right)(\mathcal{L} - L_r), \quad L^o(p_c) = \left(\frac{\delta}{1 - w^o/p_c)}\right)(\mathcal{L} - L_r).$$

Naturally, the higher the subcontractor price p_c, the higher the number of workers will be engaged in contract employment.

From (9), the average contract worker effort level $\bar{e}_c$ reflects the average contract wage shortfall relative to the fair contract wage:

$$\bar{e}_c(p_c) = \frac{\int_{w^o}^{w_c^+} \min\{w_c/\bar{w}_c, 1\} dH(w_c)}{1 - H(w^o)}. \tag{15}$$

By definition of $H(w_c)$ and $\bar{w}_c$ in (14) and (9), equilibrium average contract worker effort $\bar{e}_c(p_c)$ is itself a function of the subcontractor price p_c. (15) thus brings us full circle for from (10), the subcontractor price producers are willing to pay depends on average contract worker effort. We can now define a fair wage equilibrium with regular and contract work.

3 A Fair Wage Equilibrium with Regular and Contract Work

A fair wage equilibrium with coexisting regular and contract work is a range of regular wage and price pairs (w_k, p_k), $k \in [0, n]$, a price of contract labor p_c, a contract wage distribution $H(w_c)$, and an allocation of workers between the differentiated and homogeneous goods sector, and between regular and contract work such that (i) employers maximize profits by choice of (w_k, p_k) in (10) subject to the fair wage-effort relationships for regular (2) and contract (8) work respectively, (ii) subcontractors maximize profits in (13) by choice of a contract wage w_c, and (iii) producers are indifferent between hiring regular and contract labor as in (11). The equilibrium allocation of workers between the homogeneous and differentiated goods sector in the small open economy follows:

$$L_r + \bar{e}_c L_c + L^o \equiv \int_0^n x(p_k, P, Y) d_k + L^o = \mathcal{L}, \quad L_c = (1 - H(w^o))(\mathcal{L} - L_r).$$

[9]It should be noted that the case of no search friction is a special case of (14) as $\delta \to 0$. Here, the $H(w_c)$ puts unit mass on $w_c = p_c$, and zero otherwise.

3.1 The Case with Perfect Competition

In this benchmark, $\delta = 0$. From (14), the equilibrium wage distribution puts unit weight on $w_c = p_c$, and as such the only contract wage offer with positive mass is one which fully dissipate subcontractor profit: $p_c - w_c = 0$.

In a rational expectation equilibrium, producers anticipate the identity $p_c = w_c$. In turn, they can also anticipate that the subcontractor price per unit contract worker effort is:

$$p_c/\bar{e}_c = p_c/\min\{w_c/\bar{w}_c, 1\} = p_c/min\{p_c/\bar{w}_c, 1\} \geq \bar{w}_c.$$

Thus, to minimize the subcontractor price per unit effort, the producer should set the subcontractor price at the contract fair wage, or set $p_c = \bar{w}_c$. Equivalently,

$$p_c = \beta[\gamma p_c + (1-\gamma)p_k] + (1-\beta)w^o = \frac{\beta(1-\gamma)p_k + (1-\beta)w^o}{1-\beta\gamma} = \bar{w}_c. \tag{16}$$

Employer profit maximization is thus:

$$p_k^* = argmax_{p_k}(p_k - \bar{w}_c)x(p_k, P, Y) = argmax_{p_k}\left(\frac{1-\beta}{1-\beta\gamma}\right)(p_k - w^o)x(p_k, P, Y) = \frac{w^o}{\rho}. \tag{17}$$

This exactly replicates the profit maximization choices of price and associated quantity when the producer only hires regular workers.[10] Perhaps even more intriguing, subcontracting strictly increases the producer's share of profit from $(1-\beta)$ earlier to $(1-\beta)/(1-\beta\gamma)$. Using (15) and (16),

$$\bar{w}_c = w^o(1 + \frac{1-\gamma}{1-\beta\gamma}\theta) < \bar{w}_k. \tag{18}$$

Proposition 2. *If $\delta = 0$ and $\gamma > 0$, a fair wage equilibrium exists where (i) all contract workers receive the contract fair wage and provide full effort, (ii) output, pricing, and employment outcomes (x_k, p_k and ℓ_k) replicate the regular worker only setting, (iii) the implied fair contract wage is strictly less than the fair regular wage, leading producers to strictly prefer hiring contract workers.*

[10]It follows from (6), (10) and (17) that producers have the same markup pricing decision with or without contract workers. It follows that our analysis will carry on in the same way if we had allowed the price index to be endogenous.

The above highlights the potential role that multi-party employment relationship can play in depressing the contract fair wage when $\gamma > 0$. If in addition $\delta = 0$, producers prefer to completely replace regular workers with contract workers so as to take advantage of more favorable profit sharing, notably at no cost to overall efficiency as employment, output, and pricing decisions are unfettered.

3.2 The Case with Search Friction

More generally, now let $\delta > 0$. From (11),

$$\bar{e}_c = \frac{p_c}{\bar{w}_k}. \tag{19}$$

This suggests that higher subcontractor price p_c can only be justified if the average contract worker puts in more effort. This is displayed in Figure 1 as the labor market equilibrium schedule (EE). The relevant range of subcontractor price begins at $p_c = w^o/(1-\delta)$. At this price, the maximal contract wage is $w_c^+ = p_c(1-\delta) = w^o$ which just covers the reservation wage. The maximal contract wage is $p_c = \bar{w}_k = w^o(1+\theta)$ itself, for any higher subcontractor price will exceed the cost of hiring regular workers even when $\bar{e}_c = 1$.

Now, from (15), the average effort of contract workers is itself a function of the subcontractor price:

$$\bar{e}_c(p_c) = \frac{\int_{w^o}^{w_c^+} \min\{w_c/\bar{w}_c, 1\} dH(w_c)}{1 - H(w^o)}.$$

This relationship between average contract worker effort and the subcontractor price is displayed in Figure 1 as the fair wage-effort schedule (FF). It is straightforward to confirm that raising entry cost δ reduce contract wages, and accordingly reduces average effort $\bar{e}_c$. This shifts the FF schedule downwards. By contrast, raising the fair wage parameter γ associated with subcontractor value, following from the discussion preceding Proposition 2, lowers the contract fair wage $\bar{w}_c$. This shifts the FF schedule upwards since the average effort of contract workers rise if the wage that they perceive as fair decreases from (15).

A fair wage equilibrium with coexisting regular and contract worker occurs at the intersection of these two (EE and FF) schedules. In the Appendix, we prove that such an intersection always exists if δ is sufficiently small as shown in Figure 1, or if the FF schedule is not too low. Furthermore, we find a well defined range of δ such that contract workers exist, but all are paid unfair wages. For even lower but positive values of δ, contract workers continue to exist and now only some contract workers are paid unfair wages:

Proposition 3. *A fair wage equilibrium with contract and regular employment exist if*

$$0 < \delta(1+\theta)/\theta < \gamma.$$

Furthermore,

1. *For $\delta(1+\theta)/\theta$ in the subset $[\gamma(1-\beta)/(1-\gamma\beta), \gamma]$, all contract workers are paid less than $\bar{w}_c$,*

2. *For $\delta(1+\theta)/\theta < \gamma(1-\beta)/(1-\gamma\beta)$, at least some contract workers are paid less than $\bar{w}_c$.*

The unifying theme of the case with search friction is the non-payment of contract fair wage for at least some contract workers. The coexistence of regular work at a (regular) fair wage, and contract work often at less than (contract) fair wage stems from a subcontracting holdup. To wit, producers cannot tailor payment by internalizing the effort consequences of wage payment since subcontracting delegates the wage authority to subcontractors. Meanwhile, subcontractors cannot internalize the revenue consequences of higher wages since they are not the residual claimant of the full measure of the value of work. In equilibrium, therefore, $\bar{e}_c < 1$.

As shown in Proposition 3, the payment of unfair contract wages to all workers is more likely when δ is relatively high ($\delta(1+\theta)/\theta > \gamma(1-\beta)/(1-\gamma\beta)$), but not high enough to rule out subcontracting altogether ($\delta(1+\theta)/\theta < \gamma$). Viewed differently in terms of the fair wage parameters β and γ, the threshold value $\gamma(1-\beta)/(1-\gamma\beta)$ is lower when γ is lower, and when β is higher. Thus, lower values of γ and higher values of β are parameter configurations more conducive to the payment of unfair wages to all contract workers. Intuitively, a low γ increases the contract fair wage from (8), while a higher β increases the regular fair wage from (2). Effectively, therefore, Proposition 3 shows that the higher the contract and regular fair wage demands, the more likely it is that all contract workers will be paid less than when they deem as fair, extending the subcontracting holdup ($w_c < \bar{w}_c$) to all contract workers.

Such underutilization of labor has employment, wage and efficiency consequences. Since $\bar{e}_c < 1$, total labor employment in the differentiated goods sector will have to be higher to compensate for the morale shortfall:

$$\bar{e}L_c + L_r = nx(w^o/\rho, P, Y) \Leftrightarrow L_c + L_r > nx(w^o/\rho, P, Y). \tag{20}$$

However, since all contract workers receive lower pay, the total wage bill in the differentiated goods sector, paid for by producers and subcontractors combined, is in fact less than when only regular employment is allowed. Let w_c^e denote the average wage of contract workers in equilibrium according to (10) evaluated at the equilibrium subcontractor price, total wage bill is[11]

$$\begin{aligned}
\bar{w}_k L_r + w_c^e L_c &= \bar{w}_k(L_r + \bar{e}_c L_c) + (w_c^e - \bar{w}_k \bar{e}_c)L_c \qquad (21)\\
&= \bar{w}_k(nx(w^o/\rho, P, Y) + \frac{\left(\int_0^{\bar{w}_c} w_c(1 - \frac{\bar{w}_k}{\bar{w}_c})dH(w_c) + \int_{\bar{w}_c}^{w_c^+}(w_c - \bar{w}_k)dH(w_c)\right) L_c}{1 - H(w^o)}\\
&< \bar{w}_k nx(w^o/\rho, P, Y).
\end{aligned}$$

Finally, denote W as the gross national product function, which sums the income of all producers and workers in the economy:

$$\begin{aligned}
W &= \int_0^n p_k x(p_k, P, Y)dk + w^o(\mathcal{L} - L_r - L_c) \qquad (22)\\
&= \int_0^n p_k x(p_k, P, Y)dk + w^o(\mathcal{L} - L_r - \bar{e}_c L_c) + w^o L_c(\bar{e}_c - 1))\\
&= nw^o(1/\rho - 1)x(w^o/\rho, P, Y) + w^o\mathcal{L} + w^o L_c(\bar{e}_c - 1))\\
&< nw^o(1/\rho - 1)x(w^o/\rho, P, Y) + w^o\mathcal{L}.
\end{aligned}$$

Subcontracting thus leads to efficiency losses whenever subcontracting holdup applies, or $\bar{e}_c < 1$[12]

[11] The following shows the case when the contract fair wage is less than the maximum contract wage. The proof of the case where the alternative applies is analogous.

[12] Note that free entry of subcontractors ensures that their expected profits are equal to zero in equilibrium. Furthermore, the third equality follows from producer profit maximization in (17).

Proposition 4. *If $0 < \delta(1+\theta)/\theta < \gamma$, regular and contract workers coexist, and a subcontracting holdup applies $\bar{e}_c < 1$. Relative to a labor market equilibrium where subcontracting is banned,*

- *total employment is higher in the differentiated goods sector;*
- *total wage is lower in the differentiated sector;*
- *overall efficiency in the economy declines.*

4 Comparative Statics

We have demonstrated so far the three parameters that collectively give rise to a fair wage equilibrium with subcontracting. These include (i) the fair wage parameter of regular work β, which determines the regular fair wage premium $(\bar{w}_k - w^o)/w^o = \beta(1 - 1/\rho))$ from (7), (ii) the fair wage parameter of contract work γ, which together with β determines the contract fair wage discount $\bar{w}_k - \bar{w}_c = \beta\gamma w^o(1/\rho - \bar{e}_c(1+\theta)(1-\delta))$ from (2), (8) and (19), and (iii) the cost of entry facing subcontractors δ. In this section, we illustrate the workings of a subcontracted labor market by elaborating on the comparative statics of the fair wage equilibrium via a series of simulation responses using the closed form solutions in (15) and (19).

Table 2 displays three labor market performance metrics: the equilibrium average effort of contract workers ($\bar{e}_c$), the subcontractor price premium relative to the reservation wage (p_c/w^o), and the average wage gap between contract and regular workers ($w_c^e/\bar{w}_k$). Respectively, these illustrate the direct impact that the fair wage parameters and the cost of subcontractor entry have on the underutilization of labor resources $1 - \bar{e}_c$ in a subcontracted labor market, the cost savings that employers can expect from using subcontractors, and the wage inequality between contract and regular workers.

The results are divided and listed in the two panels of Table 2. Panel A is a low entry cost (δ) equilibrium, and Panel B is a high entry cost equilibrium. At given δ in each panel, the equilibrium labor market performance metrics are provided in matrix format, and each cell in the table represents a particular combination of the two fair wage parameters, β and γ.

For reference, a shaded cell represents configurations of parameter values such that at least some contract workers are paid more than the contract fair wage. All other cells have parameter configurations such that all contract workers are paid less than what they deem as fair. Consistent with Proposition 3, the latter occurs when both regular and contract workers demand high fair wages or equivalently when β is sufficiently high and γ is sufficiently low.

Consider an increase the regular fair wage parameter β. From (2), this raises the regular fair wage which then prompts employers to seek contract workers as alternatives. Associated with such a change in preference are two effects: an increase in contract employment is possible only if employers raise the subcontract price p_c from (14). Meanwhile, a higher regular fair wage means that employers will tolerate lower efforts from contract workers. Table 2 shows that both of these effects are borne out when β increases. Wage inequality between contract and regular workers, measured by the average contract-regeular wage gap, $w_c^e/\bar{w}_k$, is in turn reflective of the change in mean effort levels as shown in Table 2. As shown, the higher the regular fair wage preference parameter β, the lower the contract-regular wage gap $w_c^e/\bar{w}_k$.

By contrast, an increase in the contract fair wage parameter γ decreases the contract fair wage as contract workers put more weight on subcontractor price in their assessment of how high the contract fair wage should be. All else equal, a downward revision in the contract fair wage implies that contract workers will now be willing to deliver a higher effort level following the fair wage effort hypothesis and (15). Such an increase in productivity, all else equal, raises employers' demand for contract workers. Thus, the subcontract price p_c increases, and so does the average wage associated with contract work $w_c^e/\bar{w}_k$. As shown in Table 2, all three of the variables $\bar{e}_c$, p_c and $w_c^e/\bar{w}_k$ rise with an increase in the contract fair wage parameter.

Finally, going from a low entry cost equilibrium in Panel A to a high entry cost equilibrium in Panel B, subcontracting no longer exists in equilibrium when the contract fair wage is high (low γ values), or when the regular fair wage is not too high to begin with (low β values). Furthermore, when parameter configurations are such that subcontracting does exist in equilibrium, all three variables $\bar{e}_c$, p_c and $w_c^e/\bar{w}_c$ are lower than their low entry cost counterpart. Effectively, high entry cost δ reduces available supply of contract workers from (14). Furthermore, an increase in δ also gives rise to a stochastically dominating shift in the contract worker wage distribution, consistent with an overall decrease subcontractor wage offers w_c from (14). All else equal, contract workers who receive unfair wages will reduce their effort levels even more. In the end, employers who harbor rational expectation will only pay a reduced subcontractor price, p_c.

Table 3 displays the employment, wage bill and overall welfare implications as discussed in Proposition 4, where we consider the transition from a labor market in which subcontracting is banned, with a decentralized regime as shown in Table 2. These include total employment in the differentiated goods sector in (20), total wage bill in the differentiated goods sector in (21), and aggregate welfare in (22). Consistent with Proposition 4, in every case where there is positive employment of contract labor, total employment in the differentiated goods sector including both regular and contract workers increases. The simulation results also reiterate the finding that as total employment rises, the total wage bill in factfo declines, reflecting a composition effect as employers substitute away from regular workers in favor of contract workers. Finally, whenever there is under-utilization of labor ($\bar{e}_c < 1$) in equilibrium due to the subcontracting holdup, aggregate welfare always declines.

5 Conclusion and Discussion

In this paper, we examine the circumstances under which a fair wage equilibrium accommodates the employment of both regular and contract workers. We examine the nature of fair wage preferences that gives rise to a demand for subcontracted work, and highlight two consequences associated with subcontracting: a contract fair wage discount in the face of multi-employer relationship along the supply chain, and a subcontracting holdup with gives rise to the underutiliziation of labor in equilibrium as the payment of unfair wages is an equilibrium phenomenon. In particular, we show that not only does subcontracting redistribute income between workers and employers in favor of the latter, such a redistribution, with one lone exception corresponding to a case where the subcontracting operates with cost-free entry, has adverse overall efficiency consequences.

The basic analytics of a subcontracted labor market developed as far decompose the labor market consequences of subcontracting into two parts: (i) a lower contract fair wage, and (ii) a subcontracting holdup. To gain additional insights, we briefly discuss four possibilities for extension:

An endogenous reservation wage

Suppose that the reservation wage w^o is a decreasing function of the number of workers in the homogeneous goods sector, reflecting diminishing marginal product. From Proposition 4, the subcontracting holdup raises total labor demand in the differentiated goods sector to compensate for low worker morale. It follows therefore that the same subcontracting holdup will raise the reservation wage w^o. Relative to a setting with regular workers only, prices p_k of varieties will be higher and output x_k lower from (10). These additional effects will compound the efficiency losses associated with subcontracting reported in Proposition 4 due solely to the adverse morale consequences of the subcontracting holdup.

An endogenous work force.

It is often alleged that subcontractors do not strictly abide by labor standards regulations (ILO 2015). Suppose in particular that subcontractors hire illegal immigrants but employers do not. Subcontracting in this set up will displace native workers from employment in the high wage differentiated sector. Incorporating such labor supply effects of subcontracting will likewise further reinforce the negative efficiency consequences of subcontracting.

Alternative formulation of the fair wage

Our fair wage formulation is based on a linear specification following Akerlof and Yellen (1990). Subsequent studies have incorporated for example geometric means (e.g. Danthine and Kurmann 2006)

$$\bar{w} = (p_k)^{\beta}(w^o)^{1-\beta}.$$

Introducing this formulation into our setting gives rise to a slightly different formula for producer markup in the differentiated goods sector

$$p_k = w^o \left(\frac{1}{\rho} - \frac{\beta(1-\rho)}{\rho} \right)^{1/(1-\beta)}$$

while the rest of the analysis remains qualitatively exactly as before.

Other existing labor market distortions

Suppose that a binding minimum wage which exceeds $\bar{w}_k$ in (7) applies and subcontractors are able to evade minimum wage laws. In our model, an equilibrium with co-existing regular workers at minimum wage and contract workers at below the minimum wage is possible if γ is sufficiently small. Subcontracting in this setting strictly increases output as wage decreases, though at the cost of low morale and low labor productivity. The balance between these two effects will differ case-by-case. Arguably, the first-best policy in this setting would require reducing the minimum wage, while subcontracting is at best a second-best remedy.

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Table 1: Industry Concentration and Average Establishment Size in Select Industries Employing Contract Labor

Industries	Share of Sales in Total Sales (%)				
	All firms	4 largest firms	8 largest firms	20 largest firms	50 largest firms
Facilities support services	100.0	27.6	46.5	65.8	78.2
Employment placement agencies	100.0	22.1	27.3	32.2	39.4
Temporary help services	100.0	15.6	22.6	33.1	44.3
Business support services	100.0	12.2	20.1	31.0	41.4
Security guards and patrol services	100.0	30.6	38.7	48.1	58.0
Janitorial services	100.0	10.5	14.0	19.9	27.7
Waste treatment and disposal	100.0	37.0	53.2	67.3	77.3
	Number of Workers Per Establishment				
	All firms	4 largest firms	8 largest firms	20 largest firms	50 largest firms
Facilities support services	45.3	265.9	33.0	56.2	57.9
Employment placement agencies	27.4	99.1	113.2	124.2	120.1
Temporary help services	95.3	85.2	95.4	99.4	102.3
Business support services	22.6	26.9	41.8	52.2	69.6
Security guards and patrol services	65.1	113.8	124.2	107.7	117.6
Janitorial services	17.5	452.2	411.9	229.3	184.4
Waste treatment and disposal	24.4	36.0	41.9	38.5	44.6

Source: 2007 U.S. Census and authors' calculation.

Table 2: Equilibrium Contract Worker Effort, Subcontractor Price Premium, and the Contract-Regular Wage Gap

Panel A (Low δ Equilibrium)

		Average Contract Worker Effort ($\bar{e}_c$))			Subcontractor Price Premium over Reservation Wage (p_c/w^o)			Average Contract-Regular Wage Gap ($w_c^e/\bar{w}_k$)		
		β			β			β		
		0.8	0.4	0.2	0.8	0.4	0.2	0.8	0.4	0.2
	0.8	0.64	0.90	0.95	524.24%	412.84%	267.13%	40.19%	57.26%	63.42%
γ	0.6	0.47	0.72	0.85	386.92%	329.15%	239.33%	30.25%	46.51%	57.65%
	0.4	0.25	0.38	.51	206.70%	175.89%	143.62%	17.40%	27.28%	38.74%

Panel B (High δ Equilibrium)

		Average Contract Worker Effort ($\bar{e}_c$))			Subcontractor Price Premium over Reservation Wage (p_c/w^o)			Average Contract-Regular Wage Gap ($w_c^e/\bar{w}_k$)		
		β			β			β		
		0.8	0.4	0.2	0.8	0.4	0.2	0.8	0.4	0.2
	0.8	0.40	0.61	0.74	331.51%	278.71%	206.79%	19.33%	30.19%	40.38%
γ	0.6	0.26	0.40	.	214.04%	183.32%	.	14.09%	22.87%	.
	0.4	.	.	.	.	.	.	.	.	.

1. Values calculated based on closed form solutions in equations (15) and (19) in the text. 2. Parametric assumptions are $\delta = 0.2$ and $\delta = 0.4$ respectively for the low and high δ equilibria. 3. Other parametric assumptions: $\rho = 0.1$; 4. Shaded cells indicate equilibria with parameter combinations such that some contract workers are paid more than the contract fair wage. In all other parameter combinations displayed, all contract workers are paid less than the contract fair wage.

Table 3: Employment, Wage Bill, and Welfare Effects of Subcontracting

Panel A (Low δ Equilibrium)

		% Change in Total Employment $((L_r + L_c))$			% Change in Wage Bill $(\bar{w}_k L_r + w_c^e L_c)$			% Change in GDP $(W))$		
		β			β			β		
		0.8	0.4	0.2	0.8	0.4	0.2	0.8	0.4	0.2
	0.8	13.09%	5.56%	2.23%	-8.61%	-17.61%	-15.50%	-1.28%	-0.54%	-0.22%
γ	0.6	14.71%	10.34%	5.43%	-4.72%	-9.11%	-10.40%	-1.44%	-1.01%	-0.53%
	0.4	13.55%	10.42%	5.04%	-1.41%	-1.85%	-1.30%	-1.32%	-1.02%	-0.49%

Panel B (High δ Equilibrium)

		% Change in Total Employment $((L_r + L_c))$			% Change in Wage Bill $(\bar{w}_k L_r + w_c^e L_c)$			% Change in GDP $(W))$		
		β			β			β		
		0.8	0.4	0.2	0.8	0.4	0.2	0.8	0.4	0.2
	0.8	7.69%	4.80%	1.77%	-2.72%	-3.70%	-2.26%	-0.75%	-0.47%	-0.17%
γ	0.6	4.93%	1.89%	0.00%	-0.80%	-0.53%	0.00%	-0.48%	-0.18%	0.00%
	0.4	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

1. Values calculated based on closed form solutions in equations (15) and (19) in the text; 2. Parametric assumptions are $\delta = 0.2$ and $\delta = 0.4$ respectively for the low and high δ equilibria; 3. Other parametric assumptions: $\rho = 0.1$, $nx(w^o/\rho, P, Y)/\mathcal{L} = 0.8$; 4. Shaded cells indicate equilibria with parameter combinations such that some contract workers are paid more than the contract fair wage. In all other parameter combinations displayed, all contract workers are paid less than the contract fair wage.

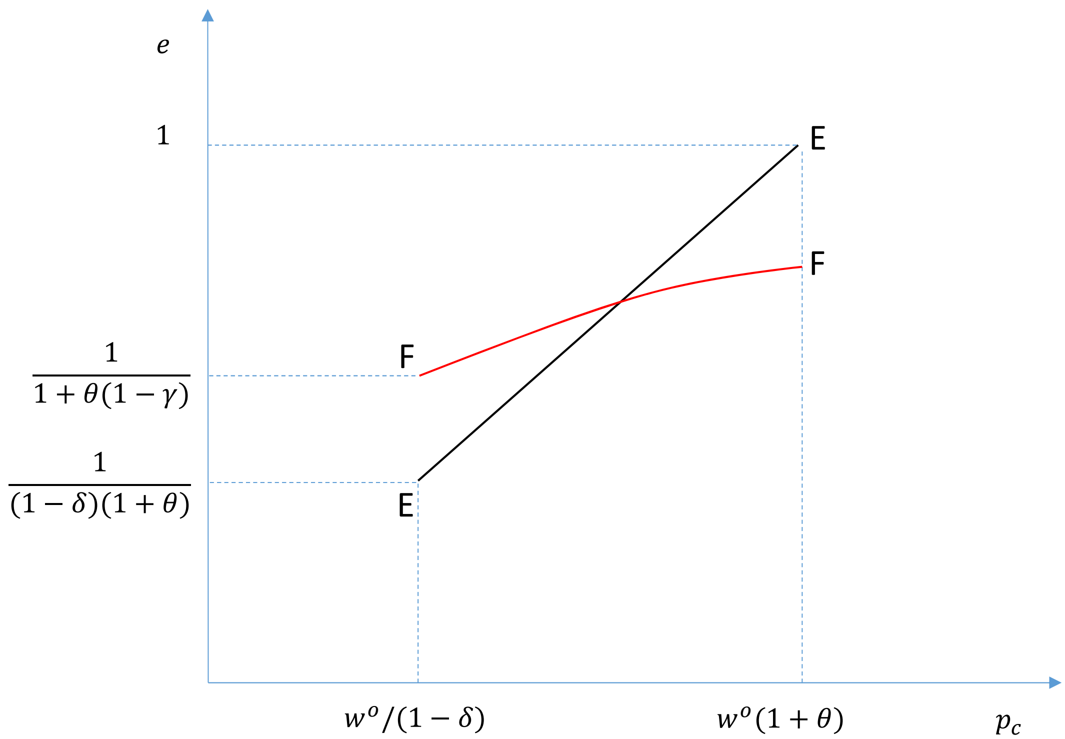

Figure 1. A Fair Wage Equilibrium with Search Friction ($0 < \frac{\delta(1+\theta)}{\theta} < \gamma$).

Appendix

Proof of Proposition 3: We begin by showing that the feasible range of p_c, $[w^o/(1-\delta), w^o(1+\theta)]$, is non-empty if and only if $\delta(1+\theta)/\theta < 1$. To this end,

$$1+\theta > \frac{1}{1-\delta} \quad \Leftrightarrow \quad 1+\theta-\delta(1+\theta) > 1.$$

The range of p_c is non-empty if and only if the entry cost δ is not too large, or $\delta(1+\theta)/\theta < 1$.

Next, we show that the fair wage equilibrium exists if

$$0 < \delta(1+\theta)/\theta < \gamma.$$

To this end, we seek a fixed point in the range $[w^o/(1-\delta), w^o(1+\theta)]$ such that

$$\Phi(p_c) \equiv \frac{p_c}{\bar{w}_k} - \bar{e}_c(p_c) = \frac{p_c}{\bar{w}_k} - \frac{\int_{w^o}^{w_c^+} \min\{w_c/\bar{w}_c, 1\} dH(w_c)}{1-H(w^o)} = 0.$$

Evaluating $\Phi(p_c)$ at $p_c = w^o/(1-\delta)$,

$$\begin{aligned}
\Phi(w^o/(1-\delta)) &= \frac{w^o}{(1-\delta)\bar{w}_k} - \frac{w^o}{\bar{w}_c} \\
&= \frac{1}{(1-\delta)(1+\theta)} - \frac{1}{\beta(\gamma+(1-\gamma)/\rho)+(1-\beta)} \\
&= \frac{1}{(1-\delta)(1+\theta)} - \frac{1}{1+\theta(1-\gamma)} \\
&< 0
\end{aligned}$$

if and only if

$$(1-\delta)(1+\theta) > 1+\theta(1-\gamma) \quad \Leftrightarrow \quad \delta(1+\theta)/\theta < \gamma.$$

Furthermore, evaluated at $p_c = w^o(1+\theta)$

$$\begin{aligned}
\Phi(w^o(1+\theta)) &= \frac{w^o(1+\theta)}{\bar{w}_k} - \bar{e}_c(w^o(1+\theta)) \\
&= 1 - \bar{e}_c(w^o(1+\theta)) \\
&> 0
\end{aligned}$$

if and only if $\delta > 0$ from (14) since at least some workers will be paid less than the fair contract wage. By standard arguments, therefore, a fixed point p_c such that $\Phi(p_c) = 0$ exists in the interior of the range $[w^o/(1-\delta), w^o(1+\theta)]$ if $0 < \delta(1+\theta)/\theta < \gamma$.

Since the highest possible contract wage is $w_c^+ = w^o(1-\delta)(1+\theta)$, evaluated at $p_c = w^o(1+\theta)$, all contract workers must be paid less than the fair wage if and only if $w_c^+ < \bar{w}_c$ evaluated accordingly at $p_c = w^o(1+\theta)$, or equivalently,

$$\begin{aligned}
& w^o(1-\delta)(1+\theta) < \beta(\gamma w^o(1+\theta)(1-\delta) + (1-\gamma)w^o/\rho) + (1-\beta)w^o \\
\Leftrightarrow\ & (1-\beta\gamma)(1-\delta)(1+\theta) < \beta(1-\gamma)/\rho + 1 - \beta \\
\Leftrightarrow\ & (1-\beta\gamma)(1-\delta)(1+\theta) < 1 - \beta\gamma + (1-\gamma)\theta \\
\Leftrightarrow\ & 1+\theta-\delta(1+\theta) < 1 + \frac{(1-\gamma)\theta}{1-\beta\gamma} \\
\Leftrightarrow\ & \delta(1+\theta)/\theta > \frac{\gamma(1-\beta)}{1-\beta\gamma}(<\gamma)
\end{aligned}$$

It follows that all contract workers must be paid less than the fair wage if $\delta(1+\theta)/\theta \in [\gamma(1-\beta)/(1-\beta\gamma), \gamma]$ as stated in Proposition 4.