Robinson meets Weyl and Fabinger: Oligopsony and exploitation in general equilibrium

by

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Abstract

This paper proposes a general equilibrium model of Robinson's (1933) oligopsony and exploitation in the labor market coupled with imperfect competition in the product market as well. By using Weyl and Fabinger's (2013) conduct parameter approach, I examine how a change in the degree of competition in the labor market or the product market affects the equilibrium product price and the equilibrium wage.

Keywords: Oligopsony; Exploitation; General Equilibrium; Conduct Parameter Approach.

JEL classification: D43; J42; L13.

1   Introduction

It has been increasingly recognized that oligopolistic firms may not only exercise their market power in the product market but they also take advantage of their dominance in the labor market as *oligopsonists* (Azar, Marinescu, and Steinbaum 2017; De Loecker, Eeckhout, and Unger 2018.).[1] An unavoidable consequence is that competitive pressure on the price hike remains weak (controlling for product quality), and what is worse, labor income does not grow as much as the national growth rate. This disparity between corporations/business executives and a majority of citizens may result in their disbelief in free market and free society in general.

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[1]See, e.g., *The Economist*'s special report (November 15, 2018), "(Across the West powerful firms are becoming even more powerful"). This issue was also extensively discussed at the 2nd and the 3rd hearings on "Competition and Consumer Protection in the 21st Century" organized by the US Federal Trade Commission in September through December 2018.

In this paper, I provide a tractable model of the simultaneous determination of the wage and the product price under imperfectly competitive labor and product markets. To do so, I make use of the *conduct parameter approach* proposed by Weyl and Fabinger (2013). I not only model the labor market as an imperfectly competitive market, and thereby generalize the concept of monopsony (Robinson 1933) to "oligopsony," I also combine the imperfectly competitive labor market (L) and the imperfectly competitive product markets (G) in a unified manner.

One of the merits in the conduct parameter approach is that in a symmetric setting, one can focus on aggregate amount of employment without specifying the market structure in the labor market such as the number of firms and the mode of competition. In other words, one does not have to worry about how workers and firms are sorted and matched in the labor market. This attractive feature of the conduct parameter approach enables one to model oligopsony in a broad manner, including perfect competition as one extreme and monopsony as the other extreme.

One caveat at this point is that I do not consider *search friction* as a source of market imperfection in the labor market. This issue has been extensively studied in the modern literature on search theory (Pissarides 2000). In this paper, I instead focus on the exercise of market power by oligopsonic firms in the labor market to extend Robinson's (1933) theory of monopsony to "oligopsony" by applying Weyl and Fabinger's (2013) method of modeling imperfect competition to the labor market.[2] Obviously, as an interesting extension, one would incorporate search friction as another important source of labor market imperfection into the model below.

2   Model

I start with pricing by a coordinated group of (symmetric) single-product firms (i.e., a syndicate). For a while, it is regarded as a monopolist in the product market and a monopsonist in the labor market until imperfect competition is explicitly introduced by the conduct parameter approach (see below). This monopolist/monopsonist faces with two imperfectly competitive markets: the product market and the labor market. It uses (homogeneous) labor $L > 0$ as a sole input to produce a single product and sells it directly to consumers. As Posner and Weyl (2018, Ch. 5) point out, data may be interpreted as labor input here in the context of IT firms. Its profit function is written as $\pi = pQ - wL$ in terms of L, where output Q is produced by the production function $Q = F(L)$, with the regularity conditions such as $F' > 0$, $F'' < 0$, and $\lim_{L \downarrow 0} F'' = \infty$ being satisfied, and $p > 0$ and $w > 0$ denote the product price and the (nominal) wage, respectively.

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[2]See, e.g., Manning (2011) and Boeri and van Ours (2013) for existing studies on imperfectly competitive labor markets in the tradition of Robinson (1933).
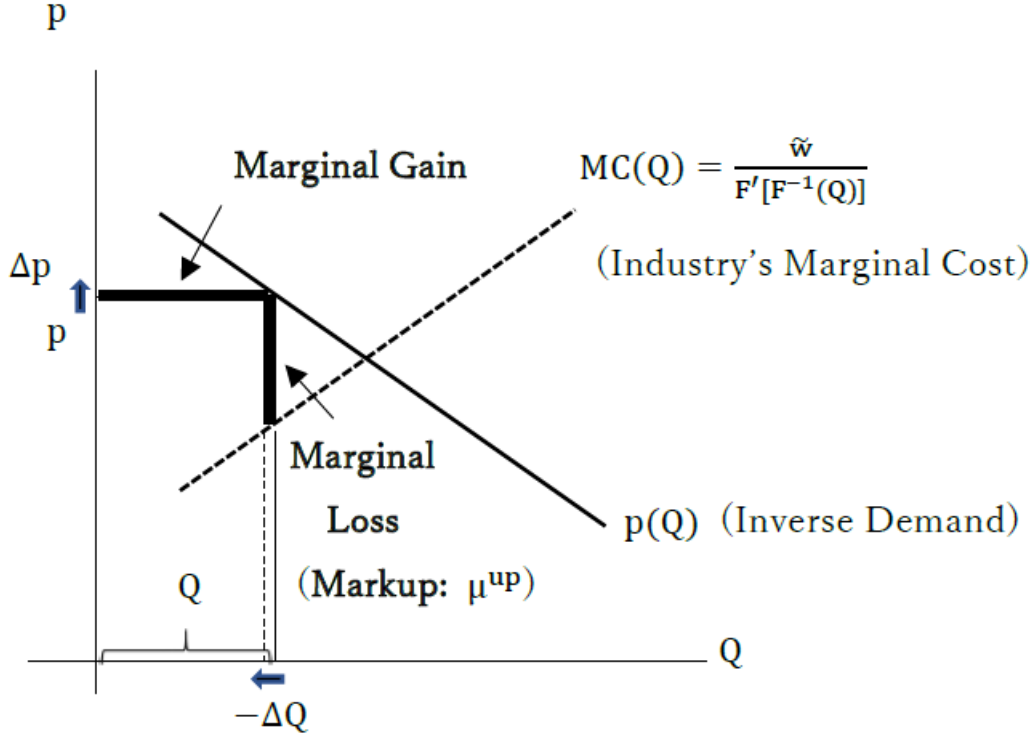
Figure 1: Marginal Profit Gain and Loss from Raising Product Price p: Product Market

2.1 Product Market

To study oligoposony in general equilibrium in a simplified manner, I follow Azar and Vives (2018) and assume that the monopolist choose output, not the product price per se. In other words, oligopolistic firms compete in a Cournot manner in the product market. In this sense, the following analysis is no longer a partial equilibrium analysis because the firms do not take p as given, but recognize that their decision on L affect the product price p. The monopolist's profit function is written as $\pi = p(Q)Q - C(Q)$, where $p(Q)$ is the industry's inverse demand, and $C(Q) = \widetilde{w}L = \widetilde{w} \cdot F^{-1}(Q)$ is the industry's cost of production, and its optimal production is summarized in Figure 1. Here, I denote $\widetilde{w}$ to emphasize that the wage is not a constant, and is an endogenous variable determined in the oligopsonic labor market.

The marginal profit loss by reducing quantity Q at a price level p is given by $\mu \times \Delta Q$, where $\mu^{up} \equiv p - MC$ is the *markup* at price p, whereas the marginal profit gain as a result of the increase in p is given by $\Delta p \times Q$. So far, the marginal cost of production is simply a function of Q: $MC(Q)$. However, it is now observed that the marginal cost is expressed by the terms in the labor market: $MC(Q) = \widetilde{w} \cdot (F^{-1})'(Q)$, where F denotes the industry's production function: $Q = F(L)$. Now, the monopolist chooses to equate these gains and loss:

$$\underbrace{(\Delta p) \times Q}_{\text{Maginal Gain}} = \underbrace{-\mu^{up} \times (\Delta Q)}_{\text{Marginal Loss}}.$$

3

Now, I introduce *imperfect competition* in the product market by Weyl and Fabinger's (2013) conduct parameter approach. If the product market is imperfectly competitive, firms recognize that their products are not perfectly substitutable as in perfect competition nor they are able to seize all marginal gains from raising a price as in monopoly. In other words, they recognize that they only capture a $100 \times \theta^G$ percent of the marginal gains, where $\theta^G \in [0, 1]$ is the *conduct parameter in the product market*. Thus, in the imperfectly competitive product market with θ^G, the equilibrium output Q solves $p(Q) - MC(Q) = -p'(Q)Q\theta^G$. This is rewritten in terms of L as:

$$\widehat{p}(L) - \frac{\widetilde{w}}{F'(L)} = -p'[F(L)]F(L)\theta^G, \tag{1}$$

where $\widehat{p}(L) \equiv p[F(L)]$ (note that $p'[F(L)]$ is not replaced by $\widehat{p}'(L)$).

2.2   Labor Market

Now, I obtain $\widetilde{w} = H(L; \theta^G)$ as a solution of Equation (1) for $\widetilde{w}$. This expresses the *firm's willingness-to-pay* or *reservation value* for the wage in the labor market. It is readily verified that $\frac{\partial H}{\partial L} < 0$ and $\frac{\partial H}{\partial \theta^G} < 0$ if *the inverse demand is not too convex* (that is, p'' is not too large a positive value) so that

$$(1 + \theta^G)\underbrace{p' \cdot F'}_{(-)} + \underbrace{\frac{wF''}{[F']^2}}_{(-)} + \theta^G \cdot \underbrace{p''}_{(+) \text{ or } (-)} \cdot \underbrace{F' \cdot F}_{(+)}$$

is negative. Workers also recognize that the product price p results from imperfect competition in the product market. They maximize their utility $u(C, L)$ by choosing their consumption $C = Q$ and labor supply L, with the budget constraint $\widehat{p}(L)C = wL$. Thus, workers choose L to maximize $u(\frac{wL}{\rho(L)}, L)$, resulting in their labor supply function, $L^S = L^S(w)$. More precisely, L^S is obtained by solving:

$$w \cdot \frac{\partial u}{\partial C}[C(L; w), L] \left(\frac{1}{\widehat{p}(L)} - \frac{L \cdot \frac{d\widehat{p}}{dL}(L)}{[\widehat{p}(L)]^2} \right) + \frac{\partial u}{\partial L}[C(L; w), L] = 0,$$

where $C(L; w) \equiv w \cdot [L/\widehat{p}(L)]$. Thus, I can also define its *inverse labor supply function, $w = (L^S)^{-1}(L)$*. Figure 2 shows how $\widetilde{w} = H(L; \theta^G)$ and $w = (L^S)^{-1}(L)$ look like.

I also introduce *imperfect competition* in the labor market, using Weyl and Fabinger's (2013) conduct parameter approach. If the firm is a monopsonist in the sense of Robinson (1993), the firm behaves as Stackelberg leader, and chooses the nominal wage w to maximize $R[L^S(w)] - wL^S(w)$, where $R(L) \equiv \widehat{p}(L)F(L)$ denotes the firm's revenue in terms of labor input, and the resulting employment and wage are L^M and w^M, respectively, as depicted in Figure 2. On the contrary, if the labor market is perfectly competitive, the equilibrium employment L^C is
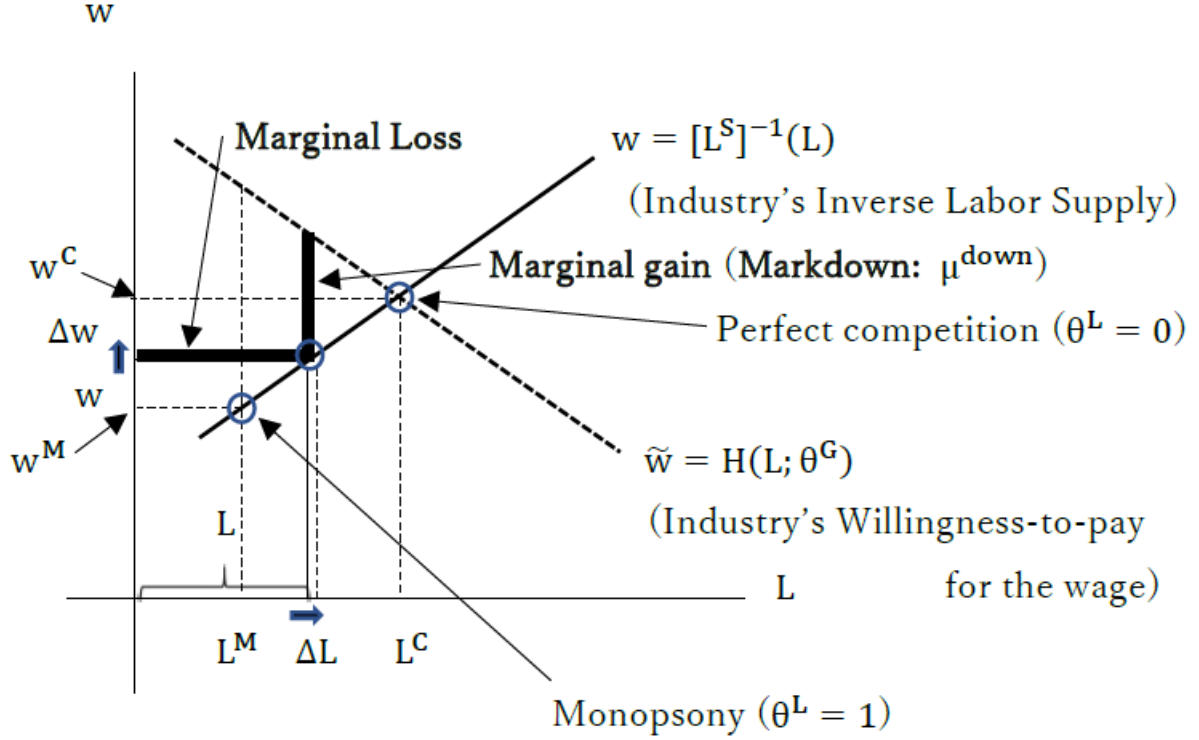
Figure 2: Wage Determination under Oligopsony

determined by $H(L; \theta^G) = [L^S]^{-1}(L)$, with the associated wage w^C in Figure 2. However, under oligopsony, symmetrically oligopsonic firms recognize that they are not perfectly substitutable as in perfect competition nor they do not incur all marginal profit losses from raising the wage w, as not all workers are employed in the same firm. Specifically, they recognize that they only incur a $100 \times \theta^L$ percent of the marginal profit losses by raising the nominal wage, where $\theta^L \in [0, 1]$ is the *conduct parameter in the labor market*. Thus, the equilibrium wage is determined by the following margin condition:

$$\underbrace{\theta^L \times (\Delta w) \times L}_{\text{Marginal Loss}} = \underbrace{\mu^{down} \times (\Delta L)}_{\text{Maginal Gain}},$$

where $\mu^{down} \equiv H[L^S(w); \theta^G] - w$ denotes the *markdown* at employment $L = L^S(w)$. In the terminology of Robinson (1933, Ch. 25), *exploitation* in the labor market is defined by the case of $\mu^{down} > 0$. More formally, the equilibrium nominal wage $w^*(\theta^L, \theta^G)$ is determined by

$$\theta^L L^S(w) = \{H[L^S(w); \theta^G] - w\} \frac{dL^S}{dw}(w), \tag{2}$$

which implies that

$$\frac{\partial w^*}{\partial \theta^L} < 0 \text{ and } \frac{\partial w^*}{\partial \theta^G} < 0,$$

that is, the nominal wage w^* decreases as the labor market or the product market becomes less competitive (an increase in θ^L or θ^G) , if

$$\underbrace{\left\{\theta^L + 1 - \frac{\partial H}{\partial L}\cdot\frac{dL^S}{dw}\right\}\frac{dL^S}{dw}}_{(+)} - \mu^{down}(w,\theta^G)\cdot\frac{d^2L^S}{dw^2} > 0,$$

that is, if $L^S(w)$ is *not too convex*.

Now, define the *real wage* by $\hat{w} \equiv w/\widehat{p}[L^S(w)]$. If the labor competition becomes less competitive, it not only has a direct effect in labor market to lower employment and nominal wage as seen a above, it also has an additional effect on the product market: less employment leads to less output, which raises the product price $\widehat{p}^* \equiv p[F[L^S(w^*)]]$. More formally, the effect of a change in the degree of imperfect competition in the labor market on the equilibrium real wage, $\hat{w}^*$, is described by

$$\frac{\partial\widehat{w}^*}{\partial\theta^L} = \underbrace{\left(\frac{1}{\widehat{p}^*} - \frac{w^*\cdot p'\cdot F'\cdot\frac{dL^S}{dw}}{(\widehat{p}^*)^2}\right)}_{(+)}\underbrace{\frac{\partial w^*}{\partial\theta^L}}_{(-)} < 0$$

because $p' < 0$. Now, workers as consumers may lose because their labor income, which is equal to their consumption. As above, the real consumption is defined by $\widehat{c} \equiv [wL^S(w)]/\widehat{p}[L^S(w)]$. Then, the utility change by the staggered labor market is captured by

$$\frac{\partial u}{\partial\theta^L} = [\underbrace{\frac{\partial u}{\partial C}}_{(+)}\underbrace{\frac{d\widehat{c}^*}{dw}}_{(+)} + \underbrace{\frac{\partial u}{\partial L}}_{(-)}\underbrace{\frac{dL^S}{dw}}_{}]\underbrace{\frac{\partial w^*}{\partial\theta^L}}_{(-)} \gtrless 0,$$

where

$$\frac{d\widehat{c}^*}{dw} = \underbrace{\frac{L^*}{\widehat{p}^*}}_{(+)} + w^*\cdot\underbrace{\left(\frac{1}{\widehat{p}^*} - \frac{L^*\cdot p'\cdot F'}{(\widehat{p}^*)^2}\right)}_{(+)}\underbrace{\frac{dL^S}{dw}}_{(+)} > 0.$$

Finally, it is also observed that as concentration rises in the product market, the equilibrium wage decreases: $\frac{\partial\widehat{w}^*}{\partial\theta^G} < 0$.

3   Separable Preferences

To proceed further, I assume additive separability of utility function: $u(C,L) = u^C(C) - u^L(L)$, where u^C and u^L are both increasing functions; recall that $\partial u/\partial L < 0$. Notice that the net surplus for the workers/consumers is $u(C^*, L^*)$. Under the separability, this net surplus is
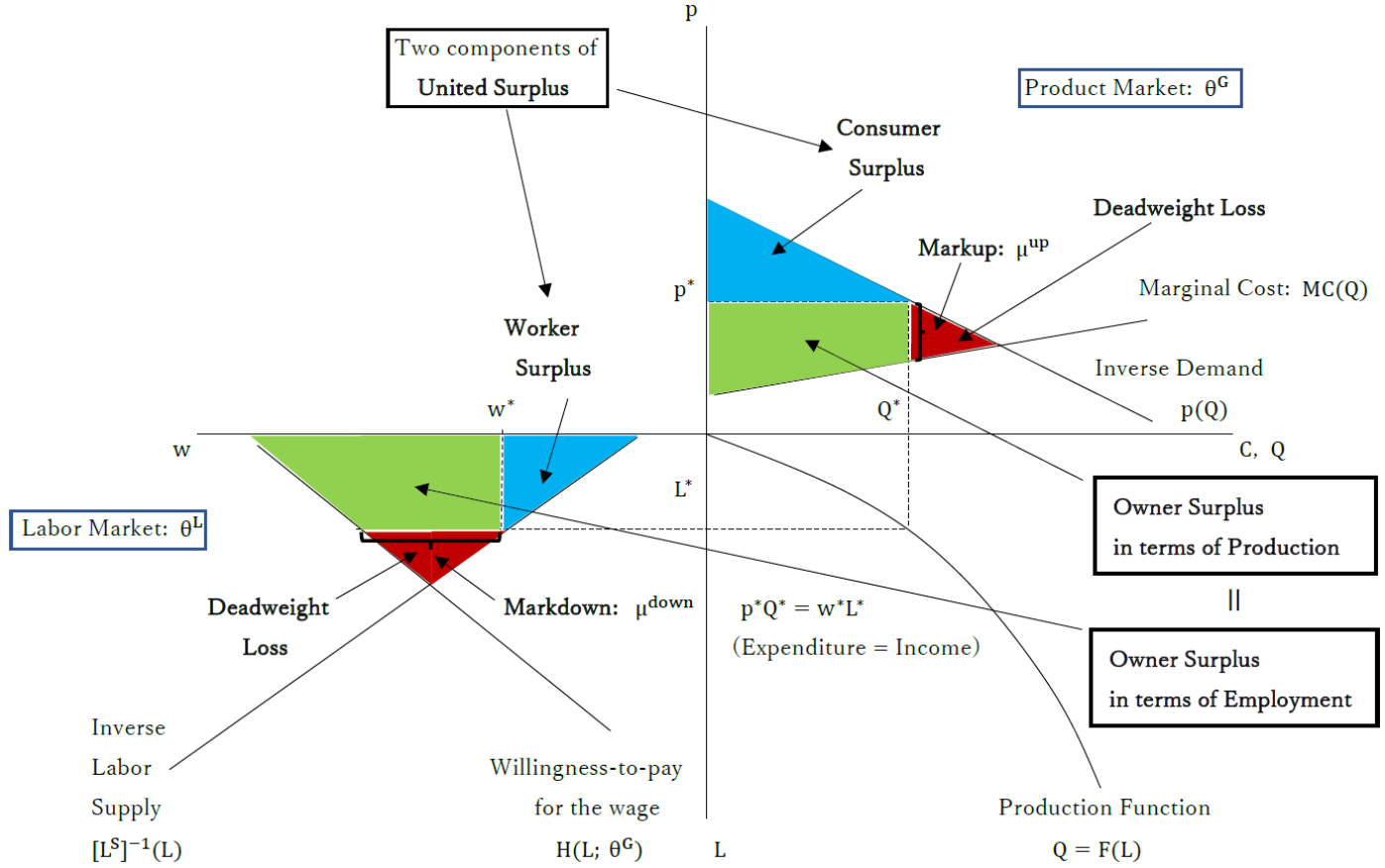
Figure 3: Labor and Product Markets under Imperfect Competition

decomposed into two parts:

$$u(C^*, L^*) - p^* C^* + w^* L^* = \underbrace{[u^C(Q^*) - p^* Q^*]}_{\text{Consumer Surplus}} + \underbrace{[w^* L^* - u^L(L^*)]}_{\text{Worker Surplus}},$$

which I call the *united surplus* (US). *Owner surplus* is simply defined by $\pi = \int_0^L [R'(\widetilde{L}) - w] d\widetilde{L}$ in terms of employment. Owner surplus can also be defined from a viewpoint of production: $\pi = \int_0^Q [p - MC(\widetilde{Q})] d\widetilde{Q}$. Figure 3 is a graphical exposition of OS (owner surplus), WS (worker surplus), and CS (consumer surplus).

Finally, I consider a tractable parameterization for production and utility functions. First, the utility function is given by

$$u(C, L) = \frac{\varepsilon}{\varepsilon - 1} C^{1 - \frac{1}{\varepsilon}} - \left\{ \frac{1}{2} L^2 + \underline{w} L \right\},$$

where $\varepsilon > 1$ is the (constant) *price elasticity* of the demand in the product market, and $\underline{w} \geq 0$ is the *subsistence wage*. On the other hand, the production function is given by $Q = F(L) = L^\alpha$,

where $\alpha < 1$ (decreasing returns). Then, the inverse demand function exhibits the constant elasticity: $p(Q) = Q^{-\frac{1}{\varepsilon}}$, which implies that $\widehat{p}(L) = L^{-\frac{\alpha}{\varepsilon}}$. The labor supply function is given by

$$L^S(w) = \begin{cases} 0 & \text{if } w < \underline{w} \\ w - \underline{w} & \text{if } w \geq \underline{w}, \end{cases}$$

whereas the firm's willingness-to-pay for the wage is given by

$$H(L; \theta^G) = \alpha \left(1 - \frac{\theta^G}{\varepsilon} \right) L^{-\frac{\alpha+(1-\alpha)\varepsilon}{\epsilon}},$$

from Equation (1). Equation (2) indicates that the equilibrium nominal wage $w^*(\theta^L, \theta^G)$ is obtained by solving:

$$(1 + \theta^L)w^* - \theta^L\underline{w} = \alpha \left(1 - \frac{\theta^G}{\varepsilon} \right) (w^* - \underline{w})^{-\frac{\alpha+(1-\alpha)\varepsilon}{\epsilon}}.$$

If $\underline{w} = 0$, the equilibrium nominal wage is expressed by

$$w^* = \left[\frac{1 + \theta^L}{\alpha \left(1 - \frac{\theta^G}{\varepsilon} \right)} \right]^{-\frac{\varepsilon}{\alpha+(2-\alpha)\varepsilon}}.$$

It is observed that while an increase in α (an improvement of productivity) or in ε (a less degree of product differentiation) raises w^*, a higher degree of θ^G reduces w^*.

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