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Abstract

In an economy in which firms exercise market power in the markets for consumption goods and inputs (labor), we show that a merger to monopoly is Pareto improving when the number of firms is below a threshold. This threshold is larger the larger is the elasticity of labor supply and the smaller is the consumers' preference for goods variety. Consequently, market concentration may have non-monotonic general equilibrium effects on wage mark downs, employment and welfare.

Keywords: General Equilibrium, Market Power; Market Efficiency; Mergers.
JEL Classification: D4, D5, D6, L1, L4.

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1 Introduction

Common wisdom suggests that mergers leading to monopolies create important deadweight losses, unless they generate large production efficiencies. Well known exceptions include (impracticable) perfectly price discriminating monopolies, markets for goods whose production generates negative externalities such as pollution (see e.g. Schoonbeek and de Vries, 2009), or vertically differentiated markets in which there are status and envy effects (Skartados and Zacharias, 2022). We study this issue from a general equilibrium perspective and find results opposing common wisdom.

Specifically, we consider a simple market economy in which there are two consumption goods which firms produce using labor as input. There are two types of consumers, the firms' owners (the capitalists) who use their share of the firms' returns to buy consumption goods, and workers, who supply labor and use their labor income to buy consumption goods. There are neither public goods nor production or consumption externalities. Thus, perfect competition generates Pareto optimal outcomes.

Under imperfect competition, firms exercise market power both as good suppliers and labor users, i.e., a firm internalizes the impact of its output and labor decisions on its profits via their effect on the prices of goods and on the wage. In the extreme case of a monopolistic economy, a single firm exercises monopoly power in the goods markets and monopsony power in the labor market.

We identify the Cournot-Walras and monopoly equilibria of the economy and show that the monopoly equilibrium Pareto dominates the Cournot-Walras equilibrium when the number of firms is below a threshold. If the number of firms is below this threshold, then relative to the Cournot competitors the monopoly both, pays a greater real wage (and hence warrants a larger welfare to workers), and generates larger real returns (and hence warrants a larger welfare to capitalists). The threshold on the number of firms leading to this result is larger the larger is the elasticity of labor supply and the smaller is the consumers' preference for goods variety.

Interestingly, this result arises even though the monopoly generates no production efficiencies. Simply, when the number of firms is below the threshold, the monopolist's incentives are better aligned with those of society than those of the Cournot competitors. As the number of firms increases above the threshold then employment and real wage increase above those of the monopoly equilibrium, and workers become better off. Unsurprisingly, as the number of firms becomes arbitrarily large the Cournot-Walras equilibrium approaches the competitive equilibrium.

2 The Economy

Consider a market economy *à la* Azar and Vives (2021), in which there are two consumption goods, c_1 and c_2. Both goods are produced using labor, l, as input. There are N firms producing the good c_1, and another N firms producing the good c_2. Each firm's production function is $F(l) = l^{\alpha}$, where $\alpha \in (0, 1]$. The firms' owners, to whom we refer as *capitalists*, buy goods using their share of the firms' returns as their exclusive source of income. In addition, there is a continuum of *workers* (whose measure is normalized to 2) who supply labor and use their labor income to buy goods. Both workers and capitalists care about their consumption of a composite good c, given by

$$c = v\left(c_1, c_2\right) := \left(\frac{1}{2}\right)^{\frac{1}{\theta-1}} \left(c_1^{\frac{\theta-1}{\theta}} + c_2^{\frac{\theta-1}{\theta}}\right)^{\frac{\theta}{\theta-1}}.$$

The parameter $\theta \in (1, \infty)$ is the elasticity of substitution between c_1 and c_2. The larger is θ, the more workers and capitalists value variety. In addition, workers care about their leisure (or its counterpart, labor) and their preferences are represented by the utility function

$$u(l, c) = \frac{c^{1-\sigma}}{1-\sigma} - \frac{l^{1+\xi}}{1+\xi},$$

where l is the worker's labor supply, $\sigma \in (0, 1)$ and $\xi > 0$.

For $i \in \{1, 2\}$ let us denote by p_i the price of good c_i. By solving the problem

$$\min_{(c_1,c_2)\in\mathbb{R}_+^2} p_1 c_1 + p_2 c_2, \text{ subject to: } v\left(c_1, c_2\right) = c,$$

we get

$$c_i^* = \frac{1}{2}\left(\frac{1}{2}\left(p_1^{1-\theta} + p_2^{1-\theta}\right)\right)^{\frac{\theta}{1-\theta}} p_i^{-\theta} c$$

for $i \in \{1, 2\}$. Hence

$$p_1 c_1^* + p_2 c_2^* = pc,$$

where

$$p = \left(\frac{1}{2}\left(p_1^{1-\theta} + p_2^{1-\theta}\right)\right)^{\frac{1}{1-\theta}}. \tag{1}$$

is the effective price of c, best known as the Dixit-Stiglitz price index. Denoting by $\rho_i := p_i/p$ the real price of good $i \in \{1, 2\}$, we may write

$$c_i(\rho_1, \rho_2) = \frac{1}{2}\rho_i^{-\theta} c(\rho_1, \rho_2). \tag{2}$$

Let us denote by w the nominal wage and by $\omega := w/p$ the real wage. Solving the problem

$$\max_{(l,c)\in\mathbb{R}_+^2} u(l,c), \text{ subject to: } c = \omega l.$$

we get a worker's labor supply and demand of the composite consumption good,

$$l^s(\omega) = \omega^\eta, \; c_w(\omega) = \omega^{\eta+1},$$

where $\eta := (1-\sigma)/(\xi+\sigma) > 0$ is the elasticity of labor supply. Note that η is decreasing in both σ and ξ. The workers' aggregate supply of labor is

$$L^S(\omega) = 2\omega^\eta. \tag{3}$$

Note that $L^S(\omega)$ is strictly increasing. Also, $L^S(\omega)$ is convex (concave) if $\eta > 1$ ($\eta < 1$); i.e., when η is large, a small increase in wage leads to a large increase in employment level.

Workers' (indirect) utility as a function of the real wage is

$$U(\omega) := u(c_w(\omega), l^s(\omega)) = \frac{\sigma+\xi}{(1-\sigma)(1+\xi)}\omega^{\frac{(1-\sigma)(1+\xi)}{\sigma+\xi}} = \frac{\omega^{\eta(1+\xi)}}{\eta(1+\xi)},$$

which is increasing.

As the capitalists care only about their consumption of the composite good, it is natural to assume that a firm's objective is to maximize real returns. The capitalists' aggregate demand of the composite good is just the firms' aggregate *real returns*, which we denote by Π.

3 Competitive Equilibrium

In a competitive economy a firm producing good $i \in \{1,2\}$ chooses its labor to solve

$$\max_{l\in\mathbb{R}_+} \rho_i l^\alpha - \omega l$$

If $\alpha < 1$, then its labor demand is

$$l(\rho_i, \omega) = \left(\frac{\alpha\rho_i}{\omega}\right)^{\frac{1}{1-\alpha}}.$$

In our symmetric setting a competitive equilibrium satisfies $p_1 = p_2 = p$, and hence $\rho_1 = \rho_2 = 1$. Thus, the aggregate labor demand is

$$L^D(\omega) = 2N\left(\frac{\alpha}{\omega}\right)^{\frac{1}{1-\alpha}},$$

and the labor market clearing condition is

$$L^S(\omega) = L^D(\omega) \Leftrightarrow 2\omega^{\eta} = 2N\left(\frac{\alpha}{\omega}\right)^{\frac{1}{1-\alpha}}.$$

Hence the equilibrium real wage is

$$\omega_{CE} = \left(N^{1-\alpha}\alpha\right)^{\beta},$$

where

$$\beta := \frac{1}{1+(1-\alpha)\eta}.$$

Noting that $(1-\beta)/(1-\alpha) = \eta\beta$, we see that in equilibrium each firm uses labor

$$l_{CE} := l(1, \omega_{CE}) = \left(\frac{\alpha^{\eta}}{N}\right)^{\beta}.$$

The workers' aggregate consumption of the composite good is

$$C^w_{CE} = 2\omega_{CE}^{\eta+1}$$

and capitalists' aggregate consumption of the composite good is

$$\Pi_{CE} = 2N\left(l^{\alpha}_{CE} - \omega_{CE} l_{CE}\right).$$

If $\alpha = 1$, then in the competitive equilibrium $\rho_1 = \rho_2 = \omega$, and the formulae above identifying the workers' and capitalists' aggregate consumption of the composite good remains valid.

Interestingly, the workers' share of the output of the composite good, which we may refer to as the labor share of the economy's real GDP is

$$\frac{C^w_{CE}}{C^w_{CE} + \Pi_{CE}} = \alpha.$$

Thus, the real wage, and hence the workers' welfare, and the labor share of the economy's real GDP are larger the larger are the firms' returns to scale. Further, when firms have constant returns to scale, i.e., $\alpha = 1$, the workers capture the entire economy's real GDP.

4 Monopoly Equilibrium

Let us calculate the equilibrium of this economy assuming that a single agent controls the $2N$ firms, behaving as a monopoly in the goods markets and as a monopsony in the labor market.

If the monopoly uses the labor profile $\ell = (l_{11}, ...l_{1N}, l_{21}, ...l_{2N})$, then using the labor supply (3) we may calculate the real wage that clears the labor market,

$$2\omega^{\eta} = \sum_{j=1}^{N} l_{1j} + \sum_{j=1}^{N} l_{2j} \Leftrightarrow \omega(\ell) = \left(\frac{\sum_{j=1}^{N} l_{1j} + \sum_{j=1}^{N} l_{2j}}{2} \right)^{\frac{1}{\eta}}. \tag{4}$$

Moreover, if the monopoly supplies its outputs, then market clearing requires that the aggregate demand of good i, C_i, satisfy

$$C_i = \sum_{j=1}^{N} l_{ij}^{\alpha} =: C_i(\ell). \tag{5}$$

Hence the aggregate demand of the composite good is

$$C(\ell) = \left(\frac{1}{2} \right)^{\frac{1}{\theta-1}} \left(C_1(\ell)^{\frac{\theta-1}{\theta}} + C_2(\ell)^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}}. \tag{6}$$

Using equation (2), we derive the real price of good $i \in \{1, 2\}$,

$$C_i(\ell) = \rho_i^{-\theta} \frac{C(\ell)}{2} \Leftrightarrow \rho_i(\ell) = \left(\frac{C(\ell)}{2C_i(\ell)} \right)^{\frac{1}{\theta}}. \tag{7}$$

Thus, the monopoly solves:

$$\max_{\ell \in \mathbb{R}_{+}^{2N}} \ \rho_1(\ell) C_1(\ell) + \rho_2(\ell) C_2(\ell) - \omega(\ell) \left(\sum_{j=1}^{N} l_{1j} + \sum_{j=1}^{N} l_{2j} \right)$$

The unique solution to this problem is

$$l_{ij}^{*} = l_M = \left(\frac{1}{N}\left(\frac{\alpha\eta}{1+\eta}\right)^{\eta}\right)^{\beta}, \text{ for } i \in \{1,2\},\ j \in \{1,...,N\}.$$

Hence the equilibrium real wage is

$$\omega_M = \left(\frac{N^{1-\alpha}\alpha\eta}{1+\eta}\right)^{\beta},$$

and the real prices of the goods are equal to 1.

The workers' aggregate consumption of the composite good is

$$C_M^w = 2\omega_M^{\eta+1},$$

and capitalists' aggregate consumption of the composite good is

$$\Pi_M = 2N\left(l_M^{\alpha} - \omega_M l_M\right).$$

The workers' share of the monopolistic economy's output of the composite good is

$$\frac{C_M^w}{C_M^w + \Pi_M} = \frac{\alpha\eta}{1+\eta}.$$

Thus, also in a monopolistic economy the real wage, and hence the workers' welfare, and the labor share of the economy's real GDP are larger the larger are the firms' returns to scale. However, even when firms have constant returns to scale, i.e., $\alpha = 1$, the capitalists continue to capture a positive share of the economy's real GDP.

5 Cournot-Walras Equilibrium

Let us next calculate the equilibrium of the economy assuming that the $2N$ firms compete *à la* Cournot by choosing the amount of labor they use. Note that firms exercise market power in both the goods markets and the labor market.

Let $\ell = (l_{11}, ...l_{1N}, l_{21}, ...l_{2N})$ be the profile identifying the labor used by each of the firms. Then the real return of firm $ij \in \{1,2\} \times \{1,...,N\}$ is

$$\pi_{ij}(\ell) = \rho_i(\ell) l_{ij}^{\alpha} - \omega(\ell) l_{ij},$$

where $\rho_i(\ell)$ and $\omega(\ell)$ are given in equations (7) and (4), respectively. It is easily verified that the economy has a unique *Cournot-Walras* equilibrium, which is symmetric. In equilibrium the labor used by each firm is

$$l_{ij}^{*} = l_{CW} = \left[\frac{1}{N} \left(\frac{(2N\theta - 1)\,\alpha\eta}{(2N\eta + 1)\,\theta} \right)^{\eta} \right]^{\beta}.$$

Hence the goods' real prices are equal to 1 and the real wage is

$$\omega_{CW} = \left(\frac{N^{1-\alpha}\,(2N\theta - 1)\,\alpha\eta}{(2N\eta + 1)\,\theta} \right)^{\beta}.$$

The workers' aggregate consumption of the composite good is

$$C_{CW}^{w} = 2\omega_{CW}^{\eta+1},$$

and capitalists' aggregate consumption of the composite good is

$$\Pi_{CW} = 2N\left(l_{CW}^{\alpha} - \omega_{CW} l_{CW}\right).$$

The workers' share of the oligopolistic economy's output of the composite good is

$$\frac{C_{CW}^{w}}{C_{CW}^{w} + \Pi_{CW}} = \frac{(2N\theta - 1)\,\alpha\eta}{(2N\eta + 1)\,\theta}.$$

Thus, the labor share of the economy's real GDP increases with the number of firms, N, the firms' returns to scale, α, the elasticity of labor supply, η, and the agents' preference for variety, θ. As expected, as N approaches infinity, the labor share of the economy's real GDP approaches α.

6 Discussion

Clearly, the capitalists are better off in the monopoly equilibrium than in the Cournot-Walras equilibrium, and in the later than in the competitive equilibrium, i.e.,

$$\Pi_M > \Pi_{CW} > \Pi_{CE},$$

Notably, the comparison between employment, real wages and labor share of the economy's real GDP across equilibria is not as straightforward. The comparison of employment in competitive and monopolistic economies is clear,

$$l_{CE} = N^{-\beta}\alpha^{\eta\beta} > N^{-\beta}\alpha^{\eta\beta}\left(\frac{\eta}{1+\eta}\right)^{\eta\beta} = l_M,$$

as it is the comparison between competitive and oligopolistic economies,

$$l_{CE} = N^{-\beta}\alpha^{\eta\beta} > N^{-\beta}\alpha^{\eta\beta}\left(\frac{(2N\theta-1)\,\eta}{(2N\eta+1)\,\theta}\right)^{\eta\beta} = l_{CW},$$

where the last inequality follows since

$$(2N\theta-1)\,\eta - (2N\eta+1)\,\theta = -(\theta+\eta) < 0.$$

Consequently, real wages, satisfy

$$w_{CE} > \max\{w_M, w_{CW}\}.$$

As for the labor share of the economy's real GDP, it is easy to see that

$$\frac{C^w_{CE}}{C^w_{CE}+\Pi_{CE}} > \max\left\{\frac{C^w_M}{C^w_M+\Pi_M}, \frac{C^w_{CW}}{C^w_{CW}+\Pi_{CW}}\right\}.$$

The obvious implication of these inequalities is that workers are better off in the competitive equilibrium than in either the monopoly equilibrium or the Cournot-Walras equilibrium.

However, the comparisons of employment, real wage, and welfare in the monopoly equilibrium and in the Cournot-Walras equilibrium is more cumbersome. Specifically, it is easy to show that

$$\begin{aligned} l_M &\geq l_{CW} \Leftrightarrow N \leq \bar{N}(\eta,\theta) \\ w_M &\geq w_{CW} \Leftrightarrow N \leq \bar{N}(\eta,\theta) \\ \frac{C^w_M}{C^w_M+\Pi_M} &\geq \frac{C^w_{CW}}{C^w_{CW}+\Pi_{CW}} \Leftrightarrow N \leq \bar{N}(\eta,\theta), \end{aligned}$$

where

$$\bar{N}(\eta,\theta) := \frac{1+\eta}{2\theta} + \frac{1}{2}.$$

Thus, while capitalists are better off in the monopoly equilibrium than in the Cournot-Walras equilibrium, whether workers' are better or worse off depends on the number of firms and the parameters η and θ. The bound $\bar{N}(\eta, \theta)$ decreases with the preference for variety, θ, and increases with the elasticity of labor supply, η. If the goods are nearly perfect substitutes (i.e., θ is near 1), for example, then $\bar{N}(\eta, \theta) > 1$, that is, a monopoly produces a Pareto superior outcome to that of a differentiated product Cournot duopoly (i.e., $N = 1$). It also increases the labor share of the economy's real GDP. Note that when $N < \bar{N}(\eta, \theta)$ a merger to monopoly turns out to be pro-competitive and welfare enhancing.

Proposition 1 *In an oligopolistic economy in which $N < \bar{N}(\eta, \theta)$, a merger to monopoly leads to an increase of the employment and the real wage, and produces a Pareto superior allocation. Thus, market power may have non-monotonic effects on employment, real wage mark downs and welfare.*

To understand the intuition for this result, let us consider the case $N = 1$, for which the premise of Proposition 1 requires the inequality $\theta < 1 + \eta$ to hold. In the Cournot-Walras equilibrium of this duopolistic economy, each competitor sets its output (i.e., labor) to equate its marginal real revenue and its marginal real cost. It is easy to identify the qualitative conditions under which a merger would lead the resulting monopoly to increase the output of both goods, generating an equilibrium with a larger employment and a larger real wage: A marginal increase of the output of good 1, for example, will lead to an increase of the monopoly real revenue, as well as to an increase of the real cost (via the increase in the real wage), in both markets. The effect on the monopolist's real returns in the market for good 1 (evaluated at the Cournot-Walras equilibrium) is zero. Yet, the sign of the effect on the monopolist's real returns in the market for good 2 – an effect that is not a concern of a Cournot competitor – depends on the difference between the increase of its real revenue due to the increase of the real price of good 2, ρ_2, and the increase of its real cost due to the increase of the real wage, ω. The effect on ρ_2 is larger the smaller is θ, while the effect on ω is smaller the larger is η. Thus, when θ is sufficiently small and η is sufficiently large (specifically, when $\theta < 1 + \eta$), the effect on the real returns in the market for good 2 is positive. When this is the case, the monopoly equilibrium entails a larger output on both markets as well as a larger employment and real wage.

When $N > 1$, a marginal increase of the monopolist output in any of its plants generates an additional effect that reduces its real revenue: Since the increase of output decreases the real price of the good, it also reduces the real revenue in other plants producing that good. This negative effect is larger the larger is N, and dominates the positive effect on the real revenue generated in the market for the other good when $(2N-1)\theta < \eta + 1$.

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