General Equilibrium with Market Power: An Example

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Introduction

Toy example based on:

Moreno, D, and E. Petrakis: General Equilibrium, Welfare and Policy when Firms have Market Power, uc3m working paper 2024-02.

On the effect of market power and the influence of common interest of large investors:

▷Azar, J. and X. Vives: General Equilibrium Oligopoly and Ownership Structure, *Econometrica* 89 (2021): 999-1048.

▷Eeckhout, J.: *The Profit Paradox. How Thriving Firms Threaten the Future of Work*, Princeton University Press, 2021.)

The Economy

In an economy there are two goods, labor (l) and consumption (c).

The economy has no endowment of consumption, but there is a technology that allows to produce consumption using labor l as input, according to the production function

$$f(l) = 2l.$$

There is a *worker* that has no resources other than her labor income, and her preferences over consumption and labor (the counterpart of leisure) are represented by a utility function

$$u(l, c) = -l^2/2 + c.$$

The Economy

There are a number (n) of identical firms producing consumption with the existing technology.

Firms are owned by agents (the *owners*) who only care about their consumption and supply no labor (i.e., they use their share of the firms' profits to buy consumption).

Firms are aware of their market power in the markets of consumption and labor, and their objective is to maximize their real profits (their profits in units of consumption).

Worker

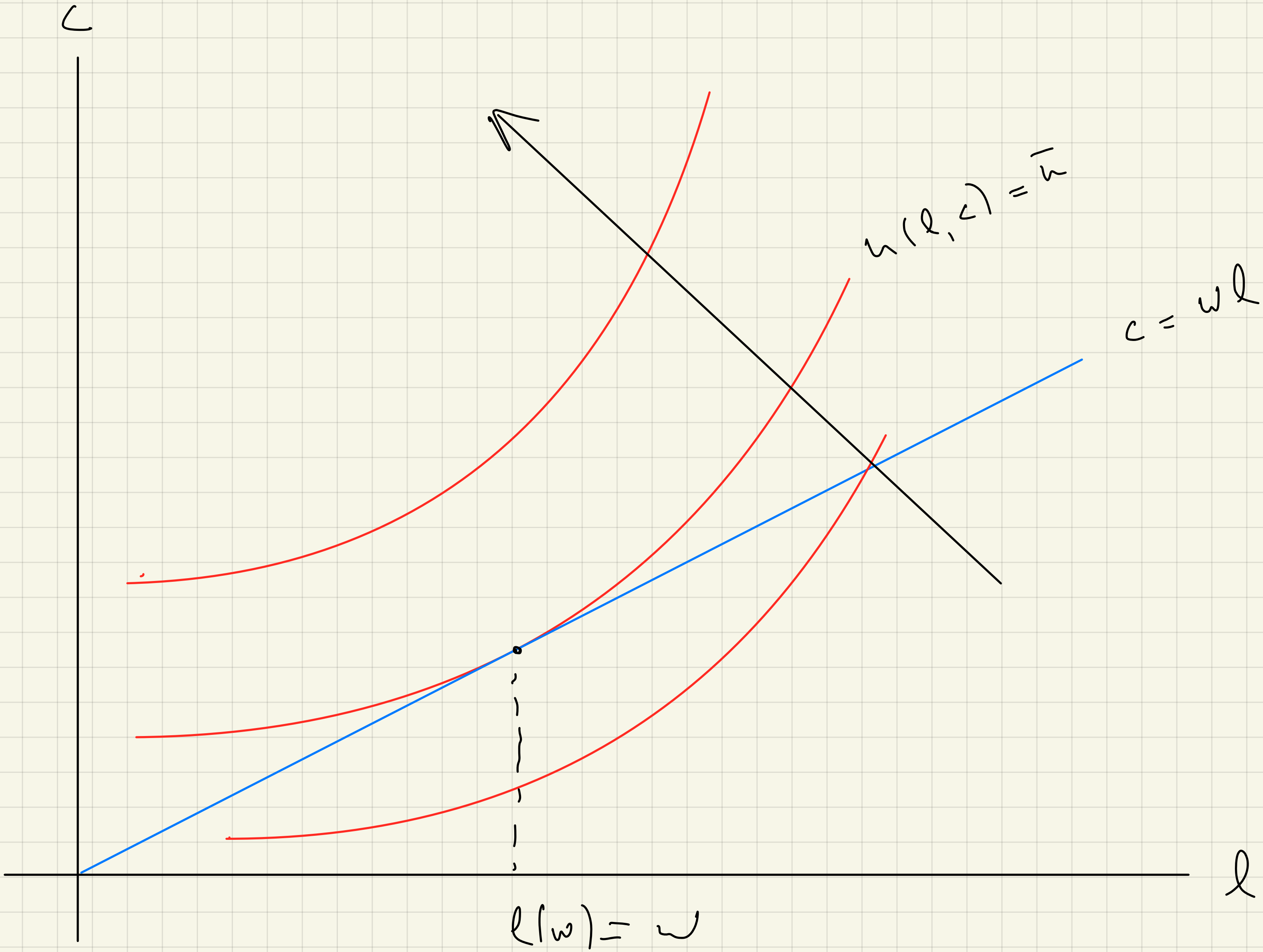
Let us denote by ω the real wage, that is, the nominal wage divided by the price of consumption. Worker's demand of consumption and supply of labor are obtained by solving the problem:

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

We calculate the worker's marginal rate of substitution,

$$MRS(l,c) = l.$$

The MRS indicates gives the number of units of consumption for which the worker is willing to supply an additional (infinitesimal) unit of labor.



c
$u(\ell, c) = \bar{u}$
$c = w\ell$
ℓ
$\ell(w) = \omega$

Worker

Solving the system

$$\begin{aligned} l &= \omega \\ c &= \omega l \end{aligned}$$

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

$$c(\omega) = \omega^2, \; l(\omega) = \omega,$$

Owners

Owners are passive since they have no decision to make.

They simply use the returns of their portfolios to buy consumption.

Competitive Equilibrium

In the competitive equilibrium constant returns to scale imply that firms profits are zero.

Hence the owners consumption is zero.

Since a unit of labor allows to produce 2 units of consumption, in equilibrium the real wage is

$$\omega_{CE} = 2,$$

and the worker's consumption is

$$c(\omega_{CE}) = \omega_{CE}^2 = 4.$$

Competitive Firm

$$\max_{l \in \mathbb{R}_+} \quad 2l - wl = (2-w)l$$

$$l^D(w) = \begin{cases} 0 & \text{if} \quad w > 2 \\ [0, \infty) & \text{if} \quad w = 2 \\ \infty & \text{if} \quad w < 2 \end{cases}$$

Labor Supply :

$$l^S(w) = w$$

Equilibrium

$$l^S(w) \overset{\in}{=} l^D(w) \iff \underline{w = 2}$$

Monopoly

Suppose that a single firms exercises monopoly (monopsony) power in the market for consumption (labor).
Obviously, the equilibrium the real wage depends on the amount of labor the firms uses according to equation

$$l = l(\omega) \Leftrightarrow \omega(l) = l.$$

Hence the real profit of the firm is

$$\pi(l) = 2l - \omega(l)l = 2l - l^2.$$

Monopoly

The monopoly chooses its labor to solve the problem

$$\max_{l \in \mathbb{R}_+} \pi(l).$$

Hence in the monopoly equilibrium

$$2 - 2l = 0 \Leftrightarrow l_M = 1 = \omega_M,$$

and therefore the worker's consumption is $c\left(\omega_M\right) = 1$, and the owners' consumption is $\pi(l_M) = 2l_M - l_M = 1$.

This allocation is NOT Pareto optimal. (Why?)

In a *Cournot-Walras equilibrium* (CWE) of the economy each firm maximizes its real profit given its rivals' labor decision.

That is, a CWE is a profile $\ell = (l_1, ..., l_n)$, such that l_i solves the problem

$$\max_{l \in \mathbb{R}_+} \pi(l, \ell_{-i}) = 2l - \omega(l, \ell_{-i}) l,$$

where

$$\omega(\ell) = \sum_{j=1}^{n} l_j.$$

Since

$$\frac{\partial \omega(\ell)}{\partial l_i} = 1,$$

the first order condition for a solution to this problem is

$$2 - l - \omega(\ell) = 0 \Leftrightarrow l(\ell_{-i}) = \frac{1}{2}\left(2 - \sum_{j \neq i} l_j\right).$$

It is easy to show that CWE is symmetric, i.e., $l_i = l$ for all i.

Hence in equilibrium the equation

$$l = \frac{1}{2}\left(2 - (n-1)\, l\right)$$

holds, and the labor of a firm is

$$l^*(n) = \frac{2}{n+1}.$$

The equilibrium real wage is

$$nl^*(n) = \frac{2n}{n+1} = \omega^*(n),$$

Oligopoly

Therefore in the CWE the workers consumption is

$$c^*(n) = \left(\frac{2n}{n+1}\right)^2 = 4\left(\frac{n}{n+1}\right)^2,$$

and a firms' real profit is

$$\pi^*(n) = (2 - \omega^*(n))\, l^*(n) = \left(2 - \frac{2n}{n+1}\right)\frac{2}{n+1} = \frac{2}{(n+1)^2}$$

Hence

$$\lim_{n\to\infty} \omega^*(n) = 2, \quad \lim_{n\to\infty} c^*(n) = 4, \quad \lim_{n\to\infty} \pi^*(n) = 0.$$

Policy: Minimum Wages

Let us assume that the government sets a minimum **real** wage $\bar{\omega} \in (\omega^*(n), 2]$. This implies that the real wage is now

$$\omega(\ell) = \begin{cases} \bar{\omega} & \text{if } \sum_j l_j \leq \bar{\omega} \\ \sum_j l_j & \text{otherwise.} \end{cases}$$

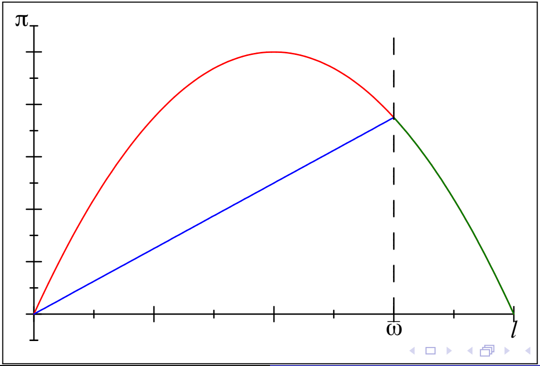
Policy: Minimum Wages

If $n = 1$ (monopoly), $\bar{\omega} \in (1, 2]$. Then $\hat{\omega}(l) = (2 - \bar{\omega})\, l$ for $l \leq \bar{\omega}$ and $\hat{\omega}(l) = (2 - l)\, l$ for $l > \bar{\omega}$.
Hence the solution to the firm's problem

$$\max_{l_i \in \mathbb{R}_+} (2 - \hat{\omega}(l))\, l.$$

is

$$l = \bar{\omega}.$$



If $n = 2$, then

$$\max_{l_i \in \mathbb{R}_+} \left(2 - \hat{\omega}(l_1, l_2)\right) l_i.$$

Then there is a symmetric equilibrium, $l_1 = l_2 = \bar{\omega}/2$, but that are also asymmetric equilibria.

Policy: Minimum Wages

Example: $\omega^*(2) = 4/3$. Take $\bar{\omega} = 5/3$. Then $l_1 = 2/3$, $l_2 = 1$ forms an equilibrium. To see this, we graph the profits of both firms: