Hidden Information as a Source of Misallocation: An Application to the Opioid Crisis

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Welfare Cost of Hidden Information

- Hidden information may drive manager to sub-optimal choices
  - Misallocation
- Recent literature: macroeconomic consequences of misallocation due to
  - taxes
  - labor laws
  - childcare policy
- I develop a macroeconomic framework to study misallocation from information hidden to employers

The mechanism

- Key information on worker productivity is hidden from employer
- This prevents wage from being equal to marginal productivity
- Affecting optimal hiring decisions

Application: Opioid Addiction

- Being addicted to opioids reduces worker productivity
- Addicts have incentives to lie to increase their wage
- I measure the output loss associated with this issue

Model Intuition

- Model builds on Lucas (1978) span of control model
  - Individuals differ in managerial ability
  - Production requires a manager paired with workers
  - Individuals self-select into occupations
    - high ability individuals become managers
    - low ability individuals become workers
- Add worker's health as hidden information
  - Addicts are absent more often, and less productive when present

Related Literature

- Resource misallocation
  - progressive taxation (Restuccia et al., 2017, RED)
  - size contingent policies (Garicano et al. 2016, AER)
  - size contingent childcare policy (Escobar et al. 2019)
- Empirical studies on impacts of the opioid crisis
  - economic cost is 2.8% of GDP in 2015 (CEA, 2017)
  - relationship between opioid dependence and absenteeism (Hasselt et al., 2015)

Model

Overview: Garicano (2006) and Lucas (2019)

- Continuum of individuals with heterogeneous ability z
- Choose to become a manager or a worker
- Production requires a manager paired with workers
- Problem of difficulty v is drawn randomly
  - if $v < z_p$ (worker's ability), worker solves
  - if $v > z_p$ and $v < z_m$ (manager's ability), a manager solves
  - if $v > z_m$, no one solves

Model Set-up

- Preference
$$U(z) = max\{w(z), R^*(z)\}$$
- Agents are heterogeneous in skill and endowed with
  - a unit of time
  - a skill level z
- Distributions, $z \in [0, \bar{z}]$:
  - Skill: $G(z)$ with density $g(z)$
  - Problem: $F(z)$ with density $f(z)$

Hidden Information

- Two types of workers:
  - Healthy
  - Unhealthy: dependent on opioids
    - ρ fraction of unhealthy workers
    - γ loss of productivity
- There are no unhealthy managers
  - Empirically very few
  - Assumption simplifies analysis

Production process

- Each worker draws a problem v, every period

$$Output = \begin{cases} 1 \text{ if } v \leq z_p \\ 0 \text{ if } v > z_p \end{cases}$$

  - healthy worker: solve a problem with probability $F(z_p)$
  - unhealthy worker: solve a problem with probability $F(z_p)$ if paying attention, and 0 if not
    - effective probability of solving problem: $\gamma F(z_p)$

- Manager receives problems unsolved and spends h units of time on each
  - solves it if $v \leq z_m$

Full Information

Full-Information equilibrium

- A rent of a manager with skill z_m:

$$\max_{z_{ph}, z_{pu}, n} \left[F(z_m) - w(z_p)\right] n$$

$$\text{s.t} \quad hn[1 - F(z_{ph})] = 1 \text{ if healthy}$$

$$hn[1 - \gamma F(z_{pu})] = 1 \text{ if unhealthy}$$

$$\text{Indifferent if } F(z_{ph}) = \gamma F(z_{pu})$$

  - n - number of workers to hire
  - w - wage

FOC:

$$w'(z_p) = \left[F\left(z_m\right) - w\left(z_p\right)\right] \frac{f(z_p)}{[1 - F(z_p)]}$$

Full-Information equilibrium

- Labor Market Equilibrium, for all $z_p \leq z^*$:

$$\int_0^{z_p} g(z)dz = \int_{m(0)}^{m(z_p)} n(m^{-1}(z))g(z)dz$$

  - $m(z)$: assigning workers to managers, and positive sorting
    - $m(0) = z^*$ and $m(z^*) = \bar{z}$
  - z^*: an agent is indifferent between two occupations

- Total output:

$$Y_{FI} = \int_0^{z^*} F\left(m(z)\right) g(z)dz$$

Hidden Information

Hidden information eqiulibrium

- A rent of a manager with skill z_m:

$$\max_{z_p,n} \left[F(z_m) - w(z_p)\right] n$$

$$\text{s.t } hn\left[1 - (1-\rho)F(z_p) - \rho\gamma F(z_p)\right] = 1$$

FOC:

$$w'(z_p) = \left[F\left(z_m\right) - w\left(z_p\right)\right] \frac{(1-\rho)f(z_p) + \rho\gamma f(z_p)}{\left[1 - (1-\rho)F(z_p) - \rho\gamma F(z_p)\right]}$$

Hidden information eqiulibrium

- Labor Market Equilibrium, for all $z_p \leq z_l$:

$$\int_0^{z_p} g(z)dz = \int_{m(0)}^{m(z_p)} n(m^{-1}(z))g(z)dz$$

  - $m(z)$: assignment function
    - $m(0) = z_l$ and $m(z_l) = \bar{z}$
  - z_l: an agent is indifferent between two occupations

- Total output:

$$Y_{HI} = \int_0^{z_l} F\left(m(z)\right) g(z)dz$$

Output loss

- Hidden information creates:

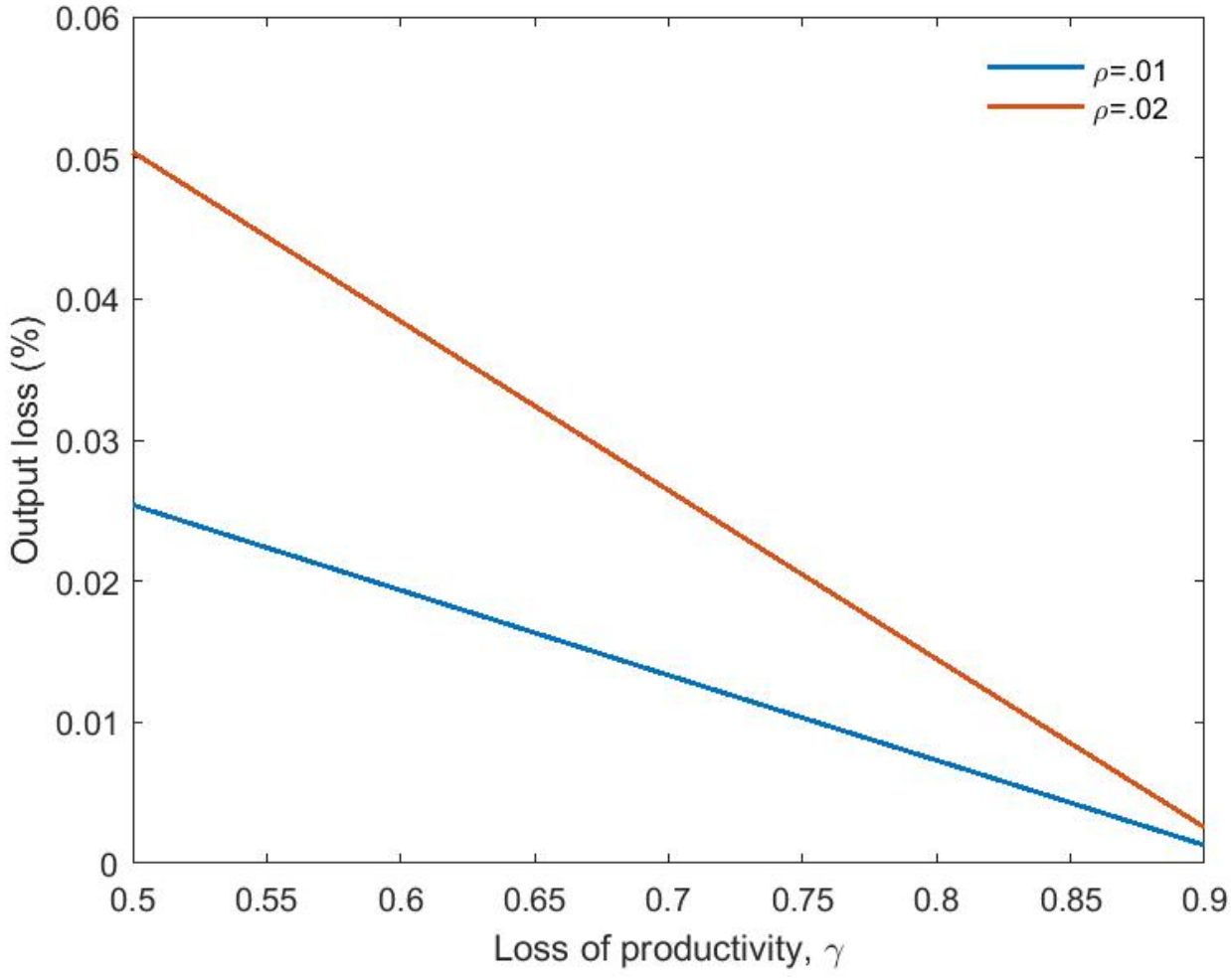
$$Output\ Loss = \frac{Y_{FI} - Y_{HI}}{Y_{FI}} \times 100$$

Numerical Analysis

Parameters

- Calibration pending
- Pareto distribution: $\theta = 2$
- Other parameters
  - $\rho = 0.01$ ▸ Fig
  - $h = 0.7$
  - $\gamma \in [0.5, 0.9]$

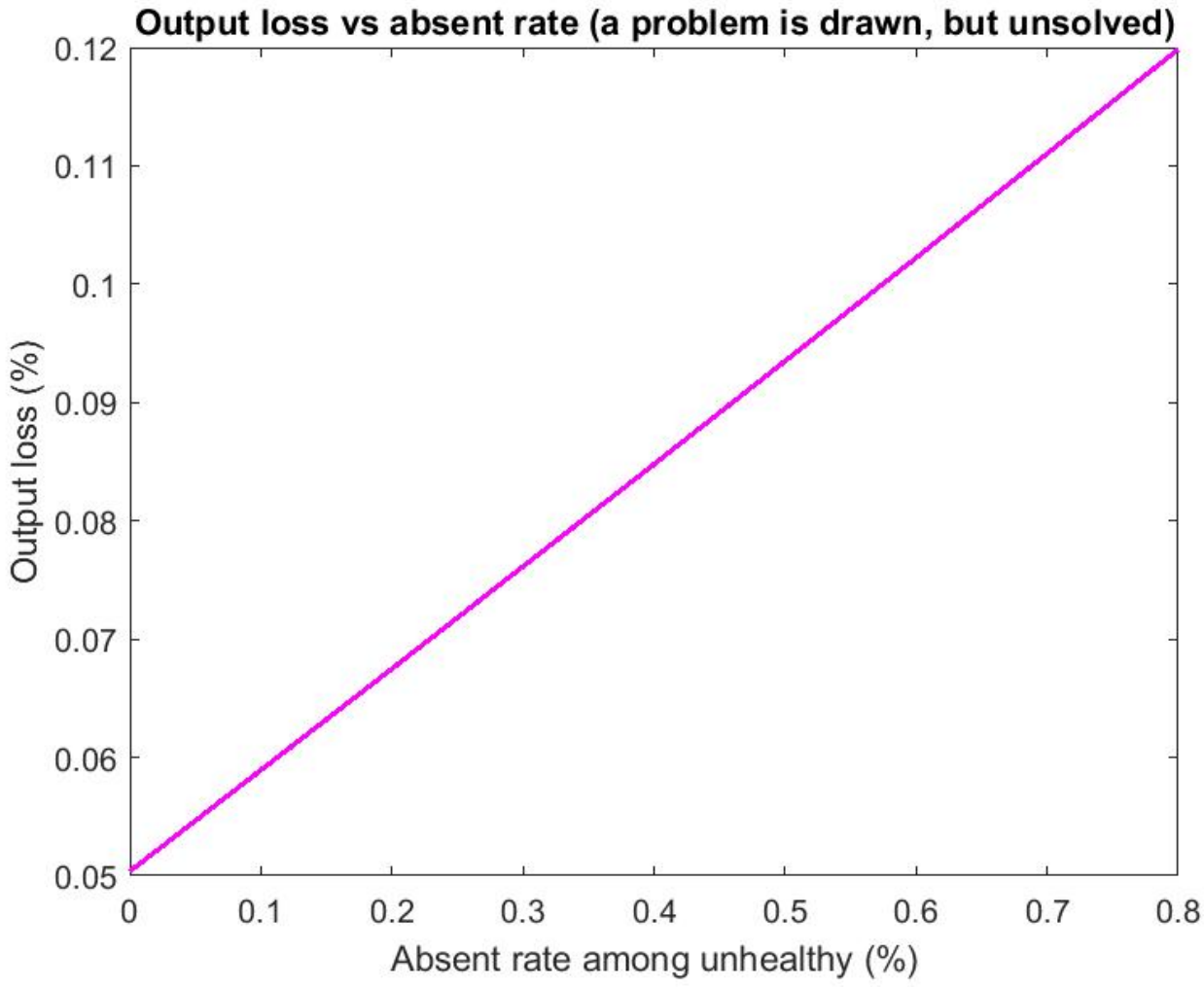
Output loss


0.06
0.05
0.04
0.03
0.02
0.01
0
Output loss (%)
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
Loss of productivity, γ
ρ=.01
ρ=.02

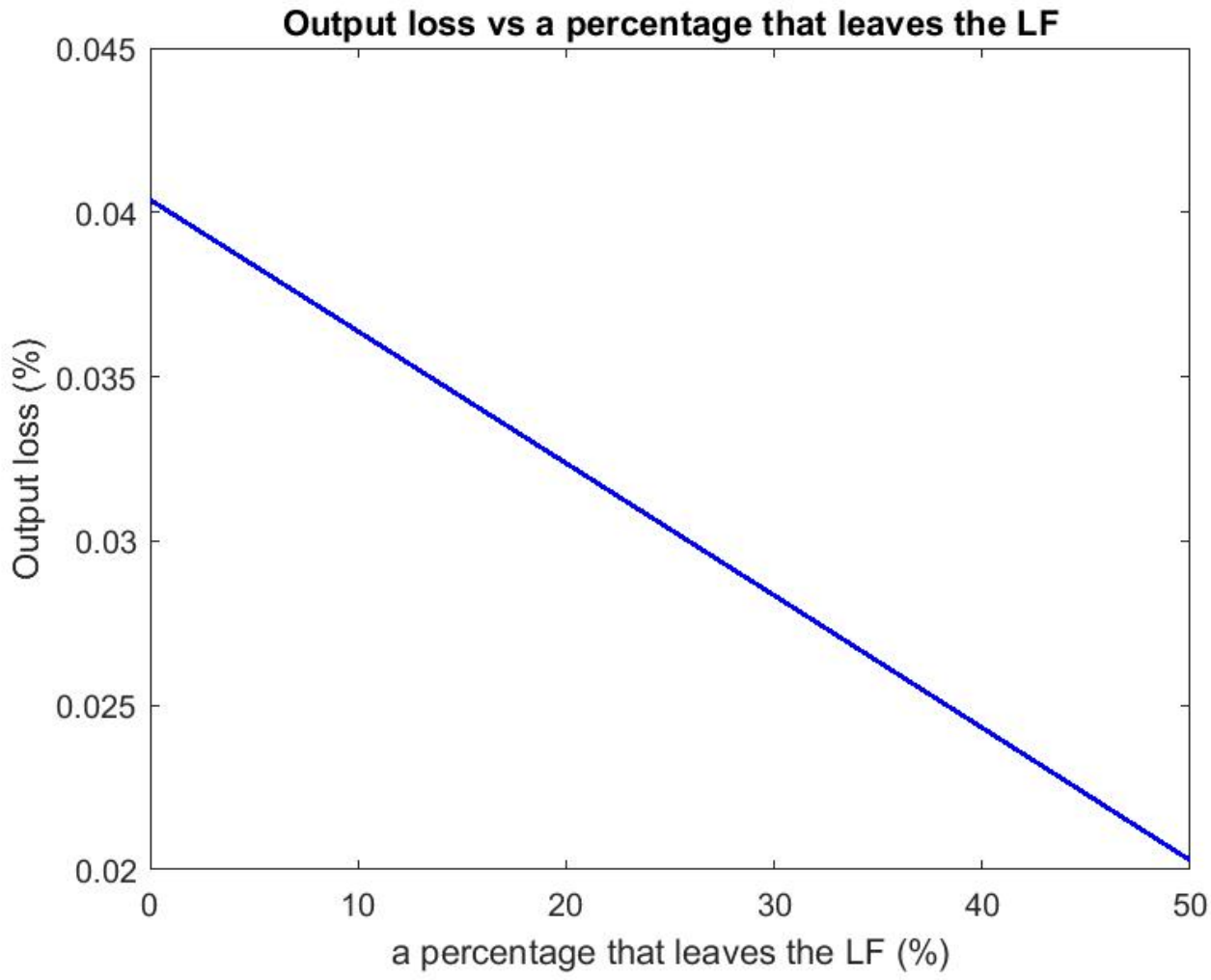
Extensions

- Absenteeism among addicted workers
  - If worker is absent, more work for managers
- Out of labor force
  - some of addicted workers leaves labor market

Output loss increase with absence rates



Output loss decreases with out of LF rates



Conclusion

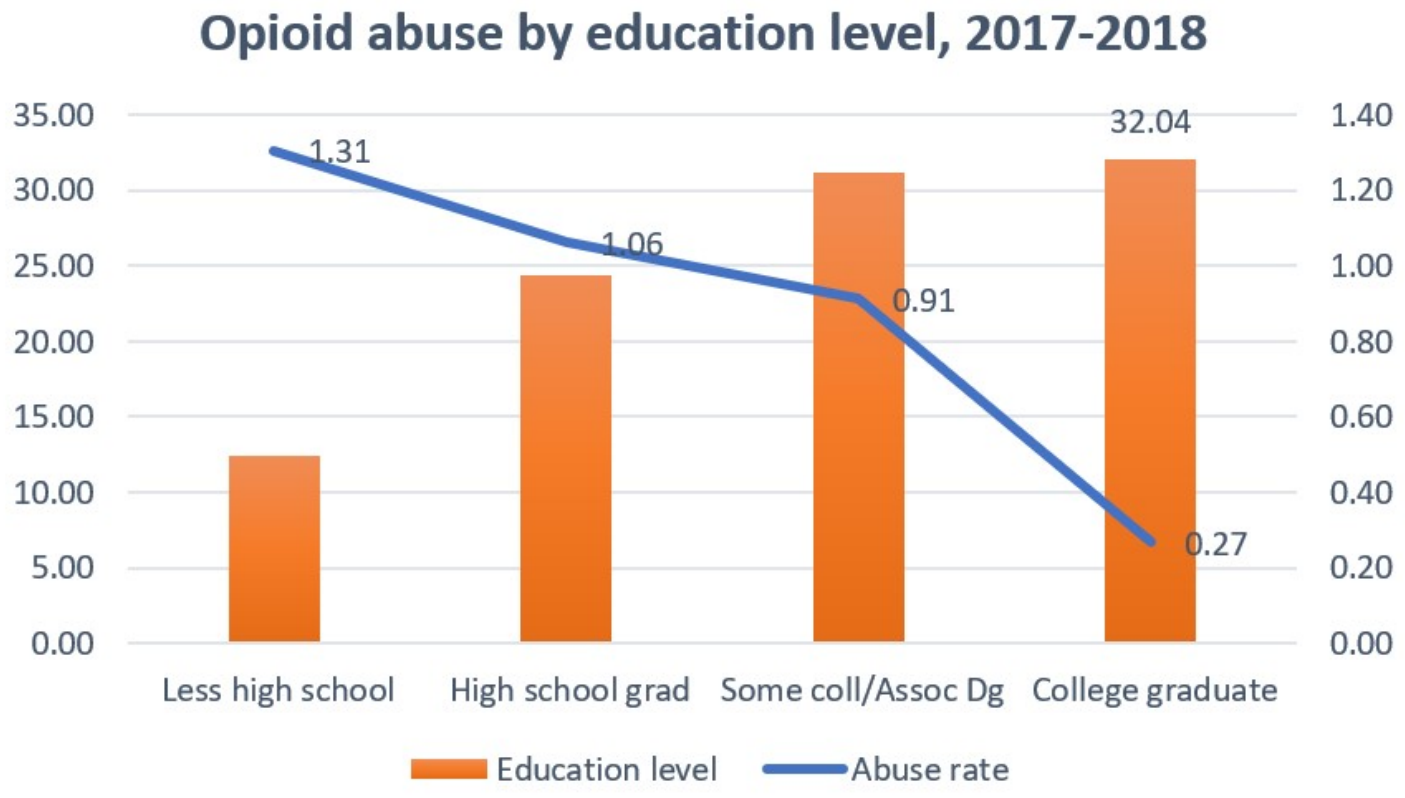
- Misallocation under hidden information
  - distorting assignment
  - changing occupational choices
- Output loss increases with
  - loss of productivity
  - a proportion of addicted workers

Future work

- Increase a number of layers
  - Related work shows that misallocation weakly increases with a number of layers
- Calibrate parameters

Thank you!

Opioid dependence decreases with education level



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Source: Substance Abuse and Mental Health Services Administration (SAMHSA)'s public online data analysis system (PDAS)