Misallocation

EC502 Macroeconomics
Topic 4

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Why Are Some Countries Richer than Others?

- Development accounting suggests differences in A are important
- Romer model endogenizes A as a process of knowledge (idea) accumulation
- So, is China poorer than the US because China has fewer ideas?
- But ideas are non-rival – they should be usable by everyone in the world
- Shouldn't China have access to the same knowledge as the US?
- Of course, there are various frictions in idea flows in reality
  … but hard to imagine they account for 5-50 times differences in income per capita

Misallocation Hypothesis

- Perhaps China and the US have access to the same technology
- But resources are more misallocated in China than US
  … due to regulations, corruption, financial frictions, etc
- Firms with low productivity produce more, high productivity produce less
- Misallocation manifests as a lower TFP, A
  - Lower output even with the same L and K

Simple Model of Misallocation – Hsieh and Klenow (2009)

Environment and Market Equilibrium

- We now move away from one production function
- Suppose there are N firms in a country, $i = 1, \ldots, N$
- Each firm i has access to the following technology

$$y_i = \underbrace{\tilde{A}_i k_i^{\alpha}}_{\equiv A_i} l_i^{1-\alpha}$$

- For simplicity, we assume k_i is fixed
- Each firm takes wage w as given, decide l_i, and sells the goods at price of 1
- The labor markets clear (labor demand = labor supply):

$$\sum_{i=1}^{N} l_i = L$$

Equilibrium without Misallocation

- Let us start with the case there is no misallocation
- All firms solve

$$\max_{l_i} A_i l_i^{1-\alpha} - w l_i$$

- The first-order condition is

$$\underbrace{(1-\alpha)A_i l_i^{-\alpha}}_{\text{Marginal product of labor}} = w$$

- This implies that the marginal product of labor is equalized across all firms

$$(1-\alpha)A_1 l_1^{-\alpha} = (1-\alpha)A_2 l_2^{-\alpha} = \cdots = (1-\alpha)A_N l_N^{-\alpha}$$

Why is there no misallocation?

- Suppose a government (planner) forces firm 1 to hire more and firm 2 to hire less
- Can we increase total output?
- Firm 1's output increases by

$$\frac{dy_1}{dl_1} = (1-\alpha)A_1 l_1^{-\alpha}$$

- Firm 2's output decreases by

$$\frac{dy_2}{dl_2} = (1-\alpha)A_2 l_2^{-\alpha}$$

- Changes in total output:

$$\frac{dy_1}{dl_1} - \frac{dy_2}{dl_2} = (1-\alpha)A_1 l_1^{-\alpha} - (1-\alpha)A_2 l_2^{-\alpha} = 0$$

Efficient Allocation

- More generally, the efficient allocation of the economy is

$$\max_{l_1,\ldots,l_N} \sum_{i=1}^{N} A_i l_i^{1-\alpha}$$

$$\text{s.t.} \qquad \sum_{i=1}^{N} l_i = L$$

- Lagrangian is

$$\mathscr{L} = \sum_{i=1}^{N} A_i l_i^{1-\alpha} + \lambda \left[L - \sum_{i=1}^{N} l_i \right]$$

- Taking the first-order condition,

$$(1-\alpha)A_1 l_1^{-\alpha} = (1-\alpha)A_2 l_2^{-\alpha} = \cdots = (1-\alpha)A_N l_N^{-\alpha} = \lambda$$

$\Rightarrow$ the marginal product of labor is equalized across all firms!

Firm's Hiring Decisions

- Now suppose that firms get different taxes for hiring labor, $(1 + \tau_i)$
- All firms now solve

$$\max_{l_i} A_i l_i^{1-\alpha} - (1 + \tau_i) w l_i$$

- First-order condition

$$\underbrace{(1 - \alpha) A_i l_i^{-\alpha}}_{\text{Marginal product of labor}} = w(1 + \tau_i)$$

Why is there "misallocation"?

- Suppose a government (planner) forces firm 1 to hire more and firm 2 to hire less
- Can we increase total output?
- Changes in total output:

$$\frac{dy_1}{dl_1} - \frac{dy_2}{dl_2} = \underbrace{(1-\alpha)A_1 l_1^{-\alpha}}_{w(1+\tau_1)} - \underbrace{(1-\alpha)A_2 l_2^{-\alpha}}_{w(1+\tau_2)}$$

$$= w(\tau_1 - \tau_2)$$

- The total output increases if firm 1 pays higher taxes than firm 2
- Firm 1 was hiring too little, while firm 2 was hiring too much
  - Reallocating labor from firm 2 to 1 improves allocative efficiency

Dispersion in MPL $\Rightarrow$ TFP Loss

- We can show that, to a second-order approximation around the efficient allocation,

$$Y \approx \bar{A} M L^{1-\alpha}$$

where

$$\bar{A} = \left(\sum_{i=1}^{N} A_i^{1/\alpha} \right)^{\alpha}$$

$$M = \exp\left[-\frac{1}{\alpha} \text{Var}(\log MPL_i) \right] \leq 1$$

- **Dispersion** in the marginal product of labor, MPL_i, lowers aggregate productivity

Second-Order Approximation

- Consider a function

$$f(x_1, \dots, x_N)$$

- The first-order approximation around $(\bar{x}_1, \bar{x}_2, \dots, \bar{x}_N)$ is

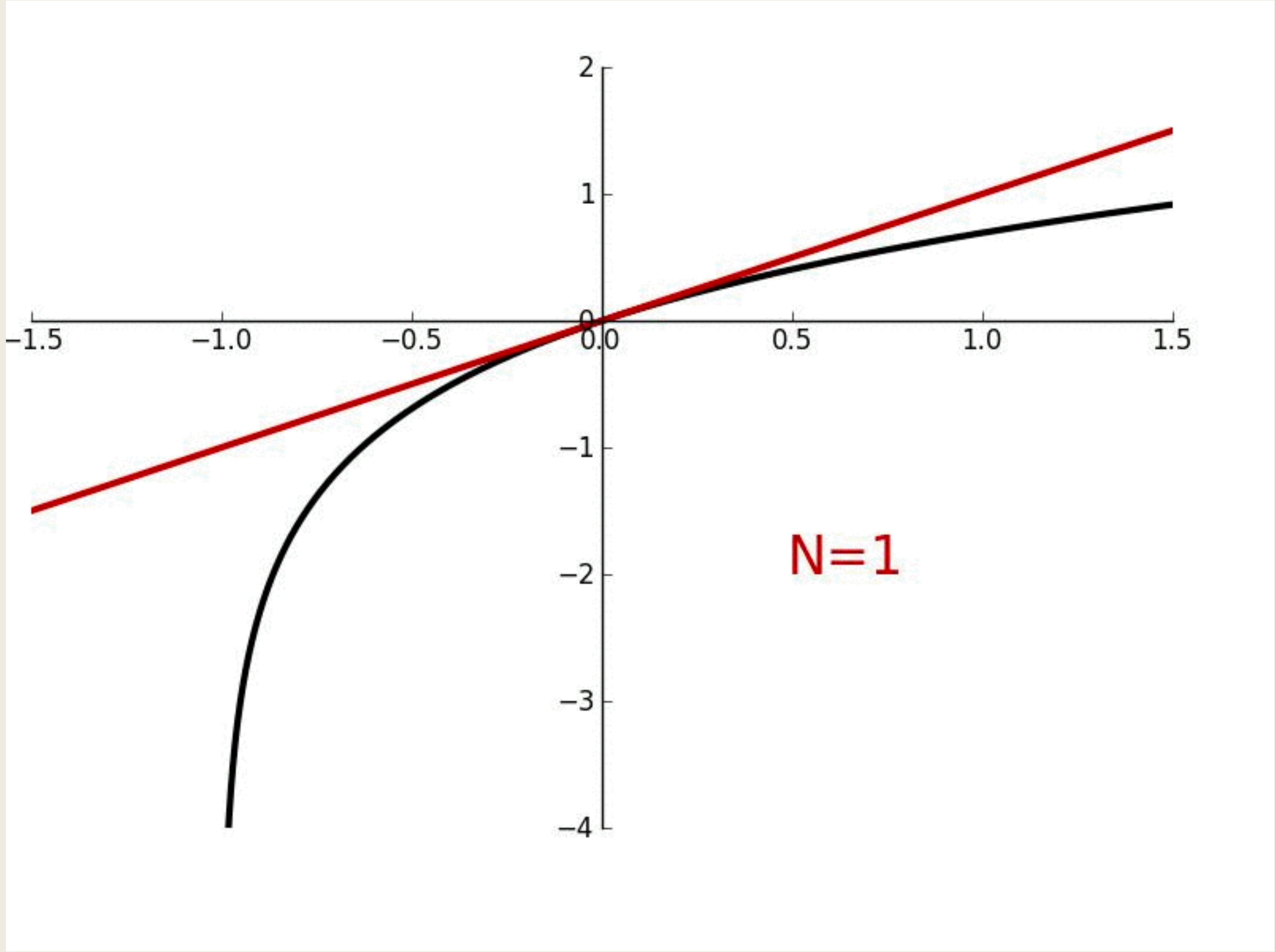
$$f(x_1, \dots, l_N) \approx f(\bar{x}_1, \dots, \bar{x}_N) + \sum_{i=1}^{N} \frac{\partial f(\bar{x}_1, \dots, \bar{x}_N)}{\partial x_i}(x_i - \bar{x}_i)$$

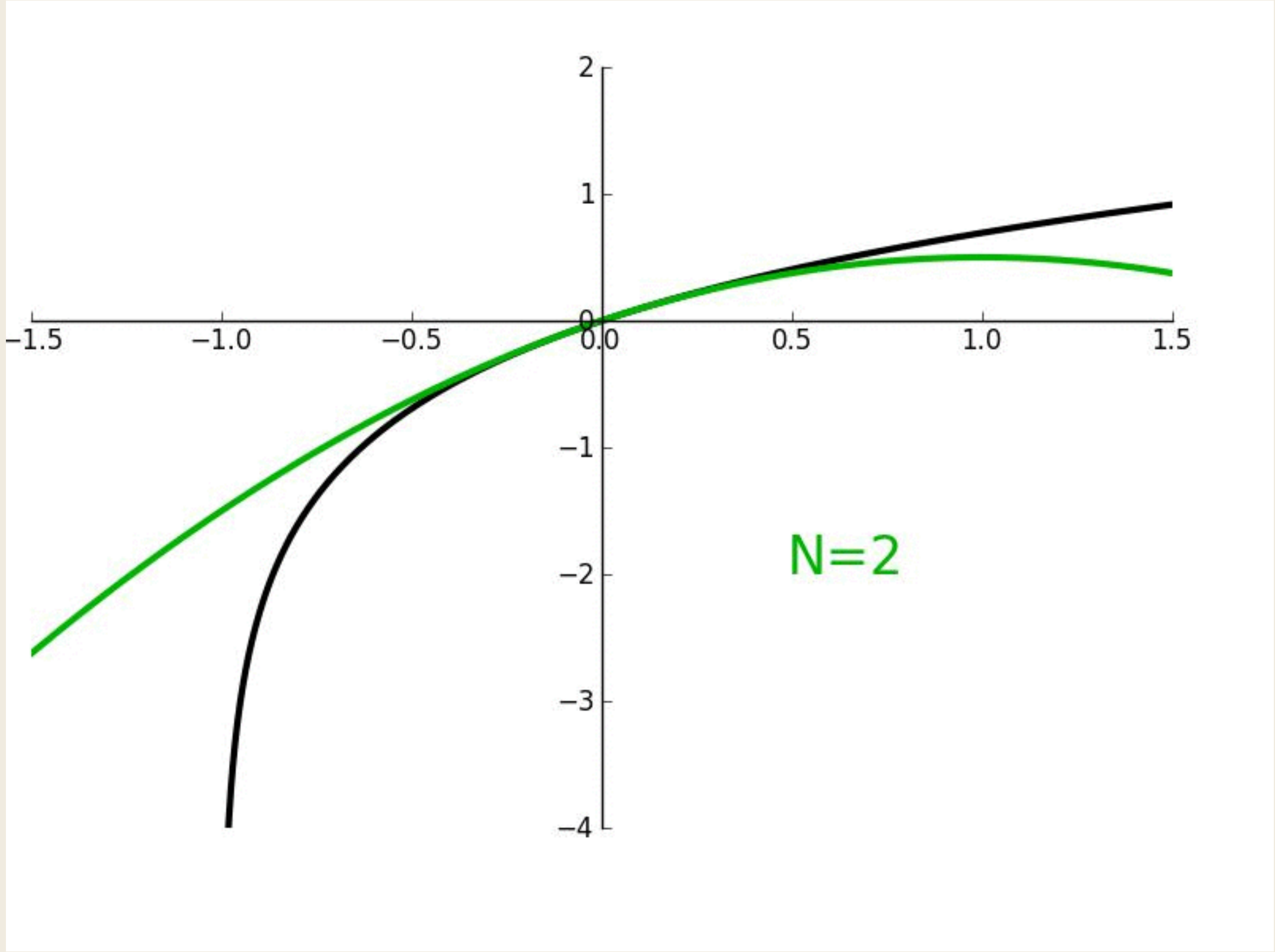
- The second-order approximation is

$$f(x_1, \dots, l_N) \approx f(\bar{x}_1, \dots, \bar{x}_N) + \sum_{i=1}^{N} \frac{\partial f(\bar{x}_1, \dots, \bar{x}_N)}{\partial x_i}(x_i - \bar{x}_i)$$

$$+\frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N} \frac{\partial^2 f(\bar{x}_1, \dots, \bar{x}_N)}{\partial x_i \partial x_j}(x_i - \bar{x}_i)(x_j - \bar{x}_j)$$

Example with One-Dimensional Function





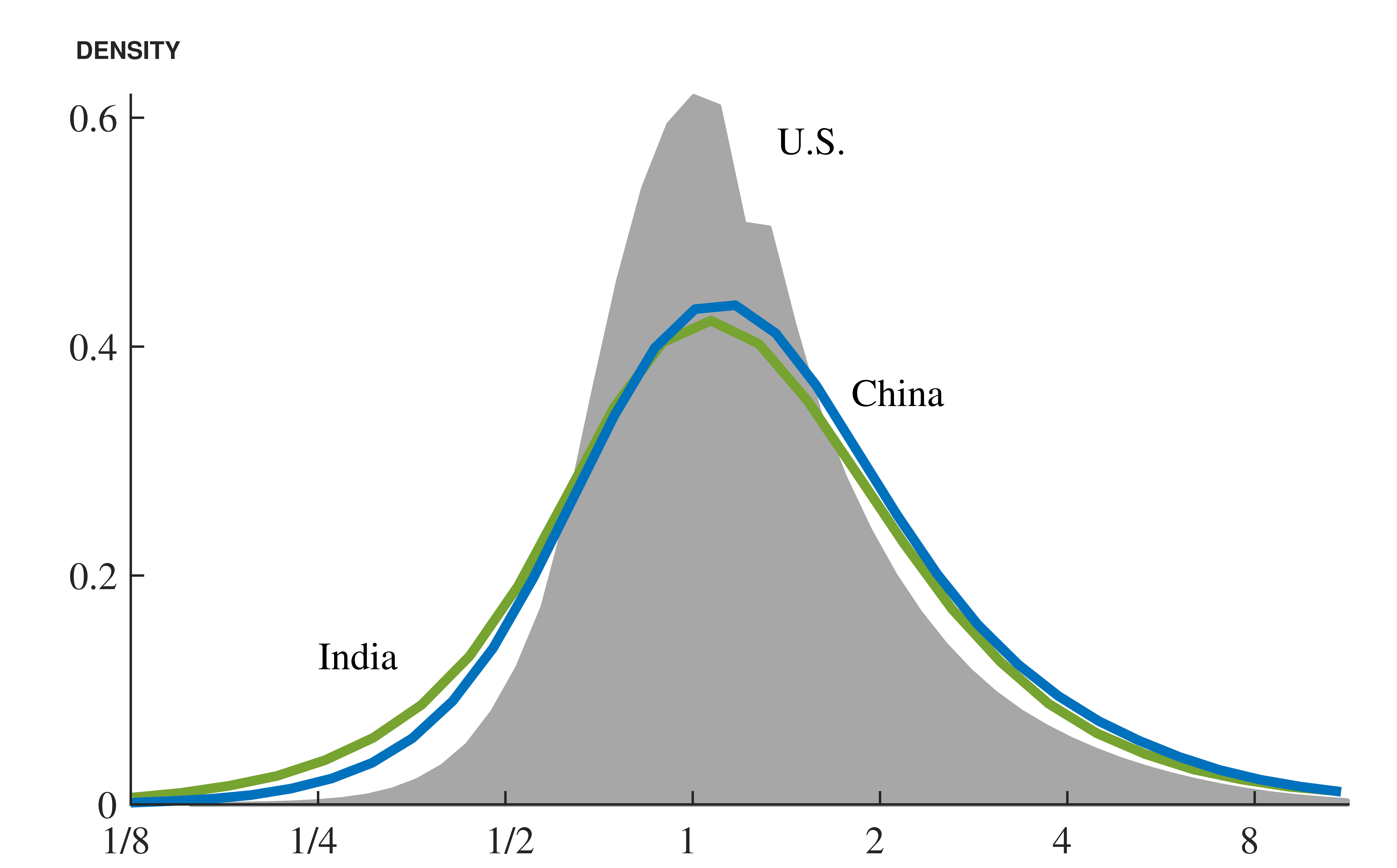
Measuring MPL

- How do we measure marginal product of labor?
- With our functional form assumption, this is easy:

$$MPL_i = (1 - \alpha)\frac{y_i}{l_i}$$

- Hsieh and Klenow (2009):
  - Use manufacturing plant-level data from the US, India, and China
  - They measure dispersions in MPL_i at the plant-level using $MPL_i = (1 - \alpha)y_i/l_i$
  - Quantify the TFP losses from misallocation

Dispersions in MPL



Huge Misallocation, More So in China & India

- More dispersions in MPL, and thereby misallocation, in China and India than the US
- Removing misallocation increases total output by
  - $\approx$ 100% in China
  - $\approx$ 120% in India
  - $\approx$ 40% in the US
- If China and India had the same level of misallocation as the US,
  - Manufacturing TFP goes up by $\approx$ 40% in China and by $\approx$ 50% in India
  - Close the manuf. TFP gap to the US by 50% for China and for 35% for India
- Misallocation accounts for 30-50% of the difference in TFP

Is This the Number We Believe in?

– Carrillo, Donaldson, Pomeranz & Singhal (2023)

Do We Believe It?

- We relied on the following equation:

$$MPL_i = (1 - \alpha)\frac{y_i}{l_i}$$

- This relies on a very strong functional form assumption, $y_i = A_i l_i^{1-\alpha}$
- Simple functional form assumptions are useful to obtain insights
  … but not something we seriously believe in
- Is there any way to test misallocation without relying on strong assumptions?

Nonparametric Test of Misallocation

- Carrillo, Donaldson, Pomeranz & Singhal (2023) develop such an approach
- If there is an exogenous demand shock to firms, and suppose we observe
  - changes in output in response to the shock, dy_i
  - changes in input in response to the shock, dl_i
- Consequently, we observe

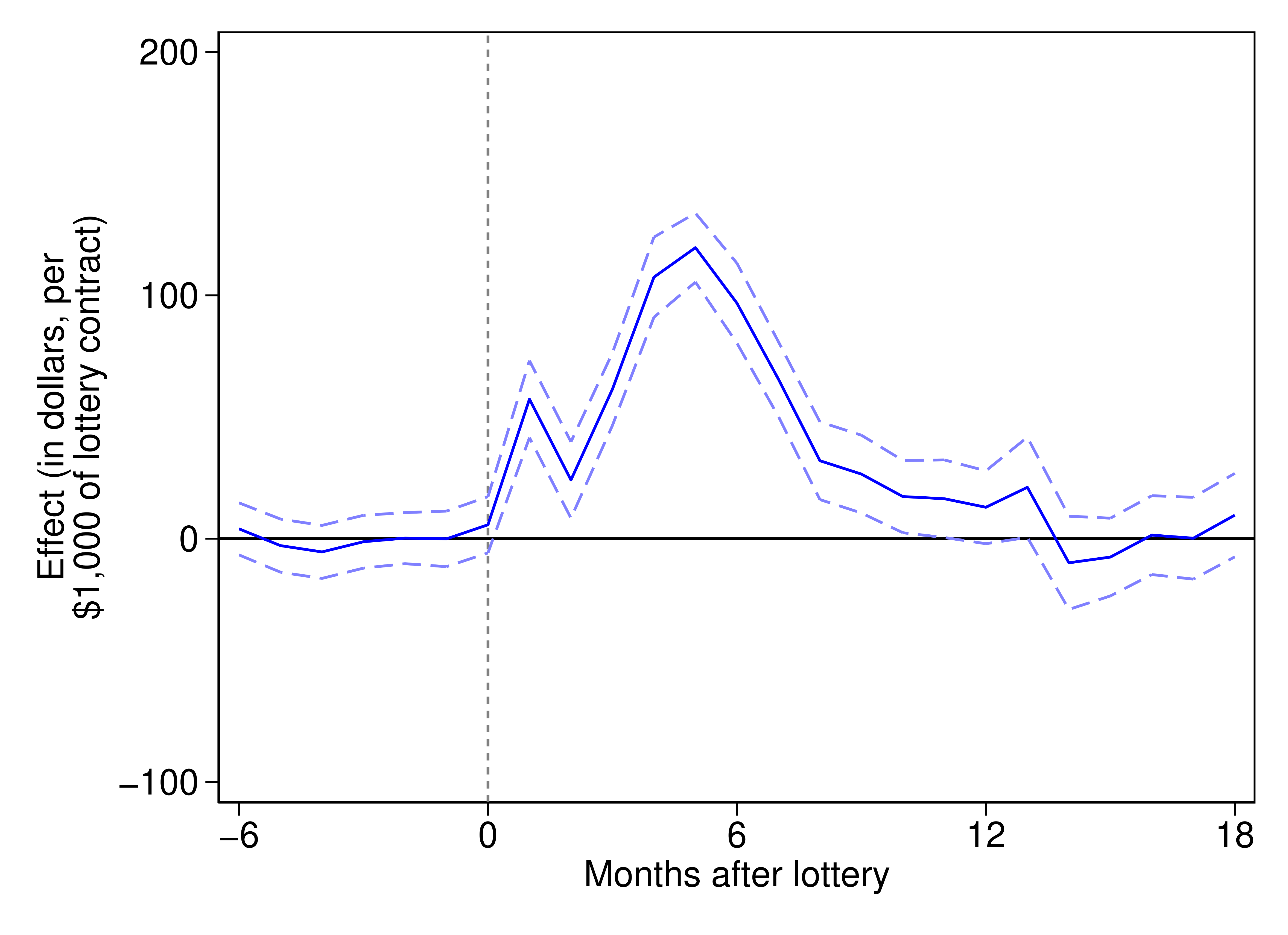
$$\frac{dy_i}{dl_i} = MPL_i$$

Construction Sector in Ecuador

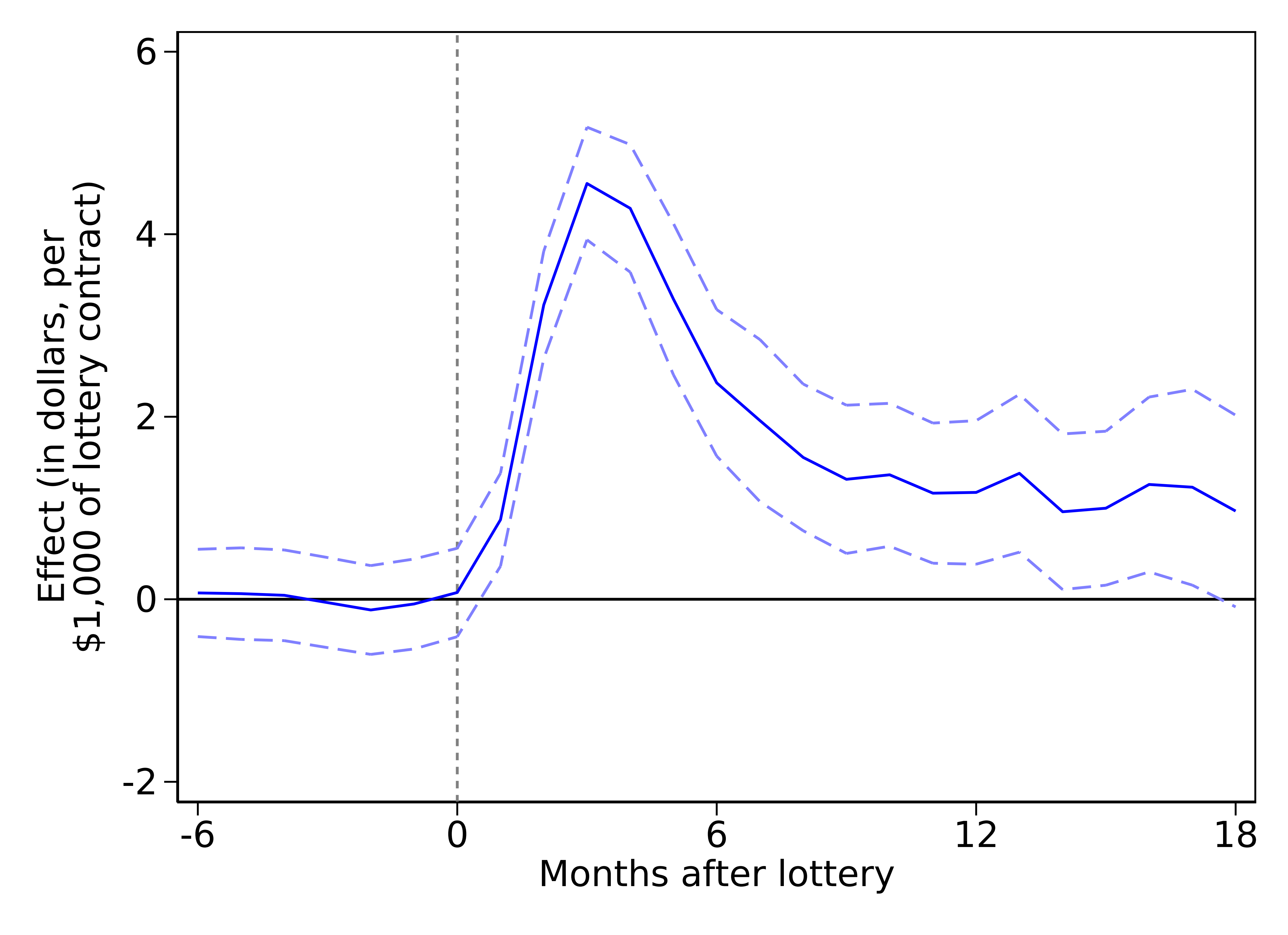
- They implement this approach in the context of the construction sector in Ecuador
- Ecuador's public procurement system allocates construction contracts by lottery
- Projects below a certain value allocated through lotteries among qualified suppliers
- This generates random demand shocks at the firm level (exactly what we want)

Impact of Winning Lottery

Sales

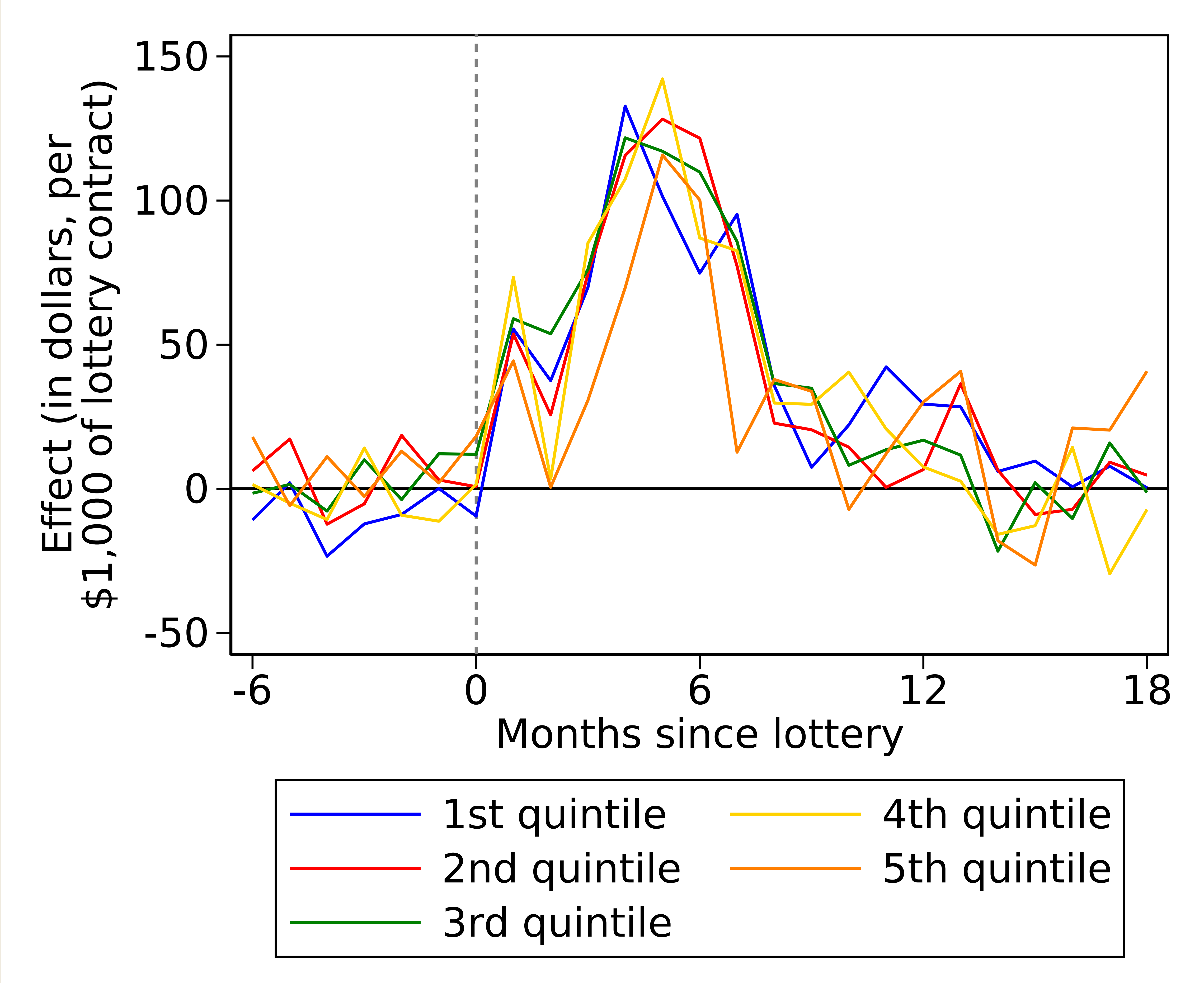


Labor Inputs

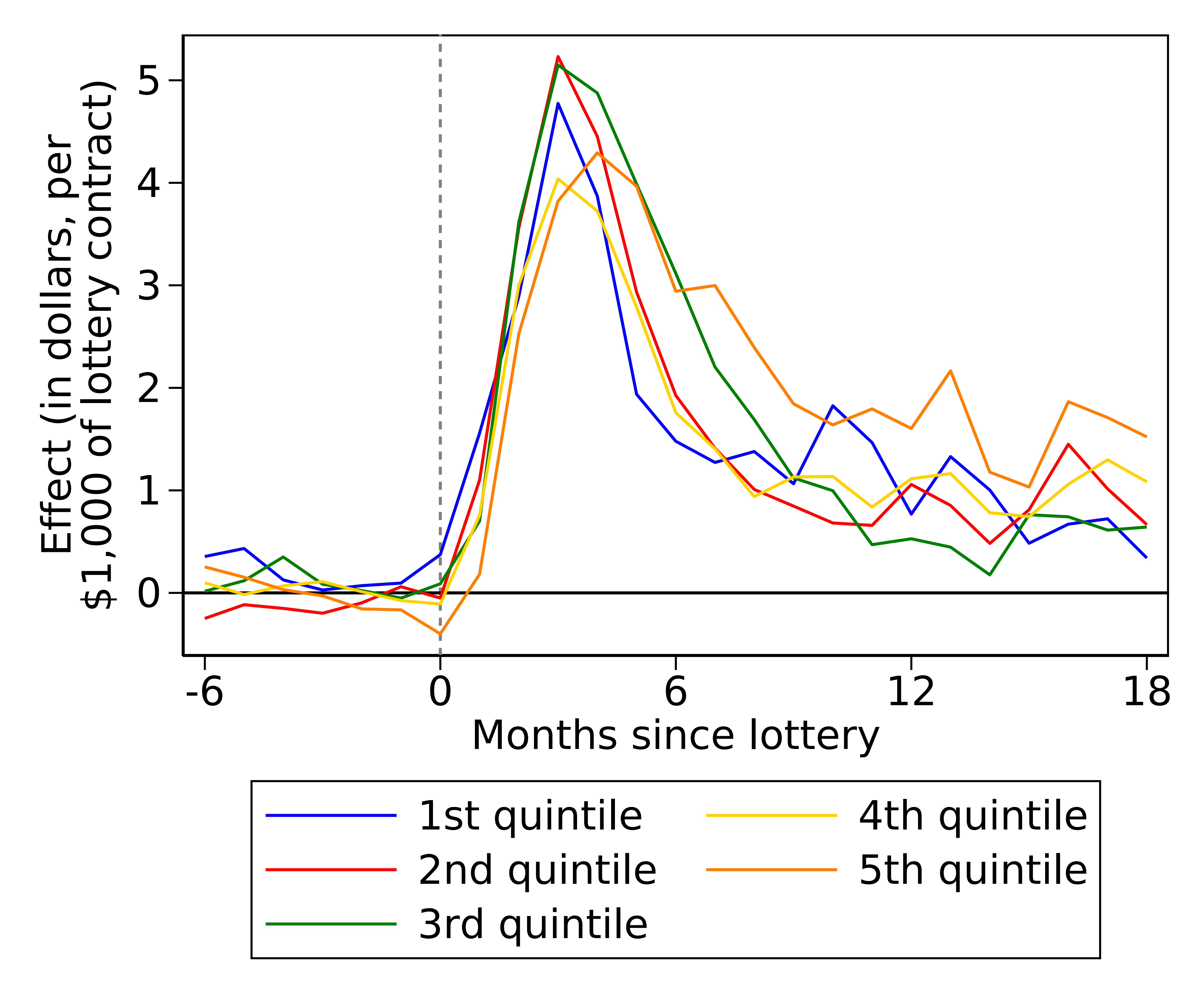


Heterogenous Responses by Firm Size

Sales



Labor Inputs

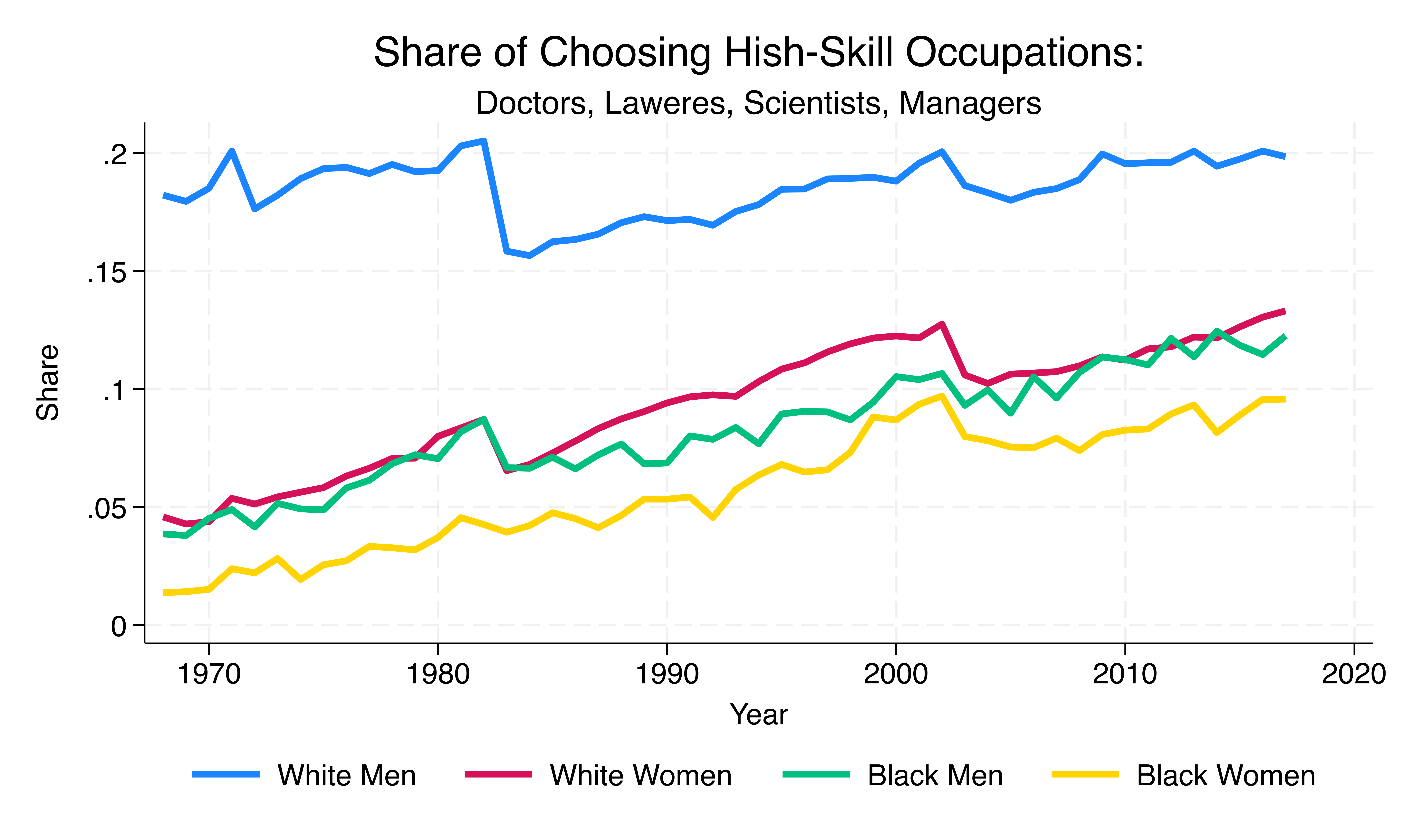


Negligible Cost of Misallocation

- Very little heterogeneity in dy_i or dl_i
- This suggests that very little differences in $MPL_i = dy_i/dl_i$ across firms
- Full calculation implies that removing misallocation increases output by 1.6%
- Compare this number to 100-140% in Hsieh-Klenow (2009)!

Misallocation of Talent and Growth – Hsieh, Hurst, Jones & Klenow (2019)

Disappearing Discrimination?



Sandra Day O'Connor

Source: https://www.nytimes.com/2023/12/01/us/sandra-day-oconnor-dead.html

- Sandra Day O'Connor was the first woman to serve on the Supreme Court justice
- She graduated from Stanford Law School in 1952, ranked 3rd in her class
- The only job she could get in 1952 was as a legal secretary

Model with Discrimination

- Suppose there are
  - N occupations (lawyers, doctors, nurses, secretaries, etc)
  - K groups of people (white men, black men, white women, black women, etc)
- Firms in occupation i hiring group k workers produces

$$y_{ik} = A_i l_{ik}^{1-\alpha}$$

- Firms can hire a group k workers with wage w_k
- However, firms have to pay extra $(1 + \tau_k)$
  - captures discrimination or barriers that a group k faces
- Firms in occupation i hiring group k workers solve

$$\max_{l_{ik}} A_i l_{ik}^{1-\alpha} - (1 + \tau_{ik}) w_k l_{ik}$$

Market Clearings

- The labor market clears for each group:

$$\sum_{i=1}^{N} l_{ik} = L_k$$

- The total output in this economy is

$$Y = \sum_{k=1}^{K} \sum_{i=1}^{N} A_i l_{ik}^{1-\alpha}$$

Discrimination and MPL

- The first-order conditions for each i, k are

$$(1-\alpha)A_i l_{ik}^{-\alpha} = (1+\tau_{ik})w_k$$

- For each group k,

$$\underbrace{(1-\alpha)A_1 l_{1k}^{-\alpha}}_{MPL_{1k}} \underbrace{\frac{1}{1+\tau_{1k}}}_{\text{discrimination in occ. 1}} = \cdots = \underbrace{(1-\alpha)A_N l_{Nk}^{-\alpha}}_{MPL_{Nk}} \underbrace{\frac{1}{1+\tau_{Nk}}}_{\text{discrimination in occ. N}} = w_k$$

- Each group k workers is allocated across occupations to equalize MPL
  … adjusted with discrimination term

- Higher τ_{ik} (more discrimination) $\Rightarrow$ higher MPL_{ik}

Occupational Choice

- Solving for l_{ik}

Share of group k workers choosing occupation i

$$\frac{l_{ik}}{L_k} = \frac{[A_i/(1+\tau_{ik})]^{1/\alpha}}{\sum_{j=1}^{N}[A_j/(1+\tau_{jk})]^{1/\alpha}}$$

- If there were no discrimination, $\tau_{ik} = 0$, for all i, k:

$$\frac{l_{i1}}{L_1} = \cdots = \frac{l_{iK}}{L_K} = \cdots = \frac{A_i^{1/\alpha}}{\sum_{j=1}^{N} A_j^{1/\alpha}}$$

  - The same share of black women and white men should choose to be lawyers

- If black women face more discrimination as lawyers than as janitors
  $\Rightarrow$ black women more likely to choose janitors than lawyers

Discrimination ⇒ Lower TFP

- Discrimination manifests as misallocation
- Like before

$$Y \approx \sum_{k=1}^{K} \bar{A} M_k L_k^{1-\alpha}$$

$$\bar{A} = \left(\sum_{i=1}^{N} A_i^{1/\alpha} \right)^{\alpha}$$

$$M_k = \exp\left[-\frac{1}{\alpha} \mathrm{Var}_i(\log MPL_{ik}) \right]$$

- Discrimination implies $\mathrm{Var}_i(\log MPL_{ik}) > 0 \Rightarrow M_k < 1$

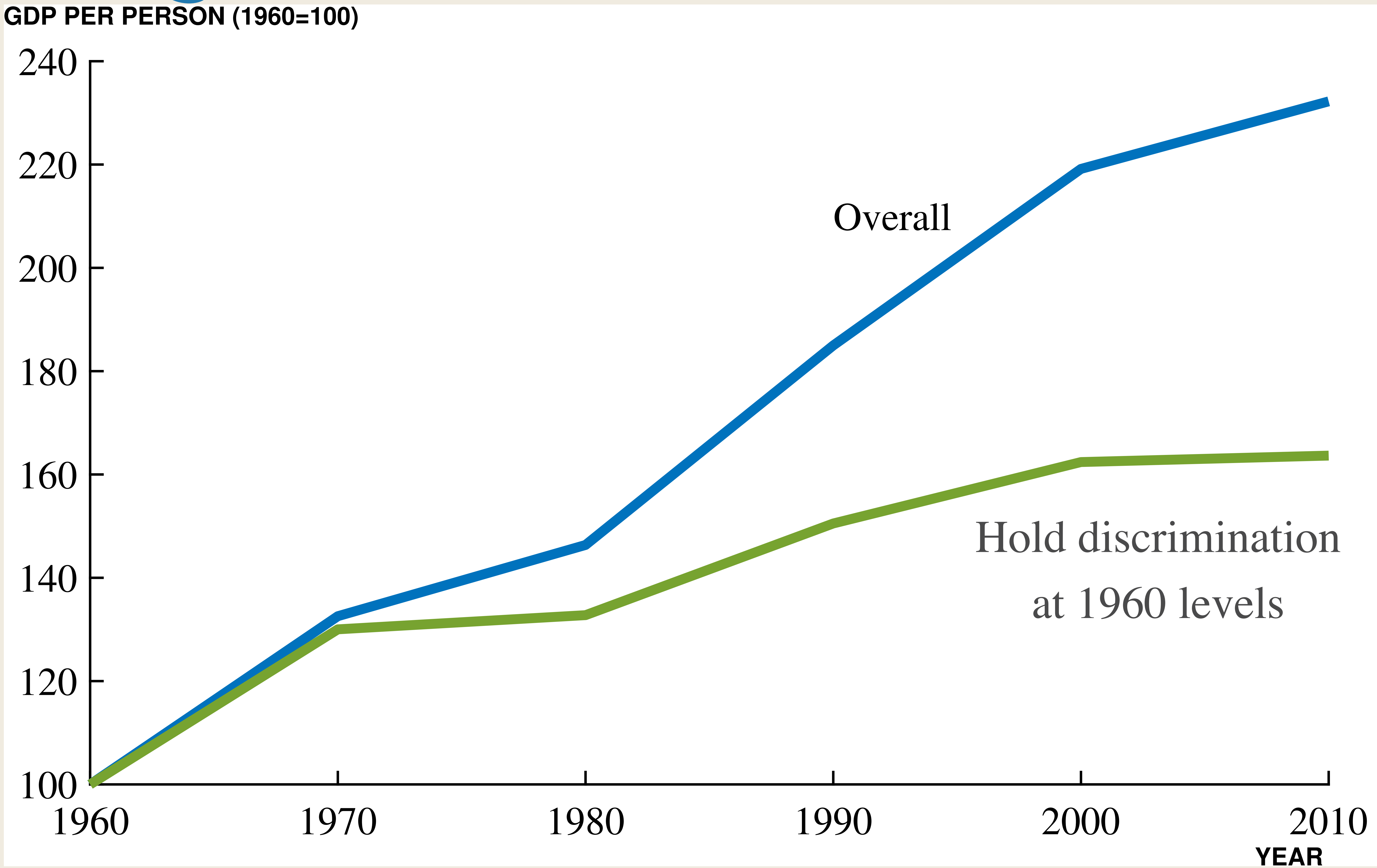
Quantifying Macro Consequence of Discrimination

- Reductions in discrimination over the past 60 years have led to economic growth
- How do we quantify it?
- Suppose that white men face no discrimination, $\tau_{ik} = 0$ for all i and $k = \text{WM}$
- We also normalize $\tau_{1k} = 0$ for all k (what matters is the dispersion in τ_{1k}!)
- Then occupational choice reveals the discrimination:

$$\frac{\frac{l_{ik}/L_k}{l_{1k}/L_k}}{\frac{l_{iWM}/L_{WM}}{l_{1WM}/L_{WM}}} = \frac{1}{1+\tau_{ik}}$$

- Choose $\{A_i\}$ to match observed l_{iWM}/L_{WM} and assume $\alpha = 1/3$

Declining Discrimination ⇒ Economic Growth



- Around 20% of US economic growth comes from a reduction in discrimination

Takeaway

- Economics often starts from an assumption that markets allocate resources efficiently
- In reality, various frictions prevent the efficient allocation of resources
  - Regulations, corruption
  - Market power, financial friction
  - Certain groups of people face barriers and discrimination
- Frictions may systematically vary across countries
  $\Rightarrow$ potentially explain cross-country income differences
- Frictions may have been reduced in the past
  $\Rightarrow$ potentially explain economic growth