Competition, Tasks and Earnings Inequality

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The Introduction

Research Question

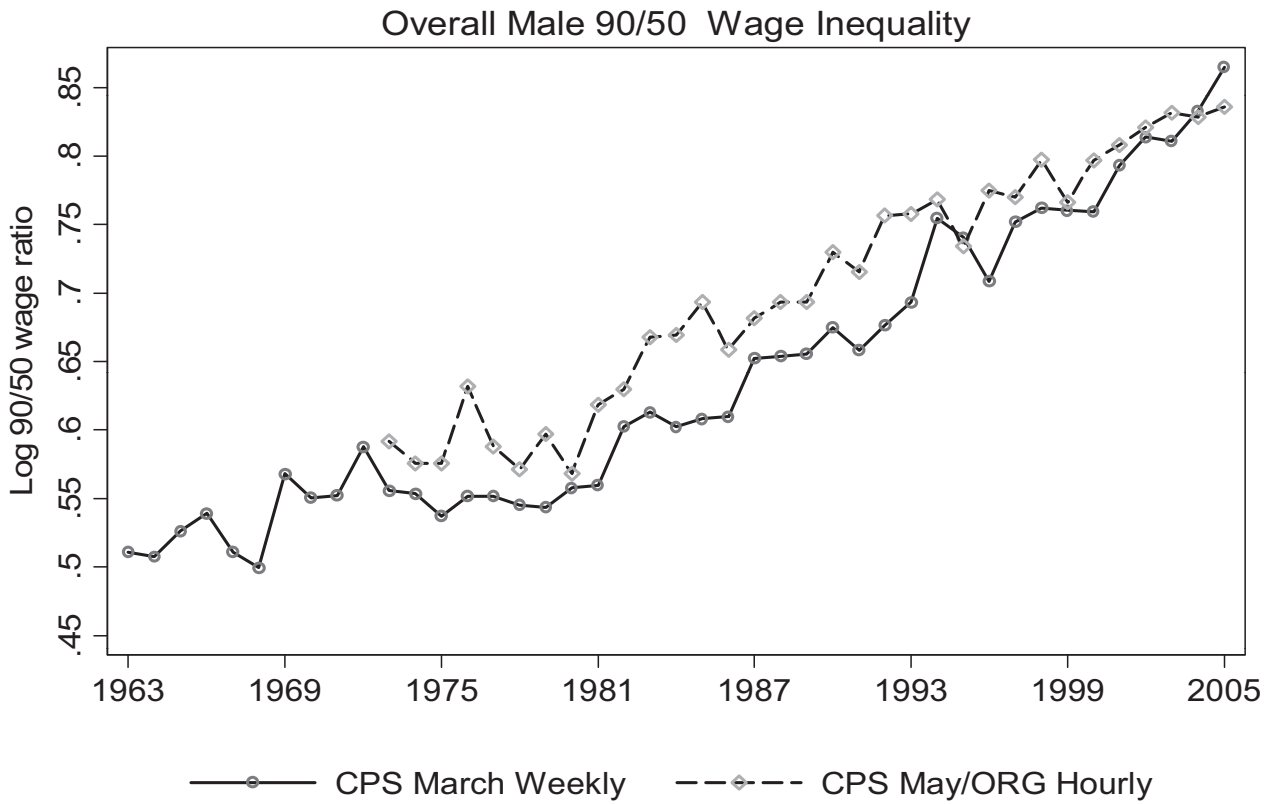
How can an increase in competition, through a more global market place, can affect earnings inequality and the composition of jobs?

- Why are **Cognitive Tasks** so important?

- Tractable theoretical model with heterogenous agents and different types of tasks
- New mechanism, based on competition, consistent with trends in earnings and demand for tasks

Wage Inequality

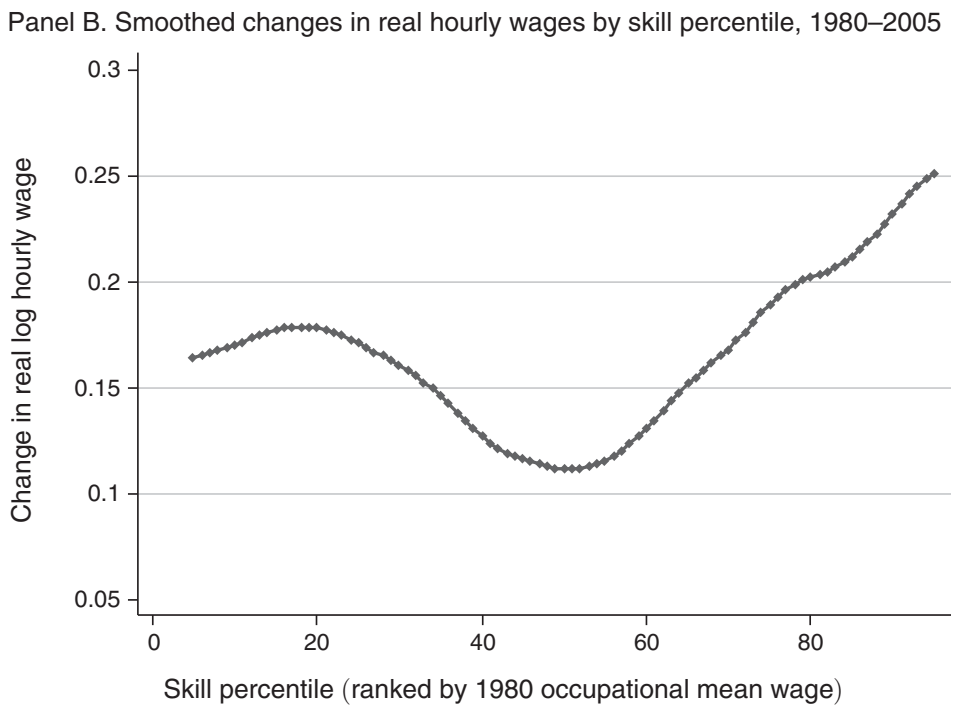
- There has been a continuous increase of the overall wage inequality. Specially between the top earners and the rest of the workers
- An *increase* of inequality between the **95th/90th** percentiles, the **90th/50th** percentiles and the **90th/10th** percentiles



Source: Autor, Katz and Kearny 2008

Polarization

- Workers in the middle percentile have seen a smaller increase compared to those in the upper and lower percentiles
- There has been an *increase* in inequality between the **95th/50th** percentiles, while there was a *decrease* in inequality between the **50th/10th** percentiles



Source: Autor and Dorn 2013

Detail

Tasks

Jobs are composed of three types of tasks

1. **Manual** Tasks
   - Situational adaptability; visual and language recognition; personal interaction
   - Flight attendant, **Service Jobs**
   - Geographically constrained and time constraint
2. **Routine** Tasks
   - Repetitive job; well-understood procedures
   - Assembly line operator, **Production Jobs**
   - Additive productivity, skill dependent and physically tangible
3. **Cognitive** Tasks
   - Problem solving; intuition; persuasion and creativity
   - Designers, **Managerial Jobs**
   - Intangible, **Scale Invariant**, **Non-additive in Skill**

Definitions from: Acemoglu and Autor 2011

Tasks

(b) Manual Occupations

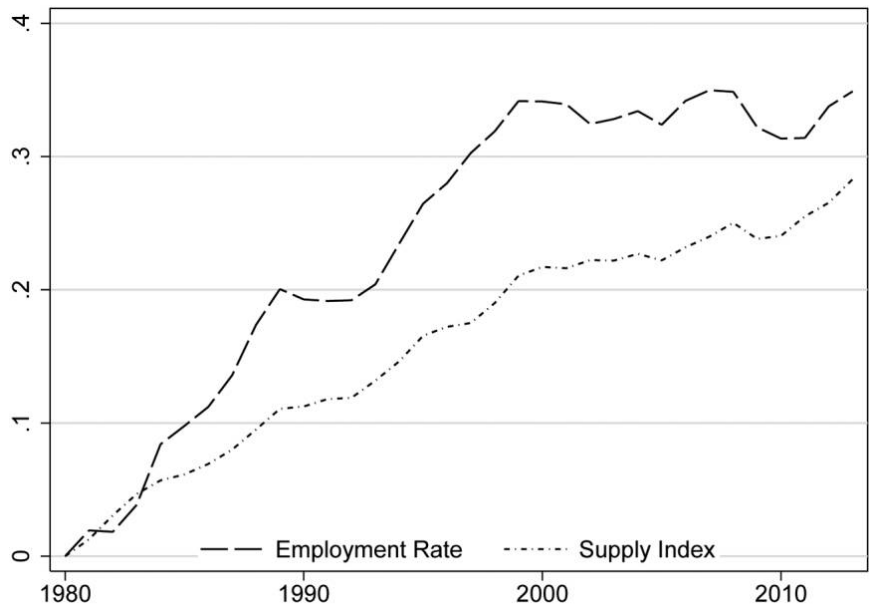


FIG. 6.—Cognitive employment rate and supply index. The employment rate is calculated as the total hours worked in cognitive jobs over the size of the workforce and plotted against the supply index as percentage growth since 1980.

Source: Beaudry, Green and Sand 2016

◂ Routine ◂ Pre-1980

Mechanism

Having Cognitive tasks in a more competitive and global market place will lead to

1. Rise of Superstars
   - Increase of Earnings inequality, specially for the highest skilled workers (ie **90th percentile**) similar to Rosen 1981
2. Fall of low skilled cognitive workers
   - Trickle down of workers, *increasing* inequality between **90th/50th** percentile
   - Increase of complementarities for manual tasks
   - *Decreasing* inequality between **50th/10th** percentiles

Contribution

- New mechanism which explains by itself both the increase of earnings inequality *and* polarization
- Mechanism consistent with increase in manual tasks and decreasing cognitive tasks
- Model with heterogenous skills
- Tractable in labour composition and earnings
- Tasks differentiate by natural characteristics

Literature Review

- Superstars: Rosen 1981, Lucas 1978, Garbaix and Landier 2008
- Trade models: Monte 2011, Egger and Kreickemeier 2012
- Skilled-Biased Technological Change: Katz and Murphy 1992, Autor, Katz and Kearney 2008
- Automation/Offshoring: Autor and Dorn 2013, Lee and Shin 2016

◂ SBTC ◂ Auto/Off

The Model

Utility

An economy with population mass of 1, which consume two types of goods: **Homogenous** good (Q_0) and **Heterogenous** good (Q).

Their utility is given by:

Utility

$$U = \left[\gamma Q_0^{\frac{\epsilon-1}{\epsilon}} + (1-\gamma) Q^{\frac{\epsilon-1}{\epsilon}}\right]^{\frac{\epsilon}{\epsilon-1}}$$

Homogenous Good

The homogenous good sector is:

- Perfectly Competitive
- Produced with a common CRS technology that utilizes Manual labour

Production

$$Q_0 = \beta L_m$$

Price

$$P_0 = \frac{w_m}{\beta}$$

Heterogenous Good

The heterogenous good sector is:

- Monopolistically Competitive
- Produced by a M differentiated types of firms indexed by ω

Heterogenous Good Aggregator

$$Q = \left[M^{-\frac{1}{\sigma}} \int_{\omega \in \Omega} q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}}$$

$\sigma > 2$

Heterogenous Good

Individual firms are characterized as:

- Producing a variety of the heterogenous good using a CRS technology which uses Routine Labour
- The quality/productivity of each firm is heterogenous and is given by φ which is the skill of its owner-manager

Production Function

$$q(\varphi) = l_r \varphi$$

Heterogenous Good

- Profit maximization implies firms use a mark-up pricing rule:

Pricing Rule

$$p(\varphi) = \frac{c(\varphi)\sigma}{\sigma - 1}$$

- Normalizing the price of the aggregate heterogenous good ($P = 1$) we get:

Individual Demand, Revenue and Profit

$$\begin{aligned} q(\varphi) &= \frac{Q}{M}\left[\frac{w_r}{\rho\varphi}\right]^{-\sigma} \\ r(\varphi) &= \frac{Q}{M}\left[\frac{w_r}{\rho\varphi}\right]^{1-\sigma} \\ \pi(\varphi) &= \frac{YQ}{M\sigma}\left[\frac{w_r}{\rho\varphi}\right]^{-\sigma} \end{aligned}$$

Heterogenous Good

- Firm's draw their manager's skill from a common distribution $g(\varphi)$, which has positive support over $[1, \infty)$ and has a continuous cumulative distribution $G(\varphi)$.
- The aggregate heterogenous good sector can be characterized by the weighted average productivity of existing firms $\tilde{\varphi}$

Average Productivity

$$\tilde{\varphi} = \left[M^{-1} \int_{\overline{\varphi}}^{\infty} \varphi^{\sigma-1} g(\varphi) d\varphi \right]^{\frac{1}{\sigma-1}}$$

$(\sigma - 1)^{th}$ moment of the distribution must be finite

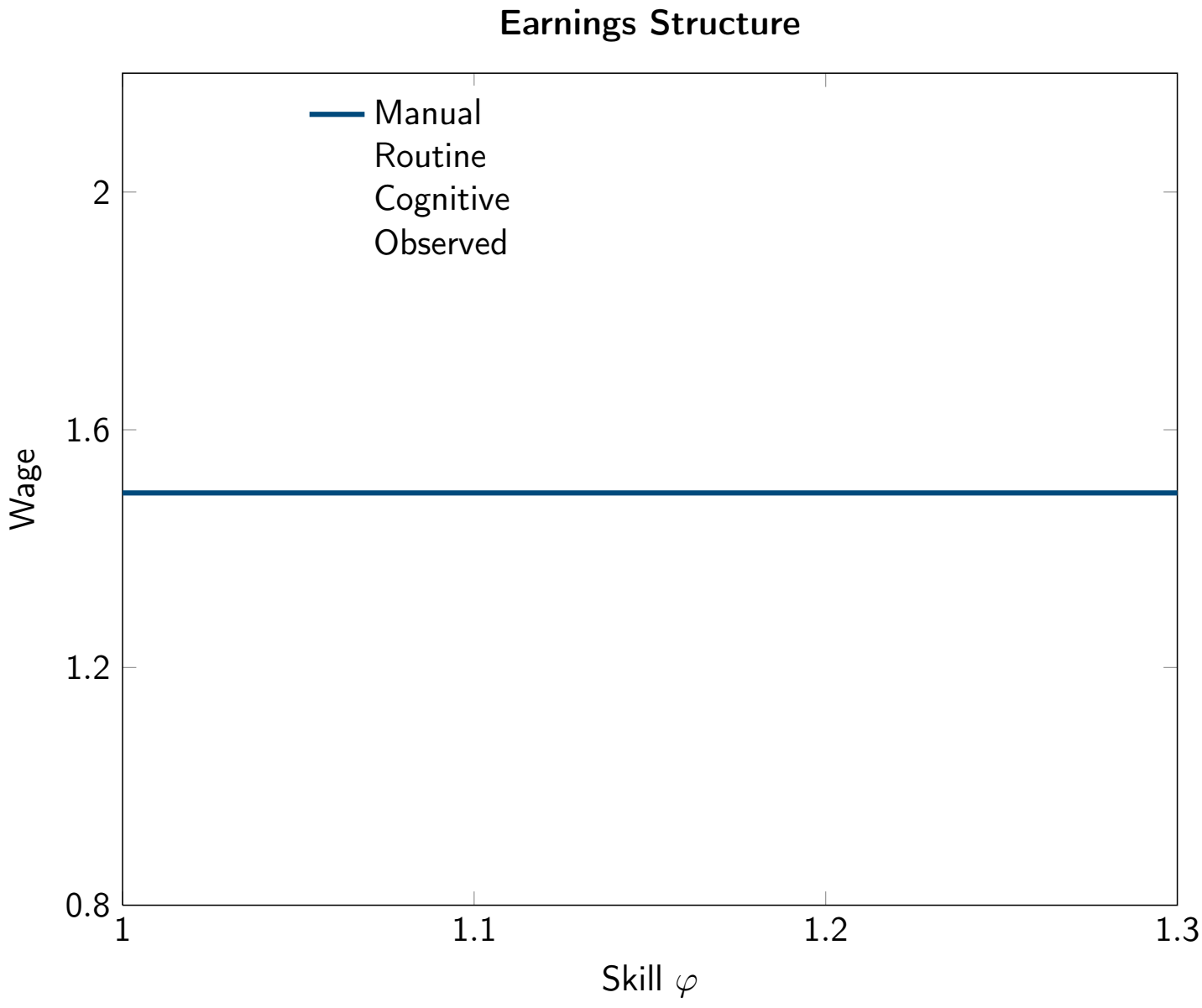
Labour Market

- Population of heterogenous agents with skill φ
- Agents can perform three types of labour: Manual, Routine and Cognitive
- Skill influences the labour provided for Routine and Cognitive jobs
- Workers will be employed in the job that maximizes their earnings

Wages

$$w(\varphi) = \begin{cases} w_m & \text{Manual Labour} \\ w_r \varphi & \text{Routine Labour} \\ \pi(\varphi) & \text{Cognitive Labour} \end{cases}$$

Labour Market



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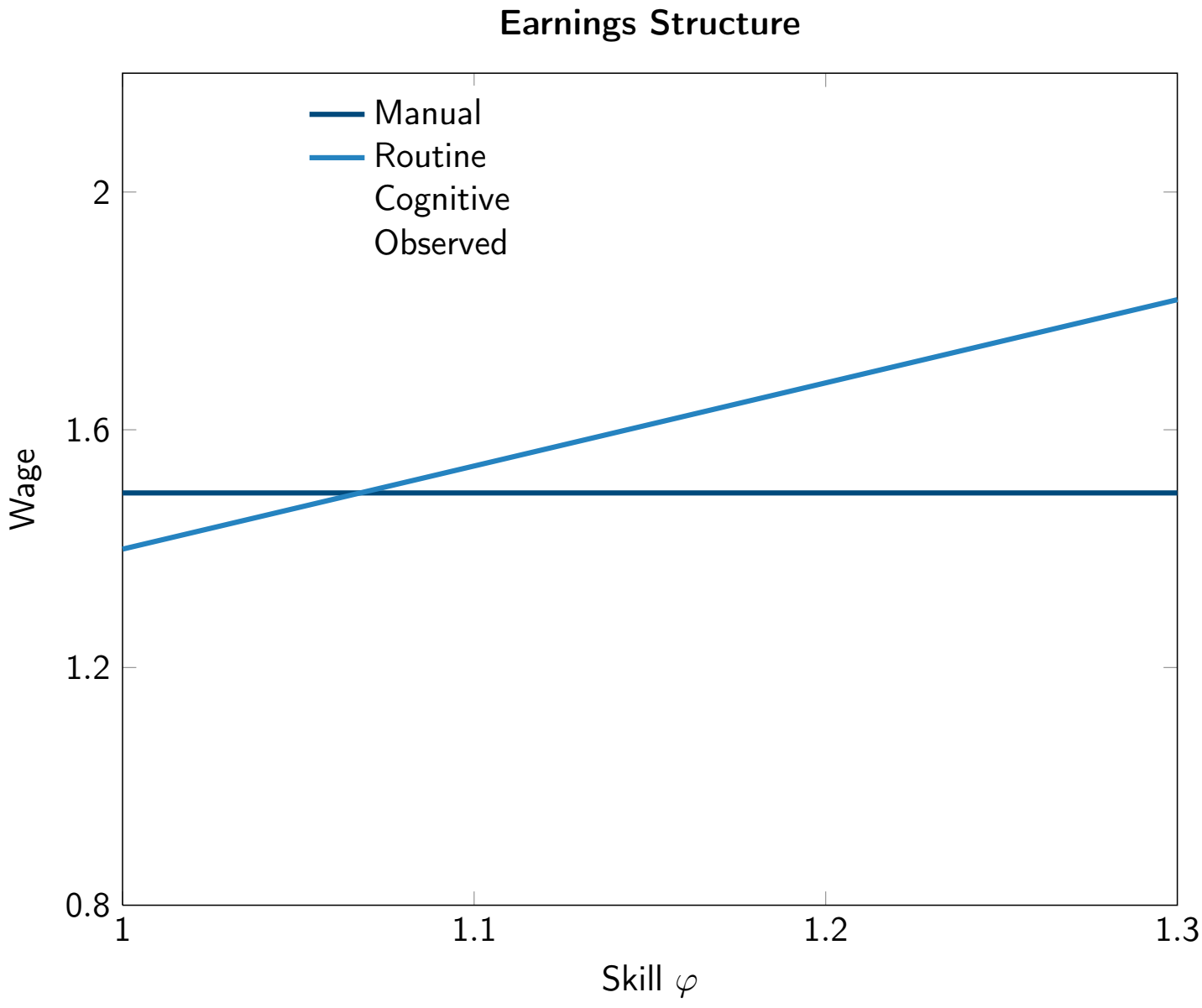

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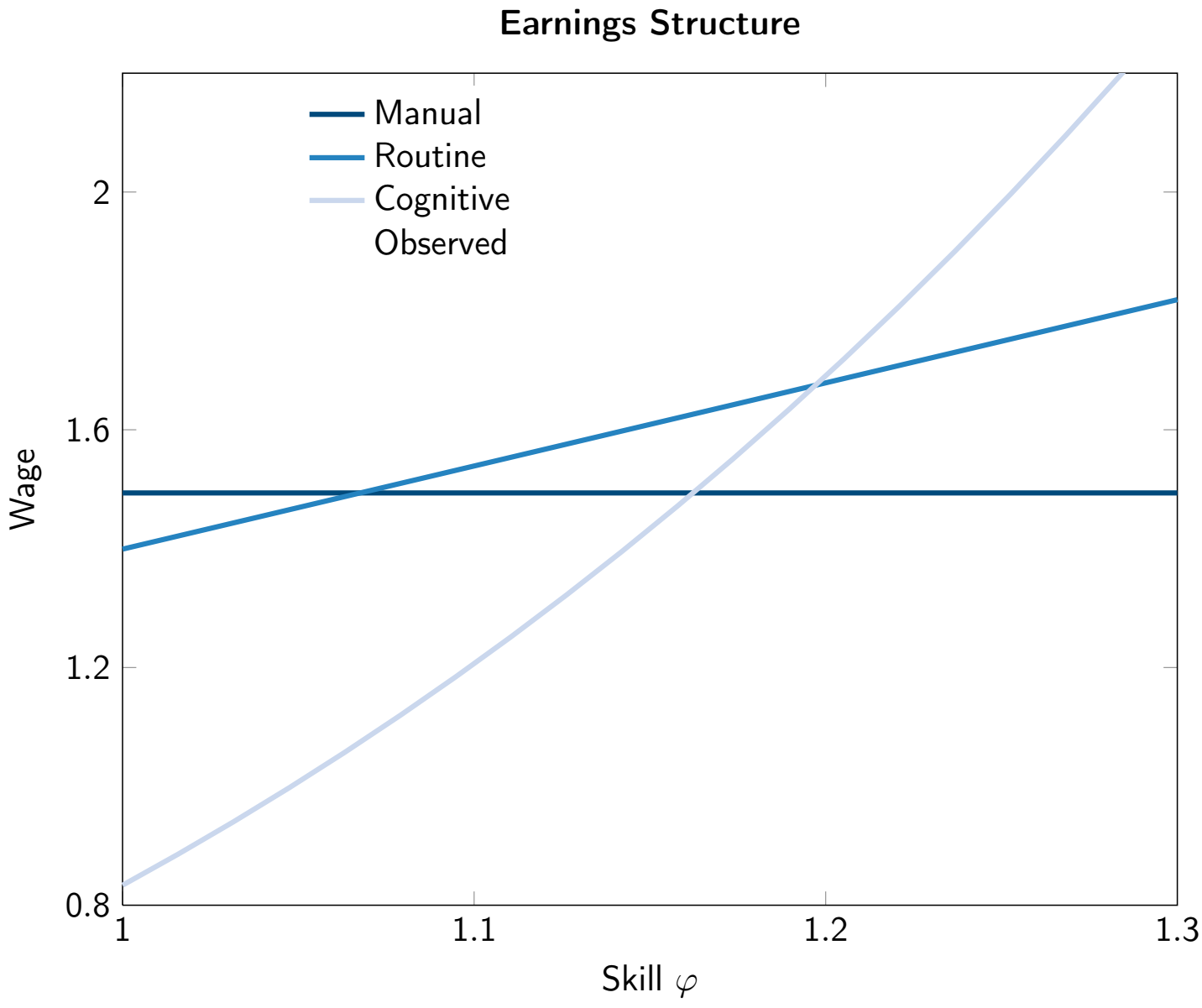

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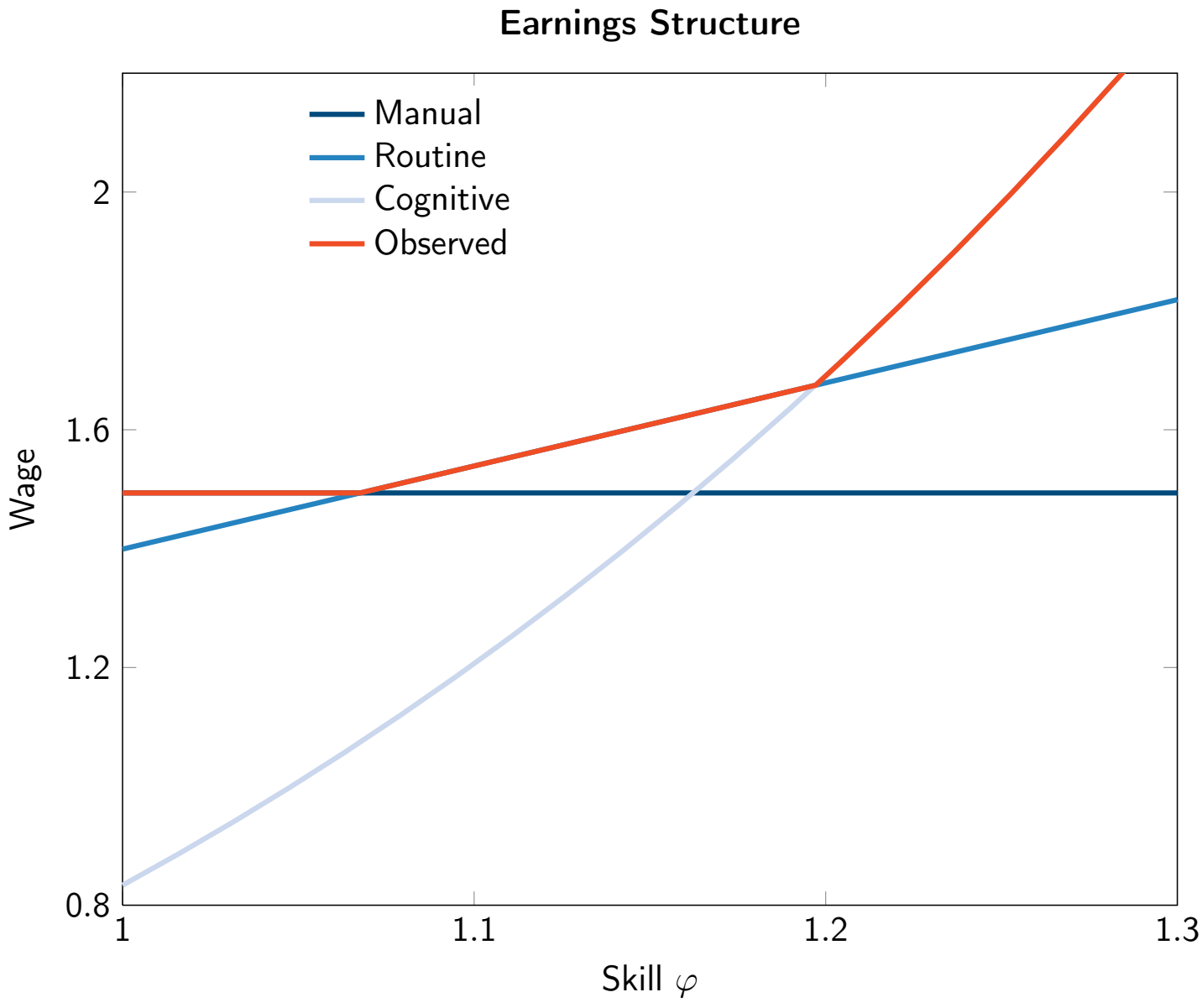

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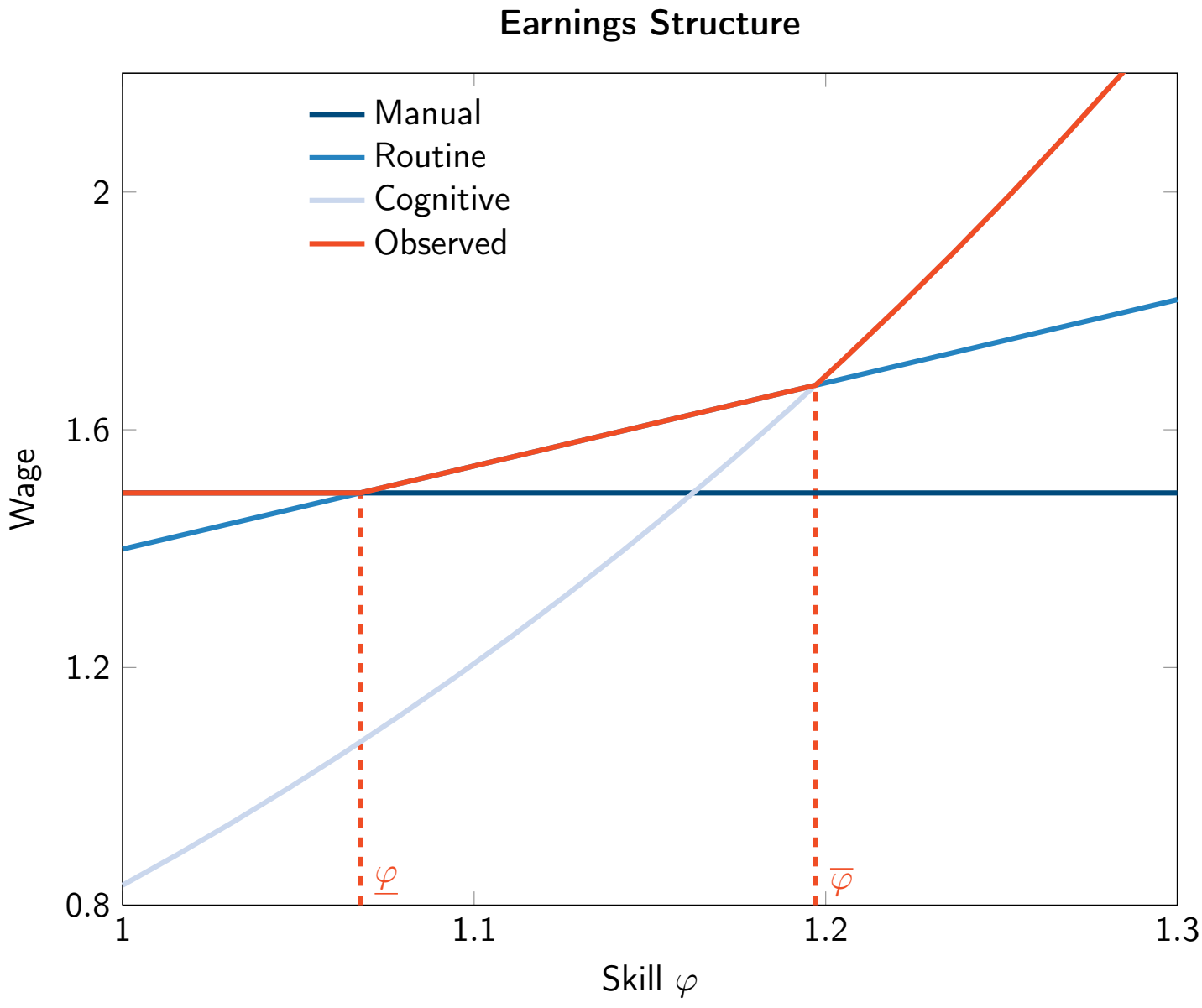


Employment Share

The worker's decision is characterized by two indifference skills $\underline{\varphi}$ and $\overline{\varphi}$ such that:

$$\begin{array}{lll} w_r\varphi & \geq w_m & \text{for } \varphi \geq \underline{\varphi} \\ \pi(\varphi) & \geq w_r\varphi & \text{for } \varphi \geq \overline{\varphi} \end{array}$$

It will determine the following labour inputs:

Labour Share

$$\begin{aligned} \lambda_m &= L_m \\ \lambda_r &= L_r/\tilde{\varphi}_r \\ \lambda_c &= M \end{aligned}$$

Equilibrium

Equilibrium

In this economy Equilibrium is characterized by the skill cut-off values $\underline{\varphi}$, $\overline{\varphi}$ such that:

- Aggregate demand of homogenous and heterogenous goods are in equilibrium
- Each firm producing a different variety of intermediate heterogenous good is profit maximizing
- Workers are employed in the job that maximizes their income
- Total production, share of employment and skill of workers clear

Equilibrium

Equilibrium is characterized by two functions:

Heterogenous Market

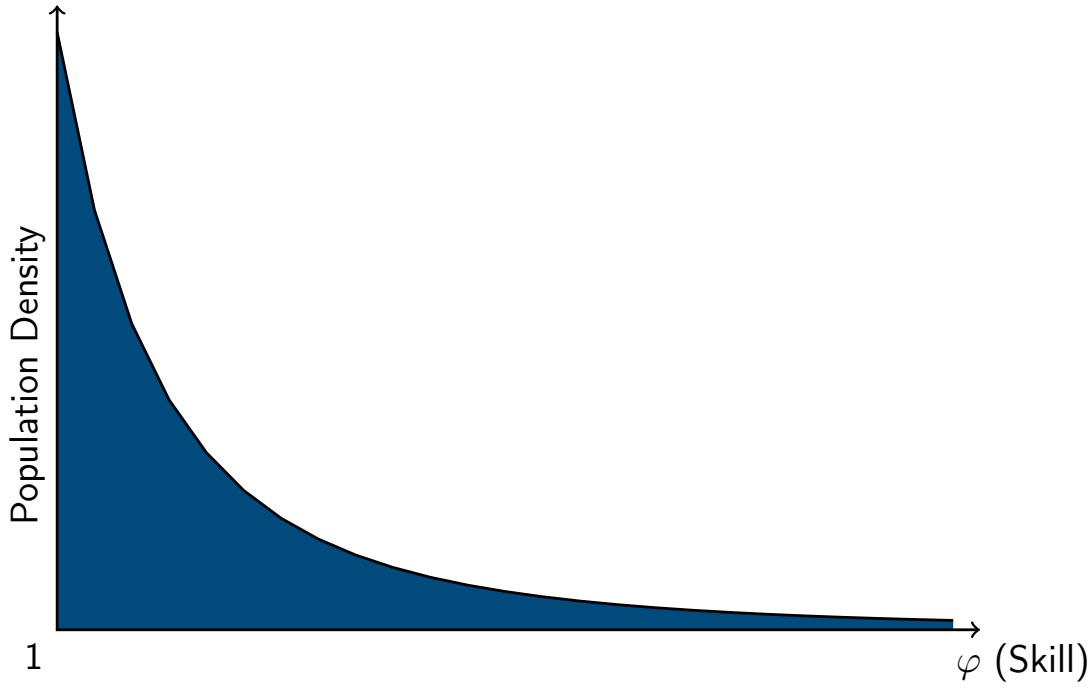
$$\frac{\overline{\varphi}^{2-\sigma}}{\sigma}\int_{\overline{\varphi}}^{\infty}\varphi^{\sigma-1}g(\varphi)d\varphi = \frac{\sigma}{\sigma-1}\int_{\underline{\varphi}}^{\varphi}\varphi g(\varphi)d\varphi$$

Market Clearence

$$w_r\underline{\varphi}G(\underline{\varphi})^{\frac{1}{\epsilon}} = \beta^{(1-\frac{1}{\epsilon})}\frac{\gamma}{1-\gamma}Q^{\frac{1}{\epsilon}}$$

Return

Outline of the Model



Outline of the Model

Homogenous Good:

Heterogenous Good:

Outline of the Model

Homogenous Good:
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- Common CRS Technology

Heterogenous Good:
- Monopolistically Competitive
- Heterogenous Firms

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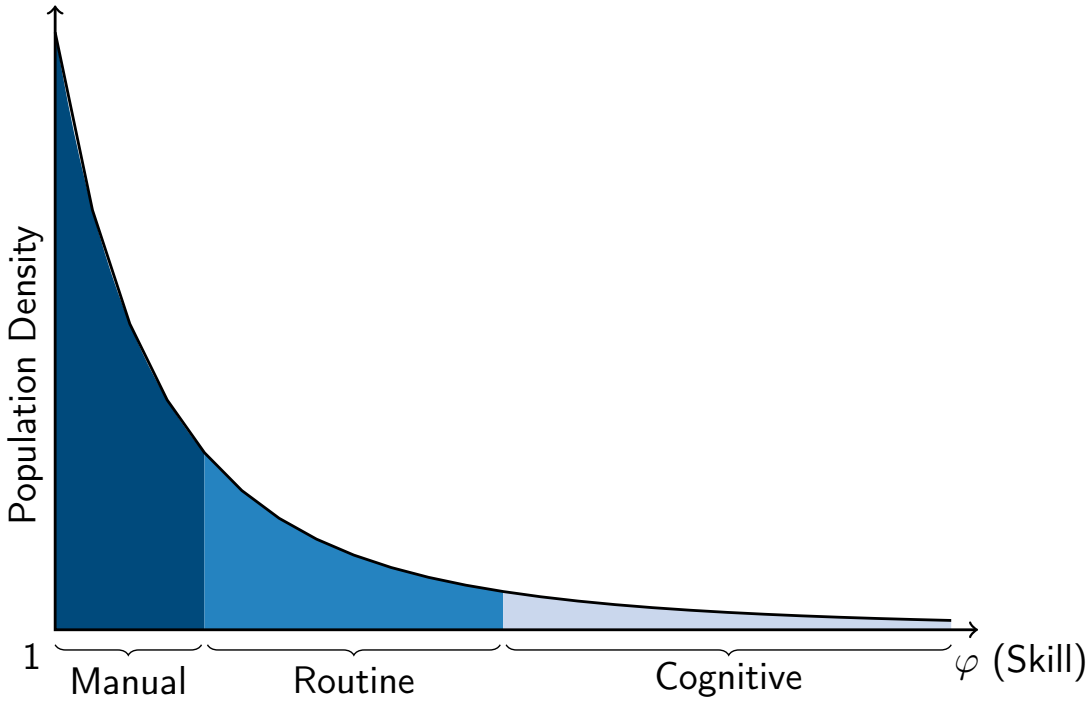

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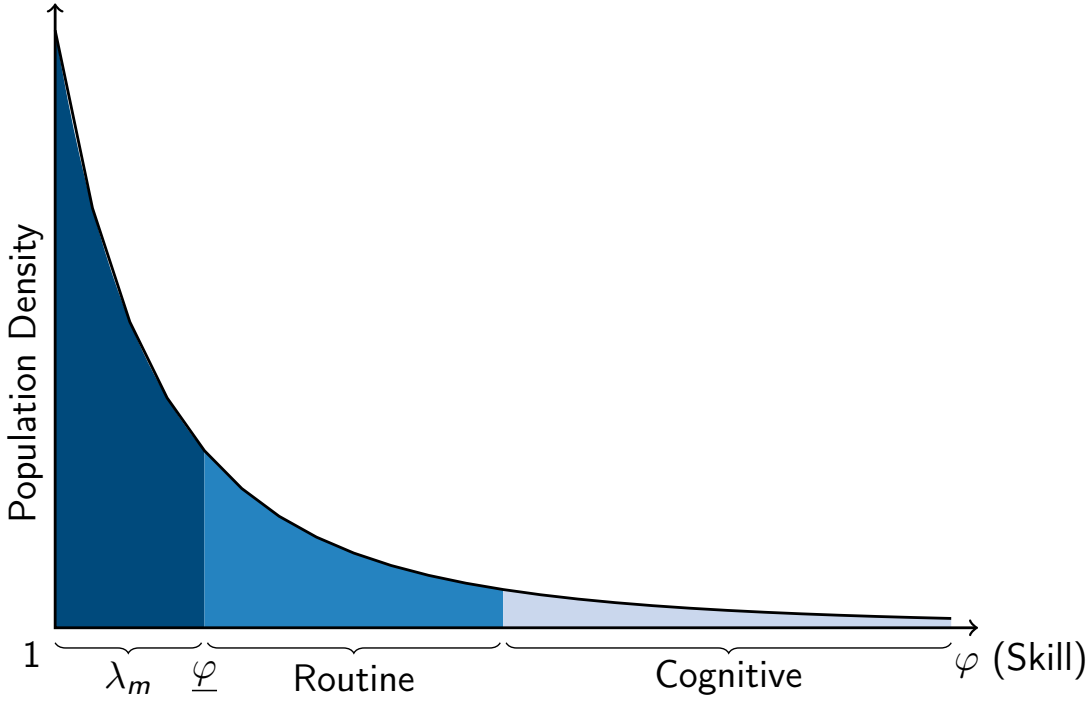

Production

Homogenous Good:

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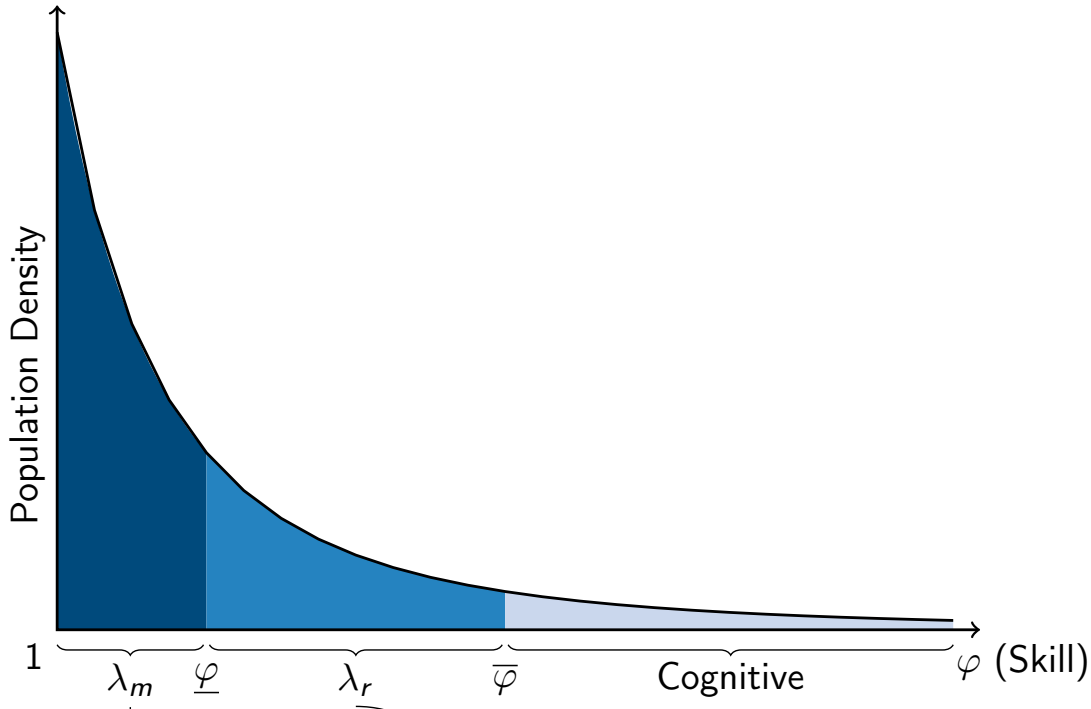

Production

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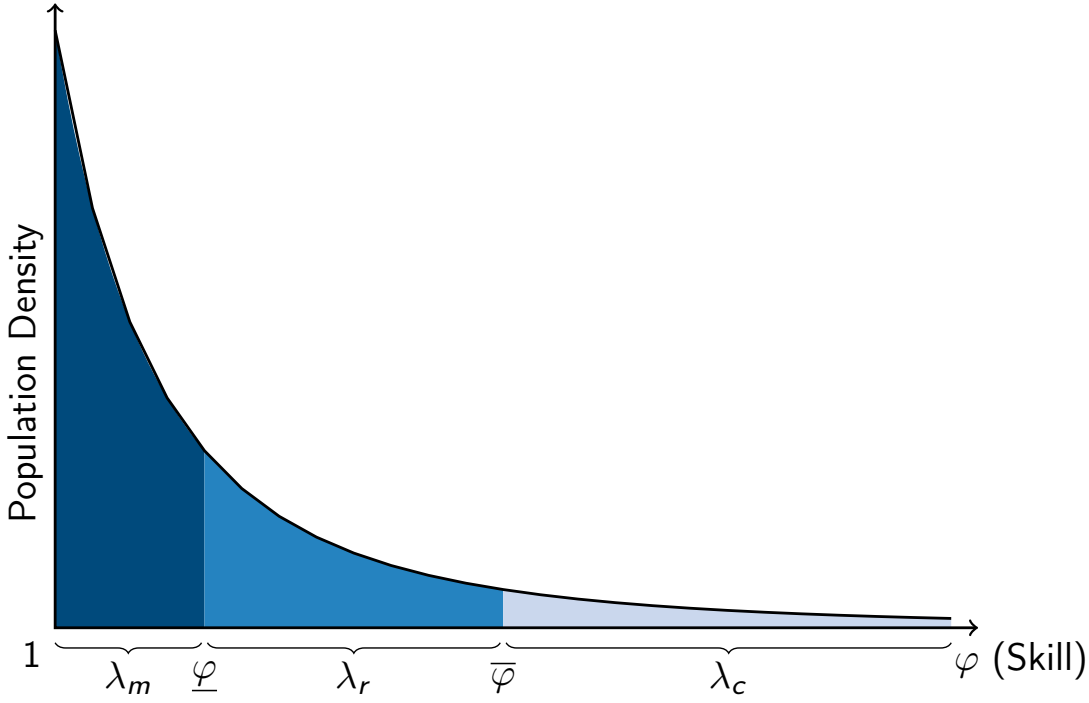

Homogenous Good:

- Perfectly Competitive
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Heterogenous Good:

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Earnings Inequality

With-in Group

- Manual

$$\frac{w(\varphi_1)}{w(\varphi_2)} = \frac{w_m}{w_m} = 1$$

- Routine

$$\frac{w(\varphi_1)}{w(\varphi_2)} = \frac{w_r\varphi_1}{w_r\varphi_2} = \frac{\varphi_1}{\varphi_2}$$

- Cognitive

$$\frac{w(\varphi_1)}{w(\varphi_2)} = \frac{\pi(\varphi_1)}{\pi(\varphi_2)} = \left(\frac{\varphi_1}{\varphi_2}\right)^{\sigma-1}$$

Earnings Inequality

Between Groups

- Routine/Manual

$$\frac{w(\varphi_1)}{w(\varphi_2)} = \frac{w_r \varphi_1}{w_m} = \frac{\varphi_1}{\underline{\varphi}}$$

- Cognitive/Routine

$$\frac{w(\varphi_1)}{w(\varphi_2)} = \frac{\pi(\varphi_1)}{w_r \varphi_2} = \frac{\overline{\varphi}}{\varphi_2} \left(\frac{\varphi_1}{\overline{\varphi}} \right)^{\sigma - 1}$$

- Cognitive/Manual

$$\frac{w(\varphi_1)}{w(\varphi_2)} = \frac{\pi(\varphi_1)}{w_r \underline{\varphi}} = \frac{\overline{\varphi}}{\underline{\varphi}} \left(\frac{\varphi_1}{\overline{\varphi}} \right)^{\sigma - 1}$$

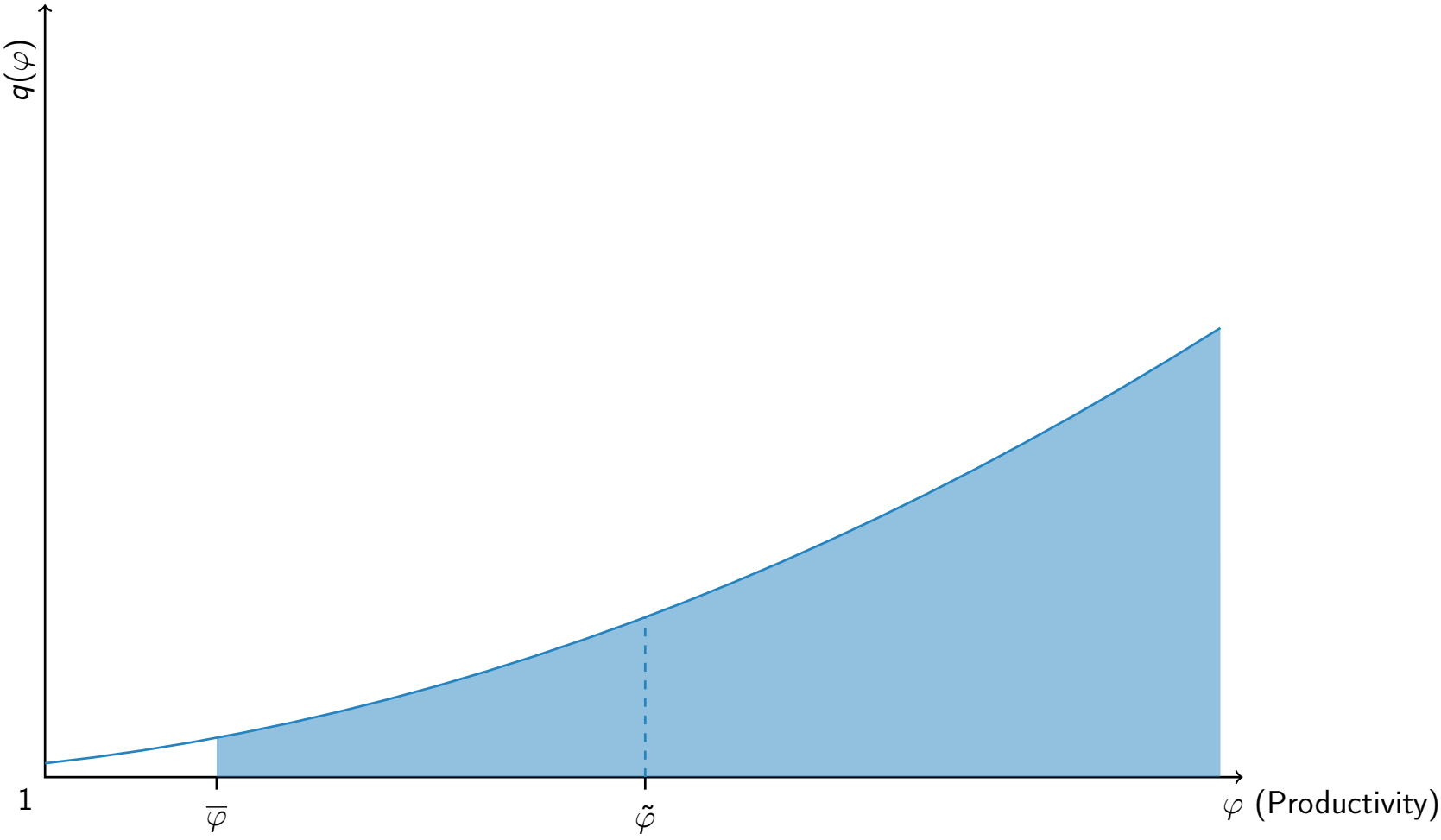
The Mechanism

Competition

- The mechanism is by an increase in competition in the heterogenous good sector
- It increases the elasticity of substitution between different
- That is, an increase of σ

Competition - Partial Equilibrium

$$\frac{q(\varphi_1)}{q(\varphi_2)} = \left(\frac{\varphi_1}{\varphi_2}\right)^{\sigma}$$



Competition - Partial Equilibrium

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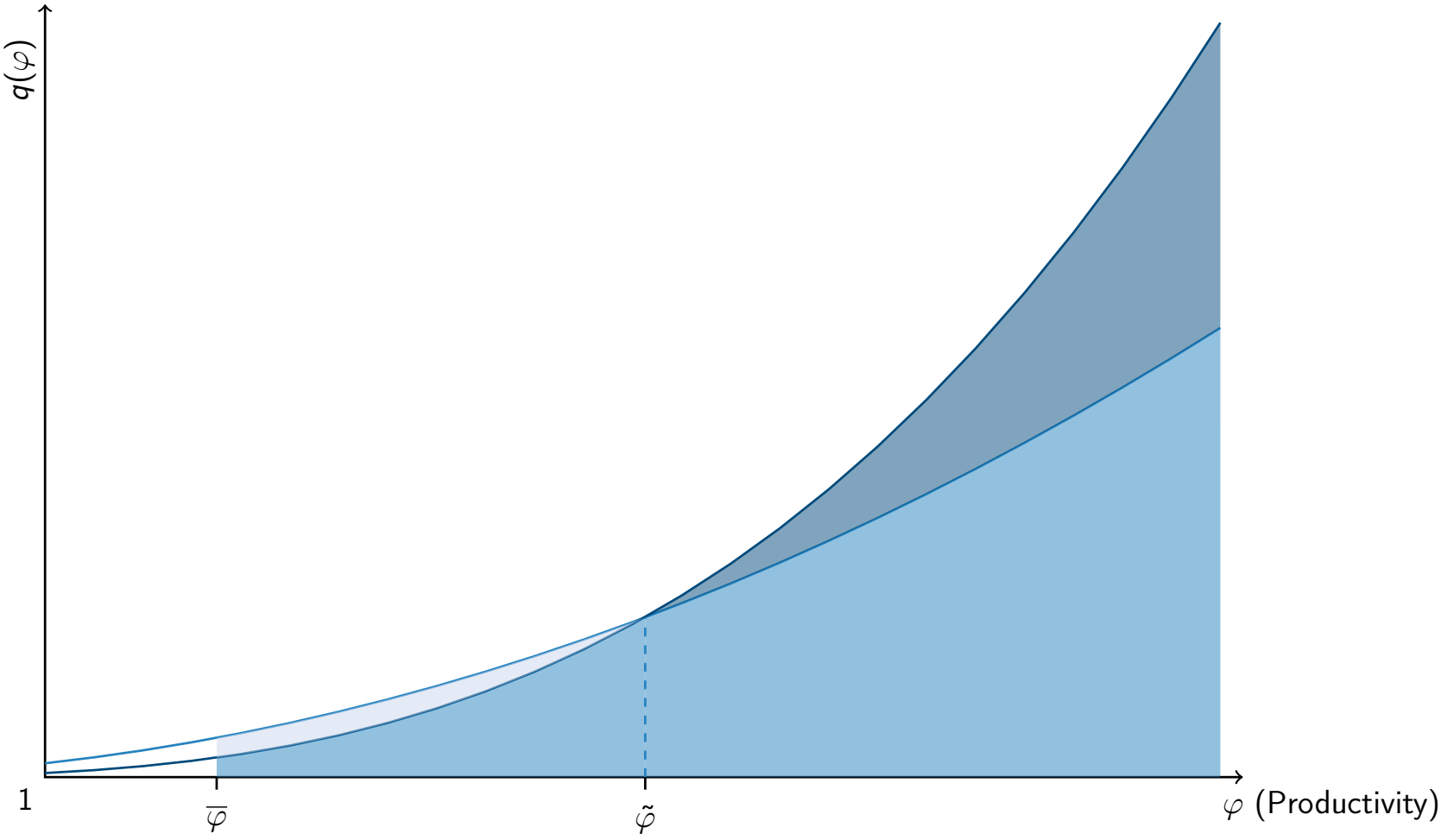

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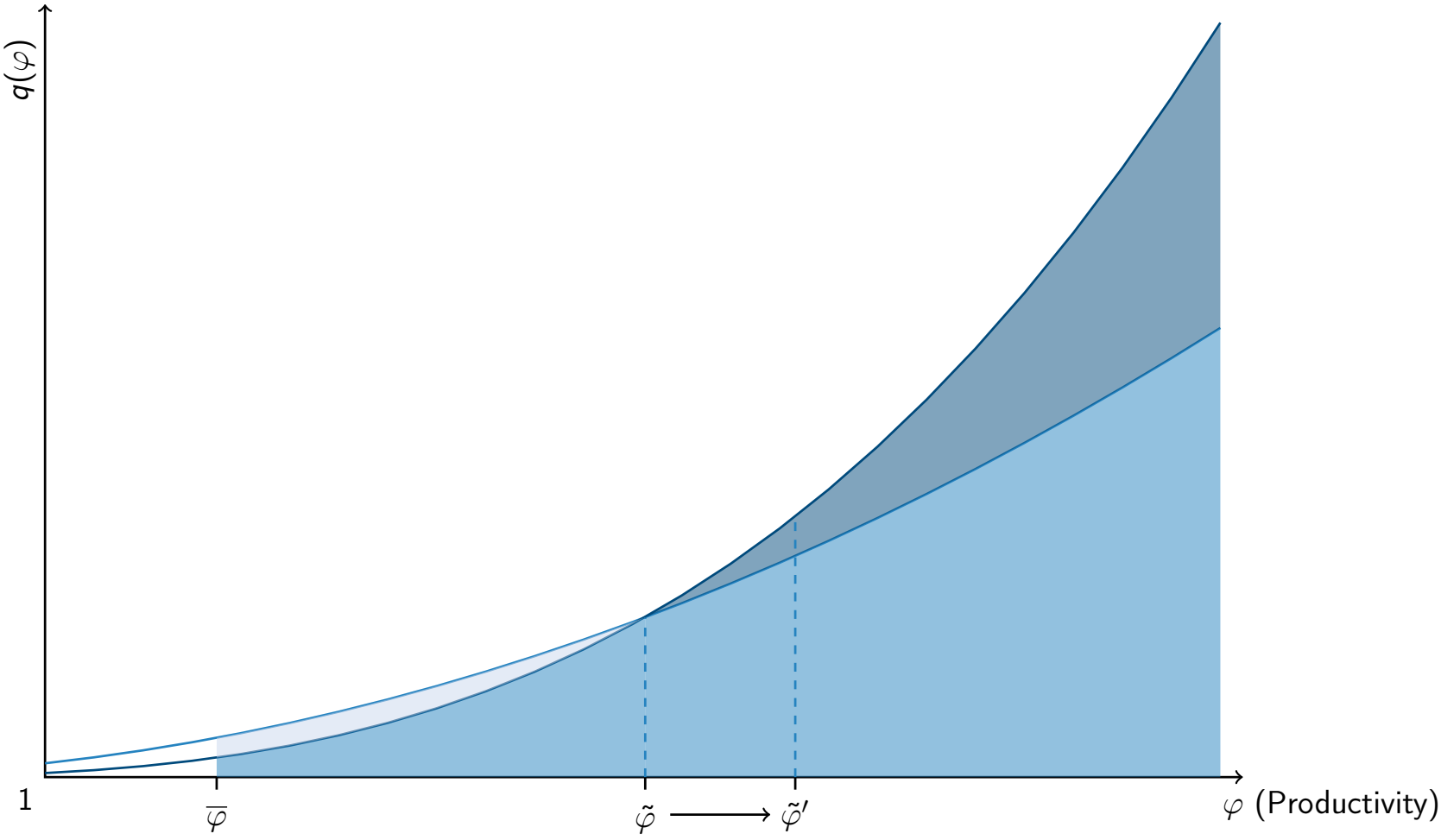

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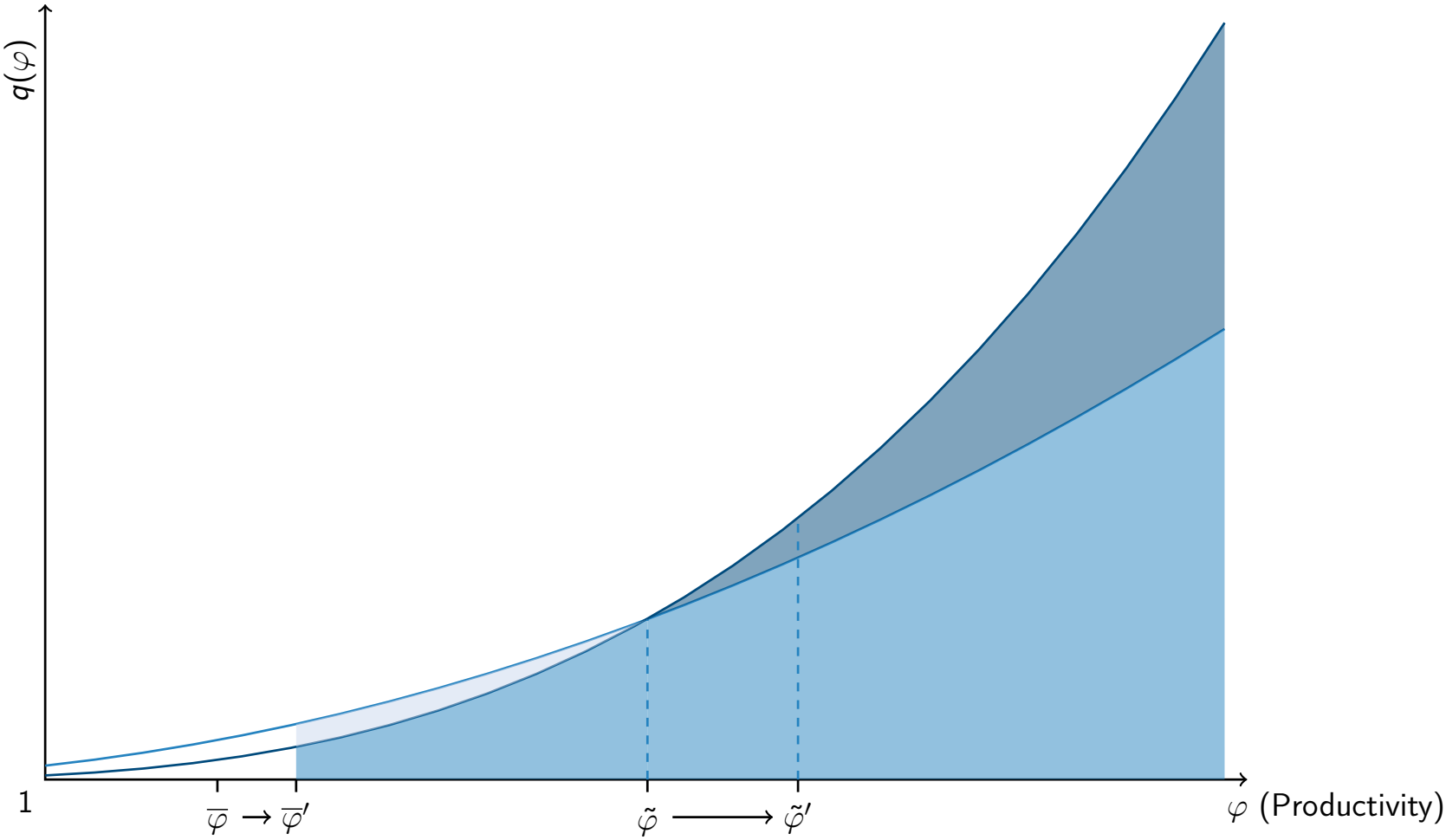


Competition

Partial Equilibrium (HM):

- Increase in $Q = L_r \tilde{\varphi}$
- Increase in $w_r = \frac{\sigma - 1}{\sigma} \tilde{\varphi}$

General Equilibrium (MC):

$$w_r \underline{\varphi} G(\underline{\varphi})^{\frac{1}{\epsilon}} = \beta^{(1-\frac{1}{\epsilon})} \frac{\gamma}{1-\gamma} Q^{\frac{1}{\epsilon}}$$

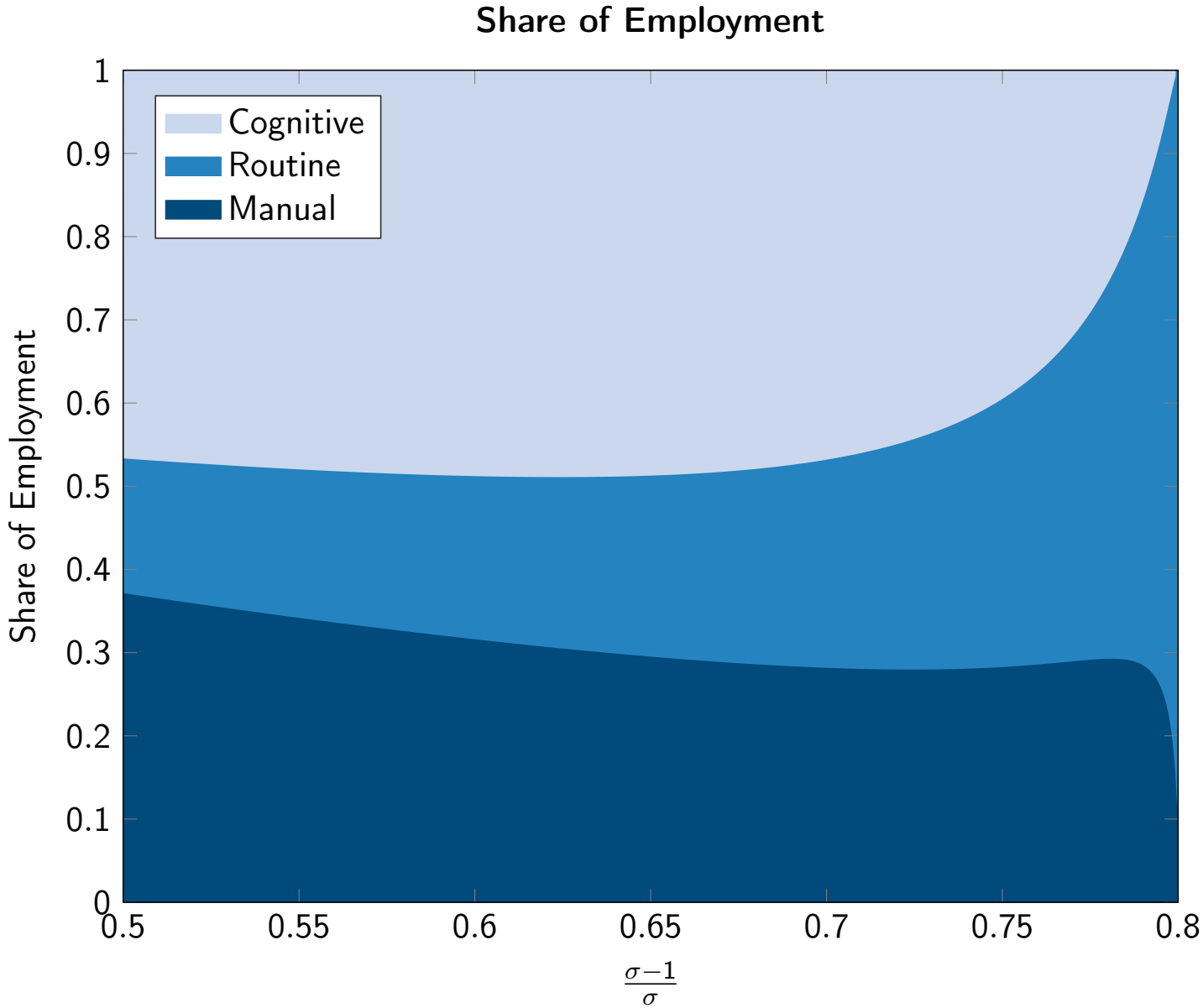
- It depends on the change of Q and w_r
- The movement of $\underline{\varphi}$ depends on the sign of

$$w_r Q' - \epsilon Q w_r'$$

Note: The derivatives are respect to σ in the partial equilibrium

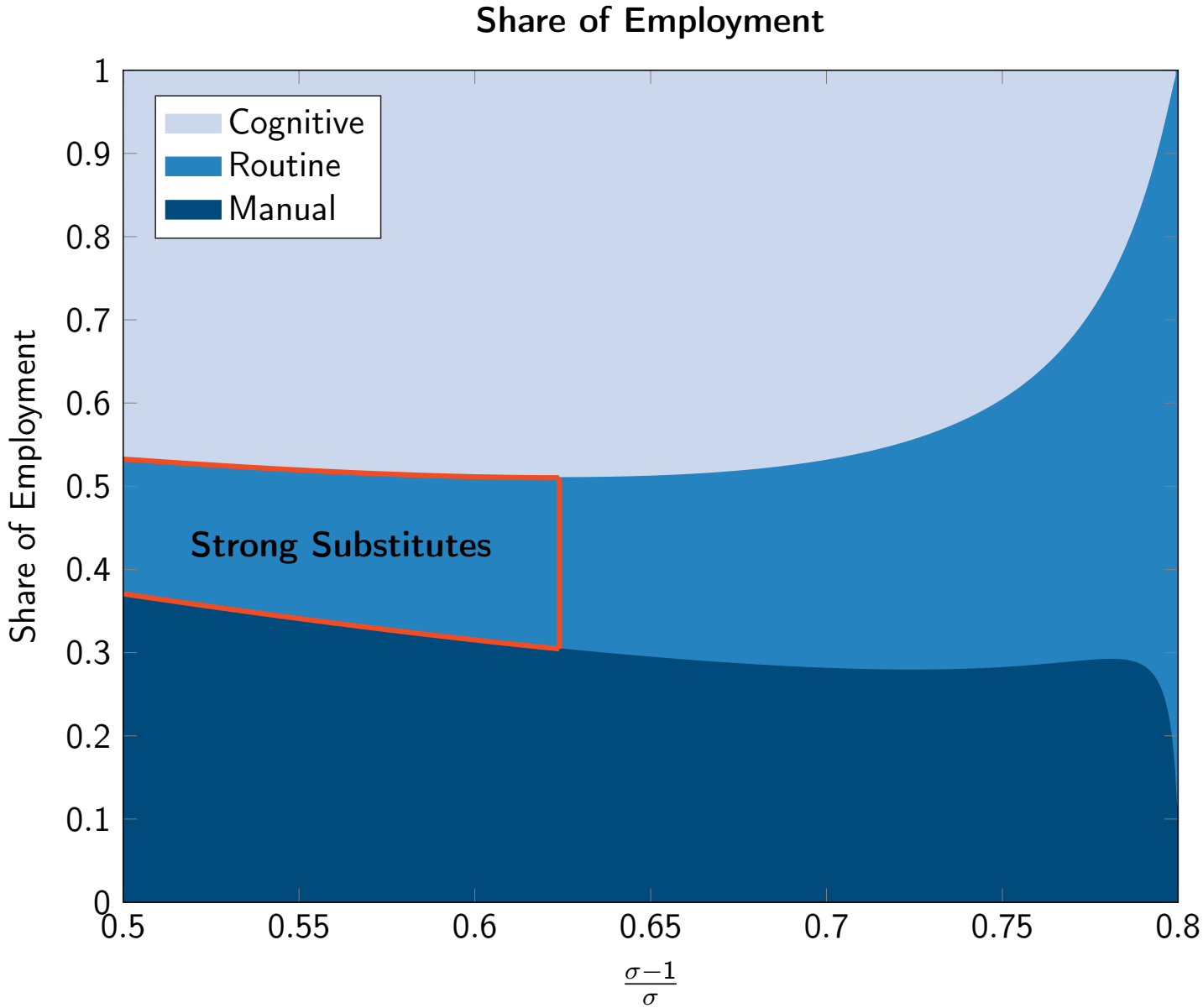
◂ Functions

Competition



Parameters: $G \sim \text{Par}(4,1)$, $\epsilon = 2$, $\gamma = 0.5$, $\beta = 1$

Competition



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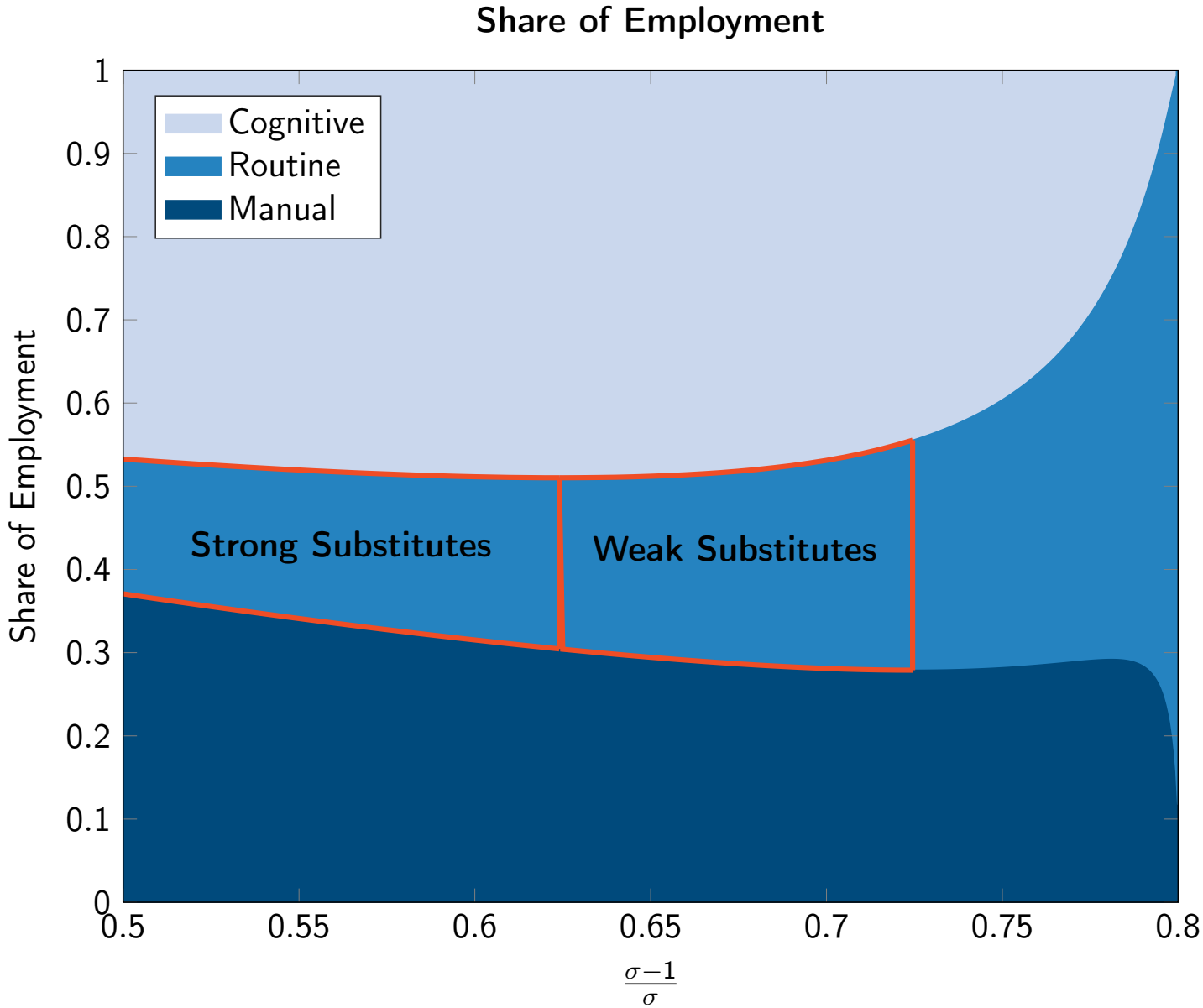

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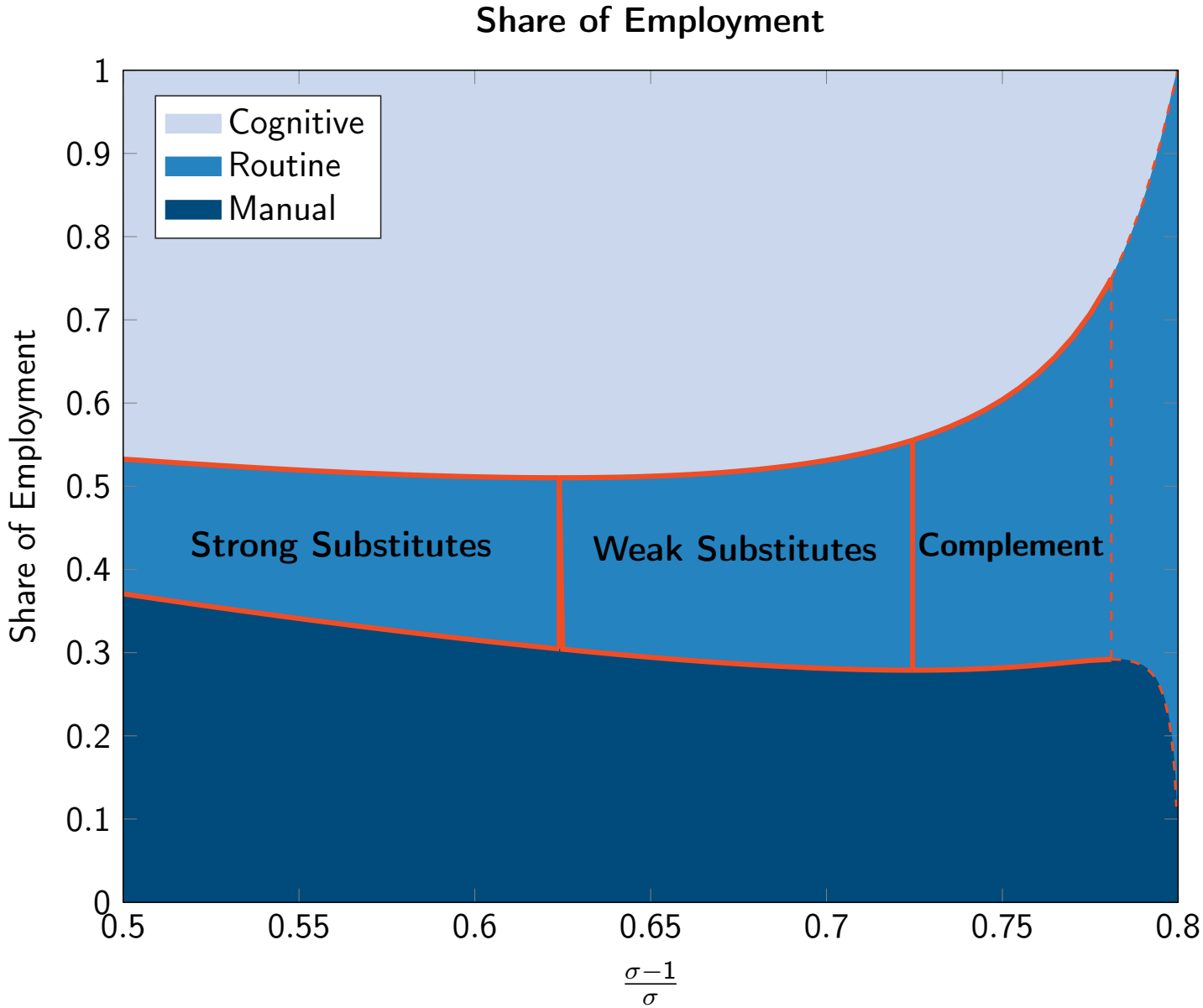


Parameters: $G \sim \text{Par}(4,1)$, $\epsilon = 2$, $\gamma = 0.5$, $\beta = 1$

Earnings Inequality

Strong Substitutes

- Overall increase of earnings inequality
- Decrease of $\underline{\varphi}$ and $\overline{\varphi}$

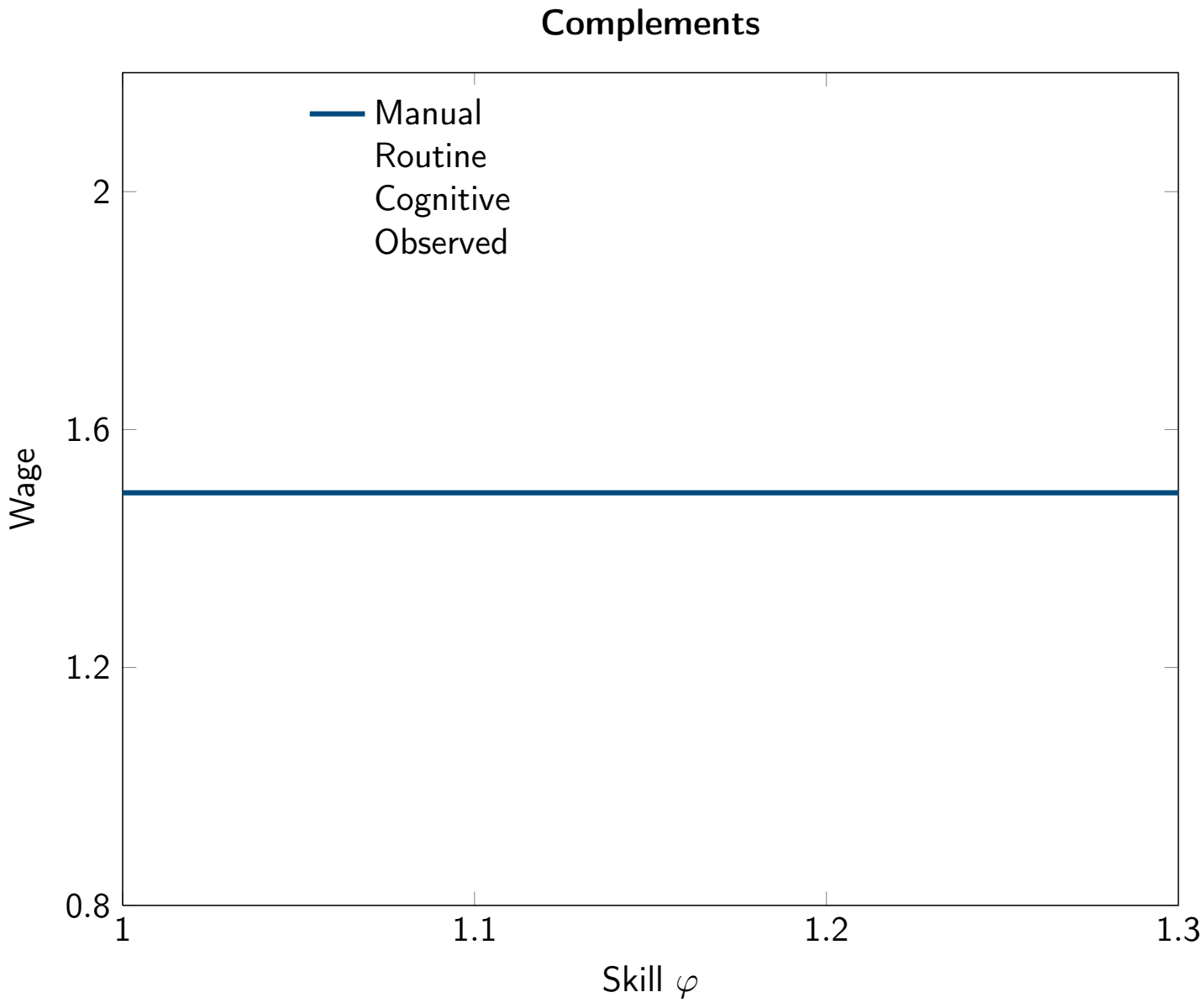
Weak Substitutes

- Nearly overall increase of earnings inequality
- Small decrease for low skilled cognitive workers

Complements

- Increase of inequality for top earnings
- Polarization of earnings

Polarization



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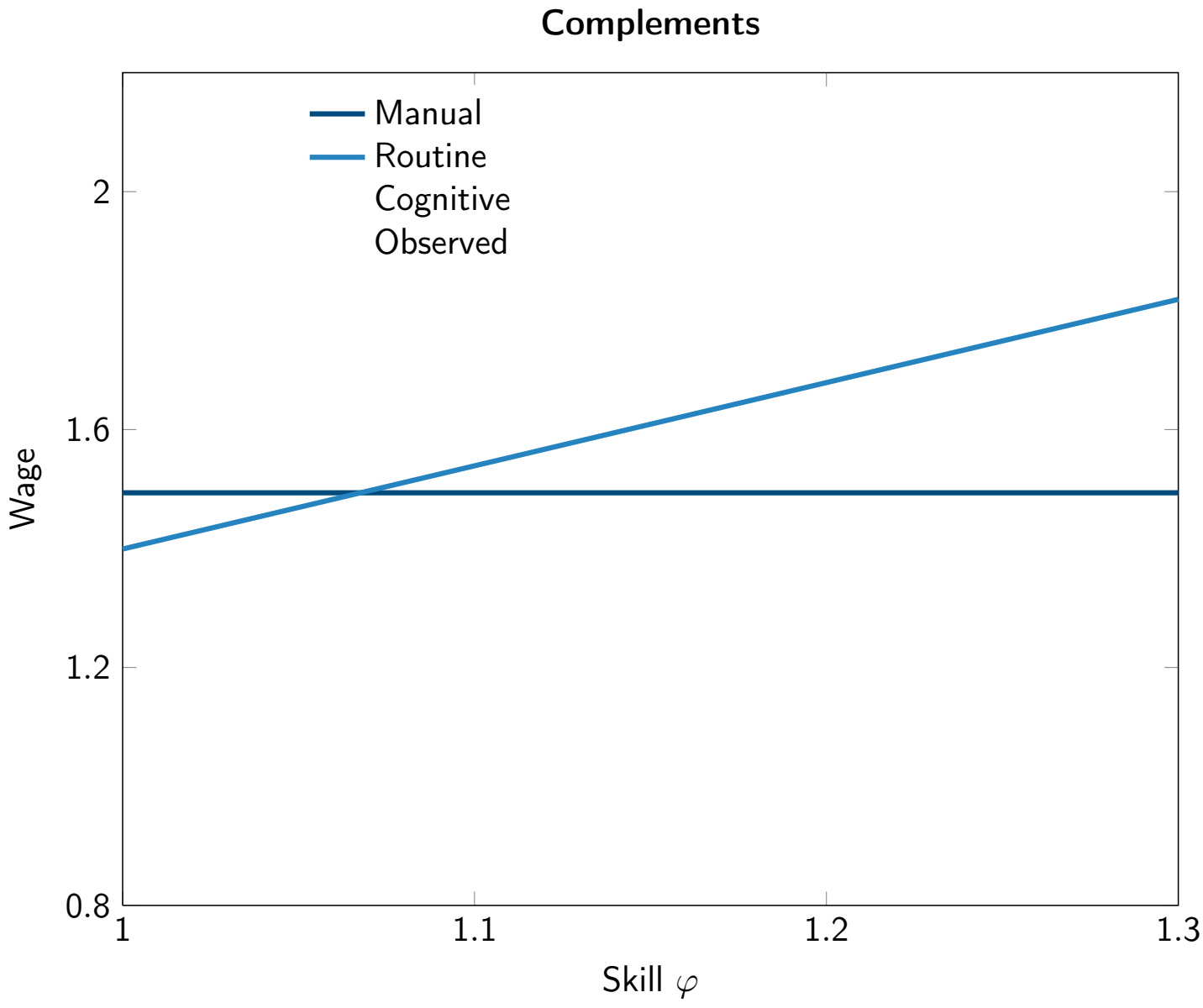

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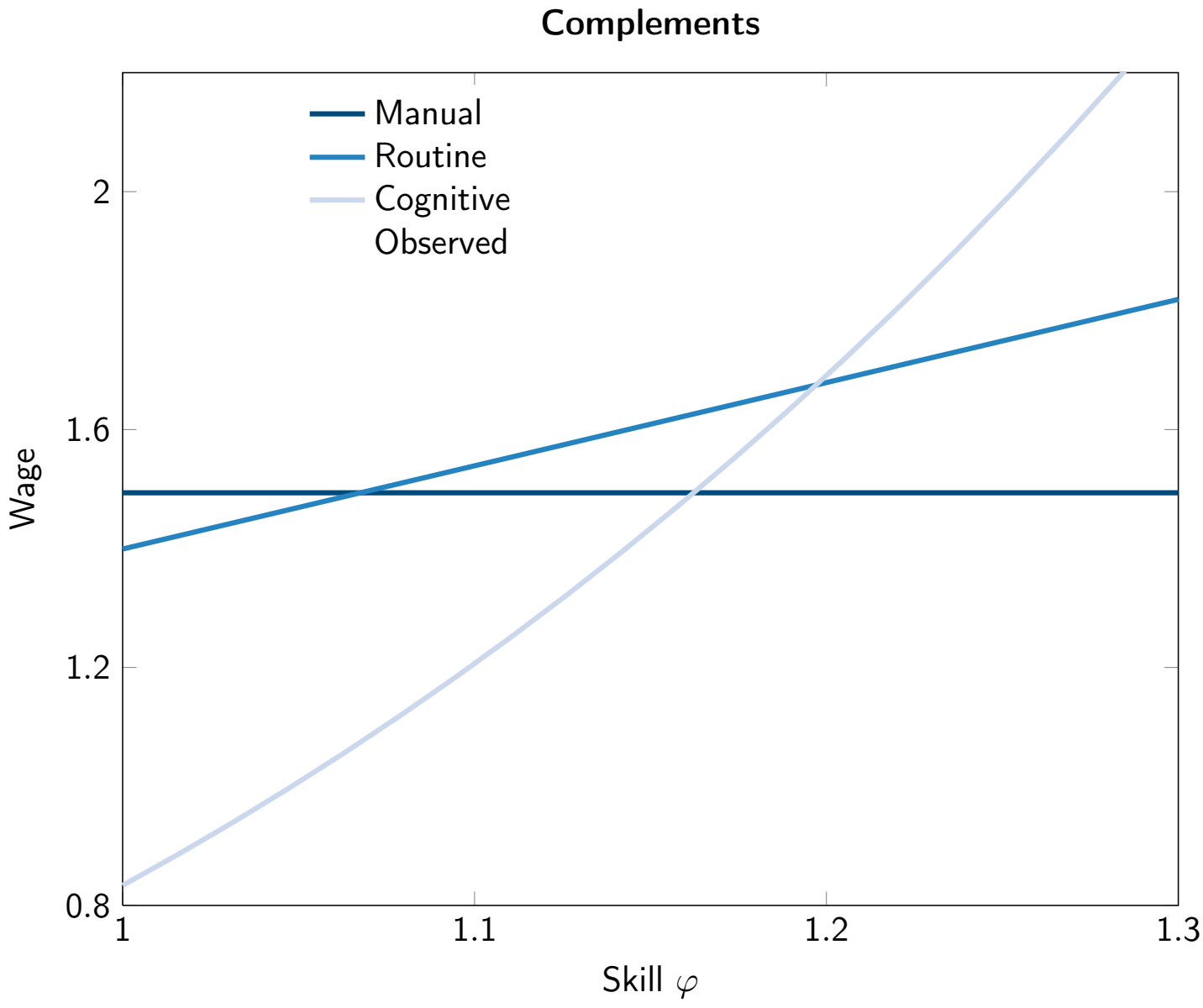

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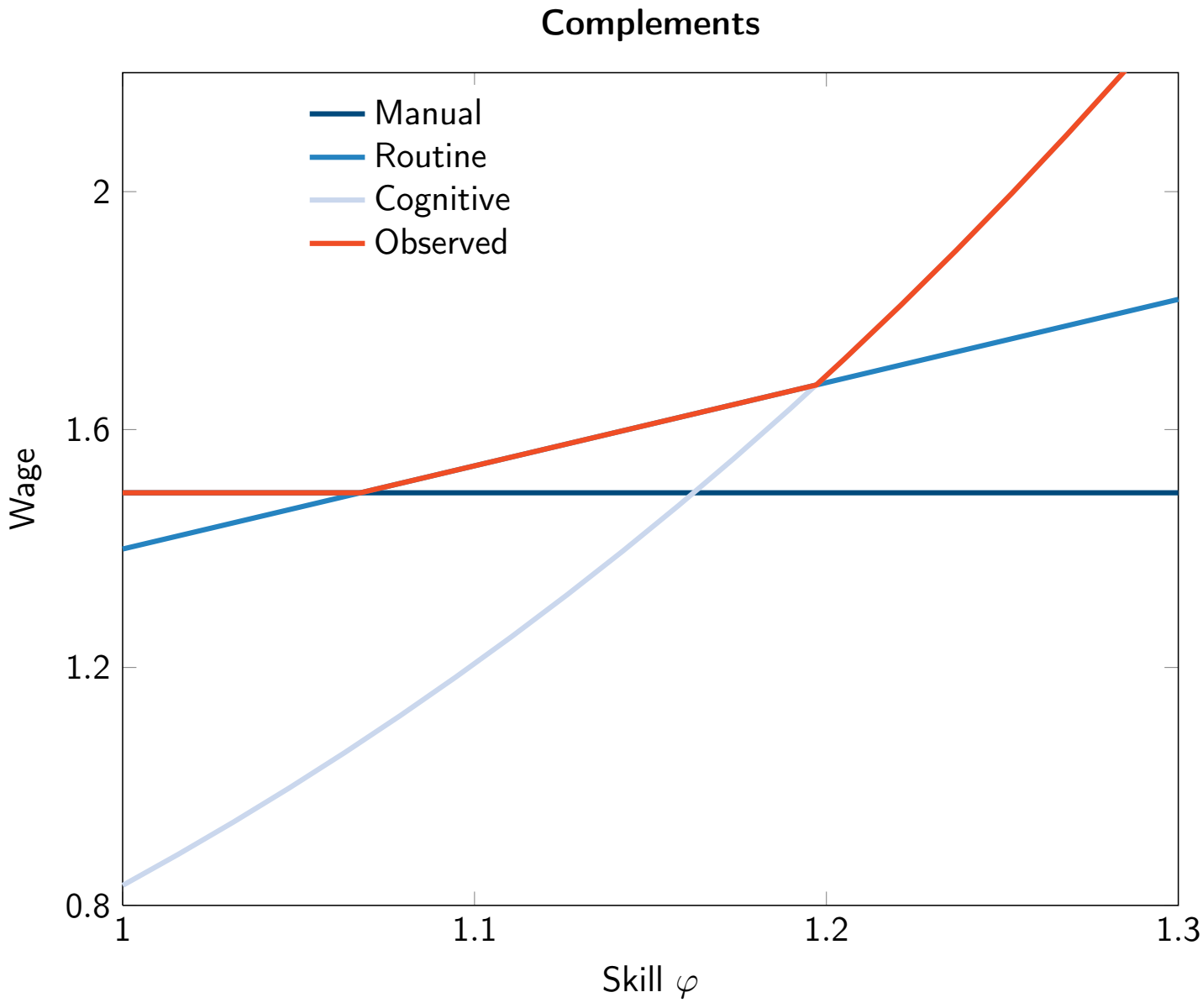

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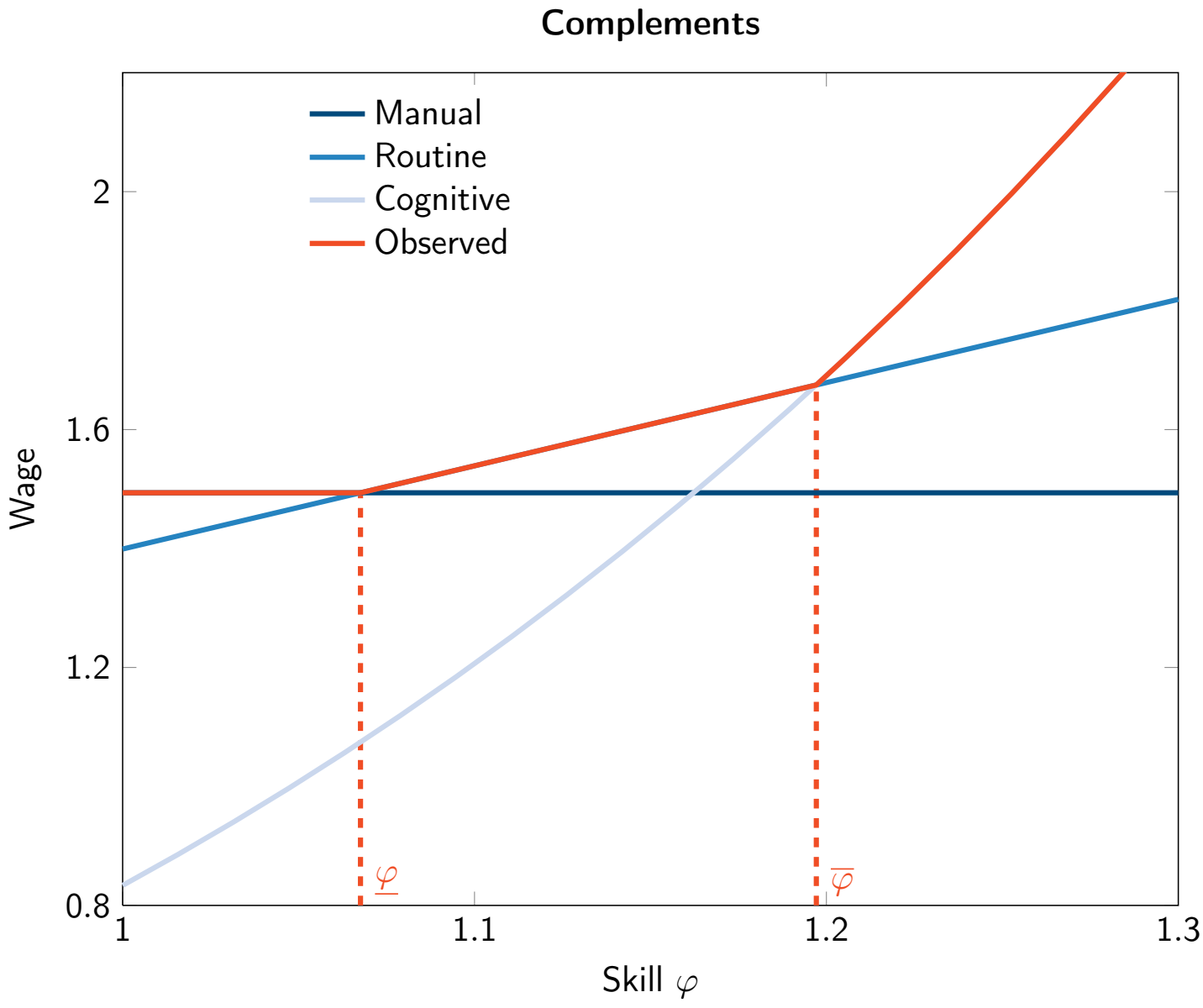

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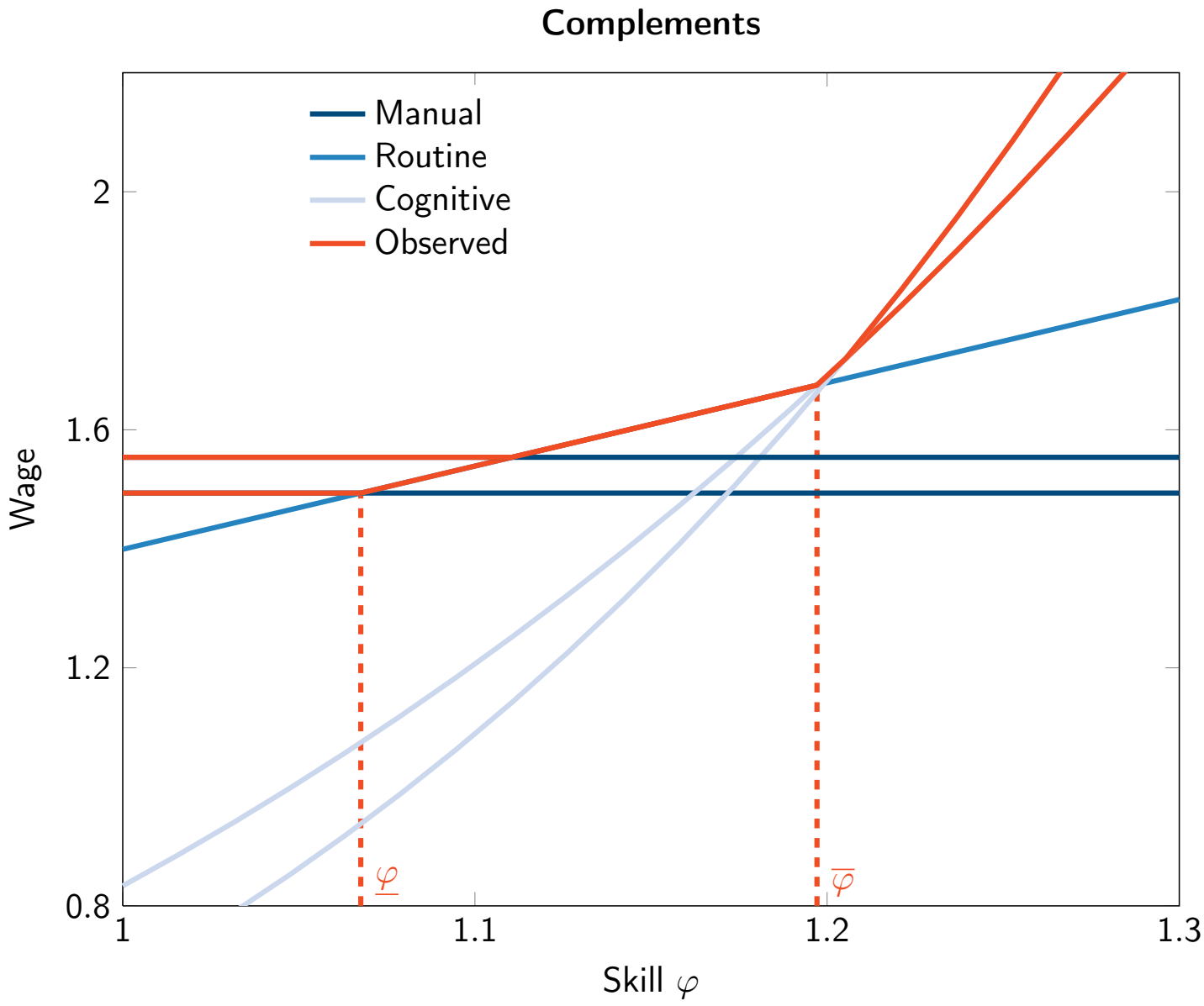

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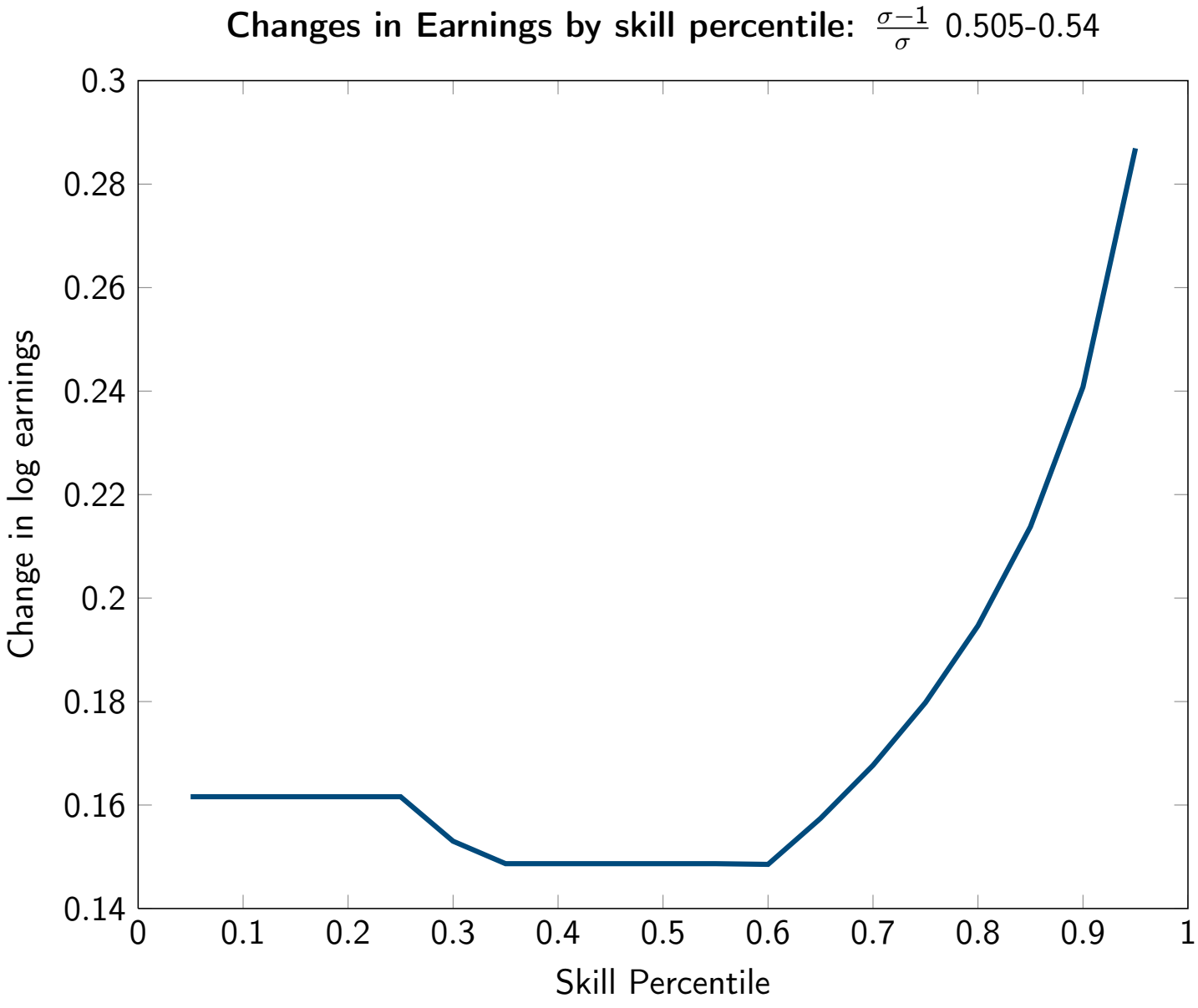

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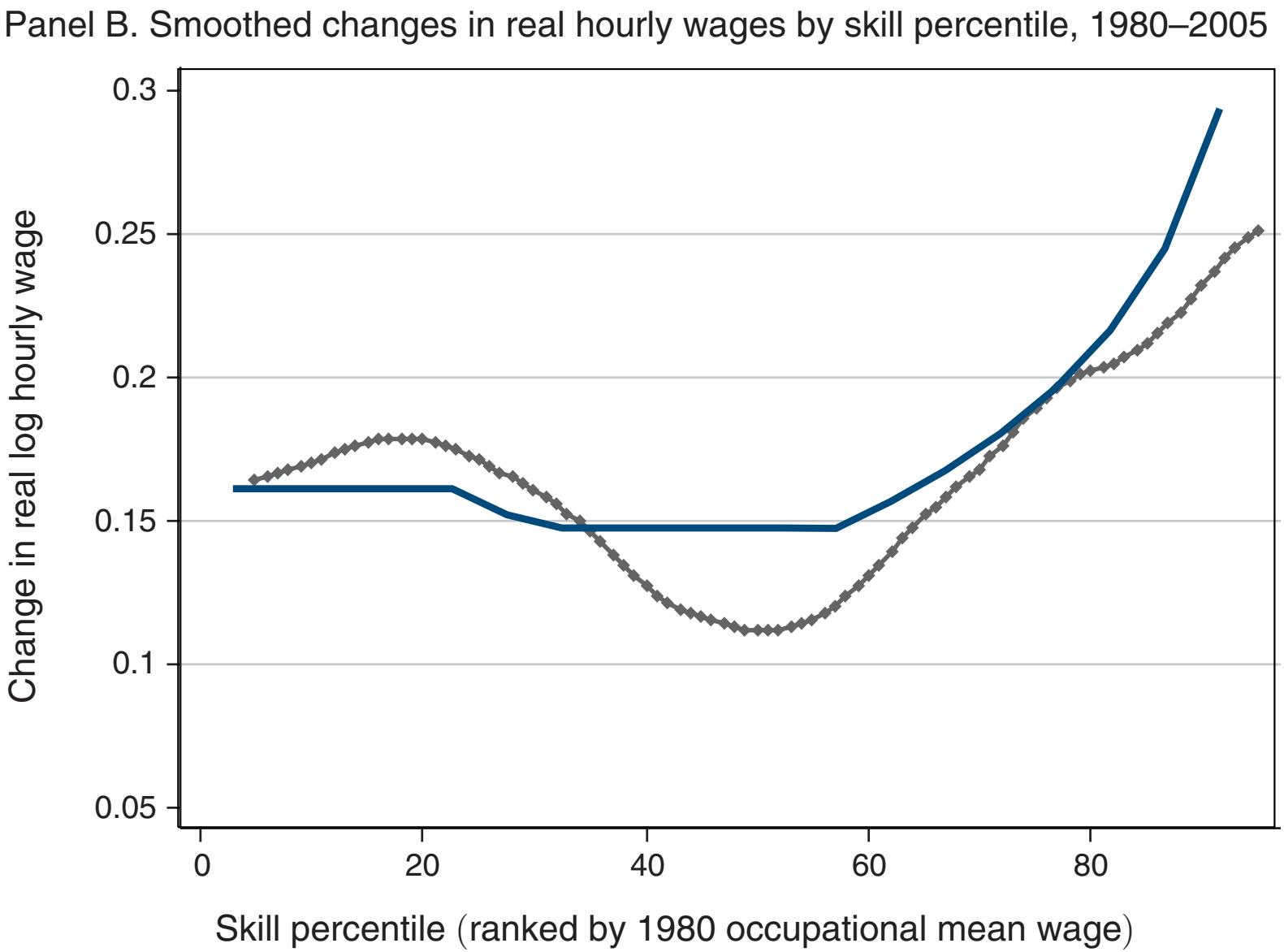


The Conclusion

Conclusion

- One mechanism that explains both, increase in earnings inequality and polarization
- Cognitive tasks in a more competitive market lead to more superstars
- Low skill cognitive workers lose out, while manual worker benefit from complementarities
- Tractable model with heterogenous skills, with endogenous labour composition and wages

The End

The Appendix

Tasks

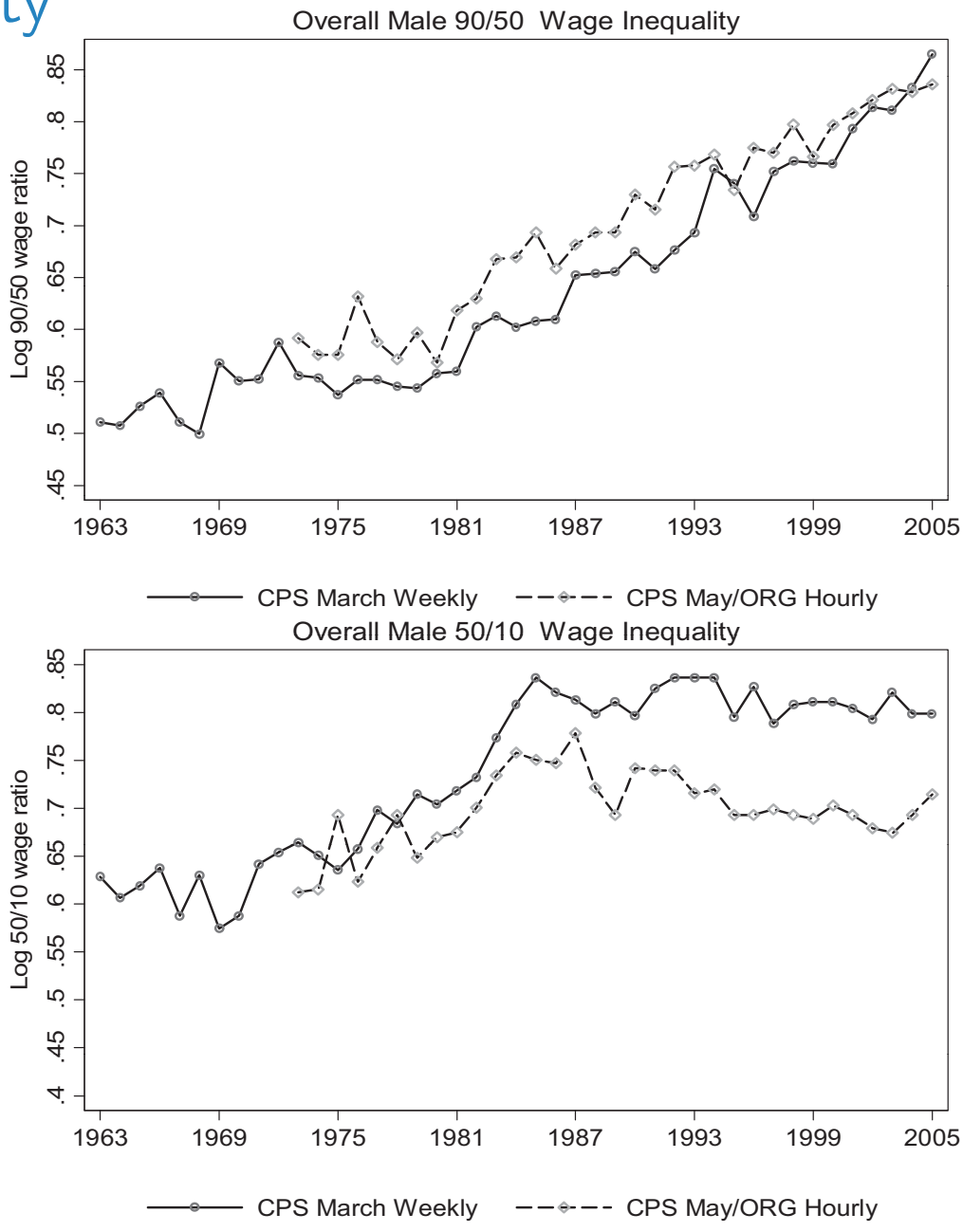
	Level						(growth per 10 yrs)	
	1950	1970	1980	1990	2000	2005	1950–1980	1980–2005
Panel A. Share of employment								
Managers/professionals/technicians/ finance/ public safety	22.3	25.8	31.6	38.2	39.6	40.9	41 (13.8)	30 (11.9)
Production/craft	5.1	4.8	4.8	3.5	3.6	3.0	−5 (−1.8)	−38 (−15.1)
Transportation/construction/ mechanics/mining/farm	29.2	22.3	21.6	18.8	18.0	18.2	−26 (−8.7)	−15 (−6.2)
Machine operators/assemblers	12.6	13.2	9.9	7.3	5.7	4.6	−21 (−7.0)	−54 (−21.5)
Clerical/retail sales	20.2	23.2	22.2	21.7	21.4	20.4	10 (3.4)	−8 (−3.3)
Service occupations	10.7	10.7	9.9	10.5	11.6	12.9	−7 (−2.3)	30 (11.9)
Panel B. Mean log hourly wage (2004$)								
Managers/professionals/technicians/ finance/public safety	2.22	2.86	2.83	2.90	3.03	3.14	61 (20.4)	31 (12.5)
Production/craft	2.24	2.73	2.75	2.72	2.70	2.72	50 (16.8)	−3 (−1.2)
Transportation/construction/ mechanics/mining/farm	2.04	2.55	2.61	2.56	2.62	2.63	57 (18.9)	2 (0.9)
Machine operators/assemblers	2.04	2.46	2.48	2.46	2.52	2.54	44 (14.7)	6 (2.3)
Clerical/retail sales	2.00	2.43	2.42	2.45	2.55	2.60	42 (14.1)	18 (7.3)
Service occupations	1.48	2.01	2.10	2.14	2.24	2.26	62 (20.7)	16 (6.4)

Notes: Sample includes persons who were age 18–64 and working in the prior year. Hourly wages are defined as yearly wage and salary income divided by the product of weeks worked times usual weekly hours. Employment share is defined as share in total work hours. Labor supply is measured as weeks worked times usual weekly hours in prior year. All calculations use labor supply weights.

Source: Census 1 percent samples for 1950 and 1970; Census 5 percent samples for 1980, 1990, 2000; American Community Survey 2005.

Return

Wage Inequality



Source: Autor, Katz and Kearny 2008

Return

Tasks

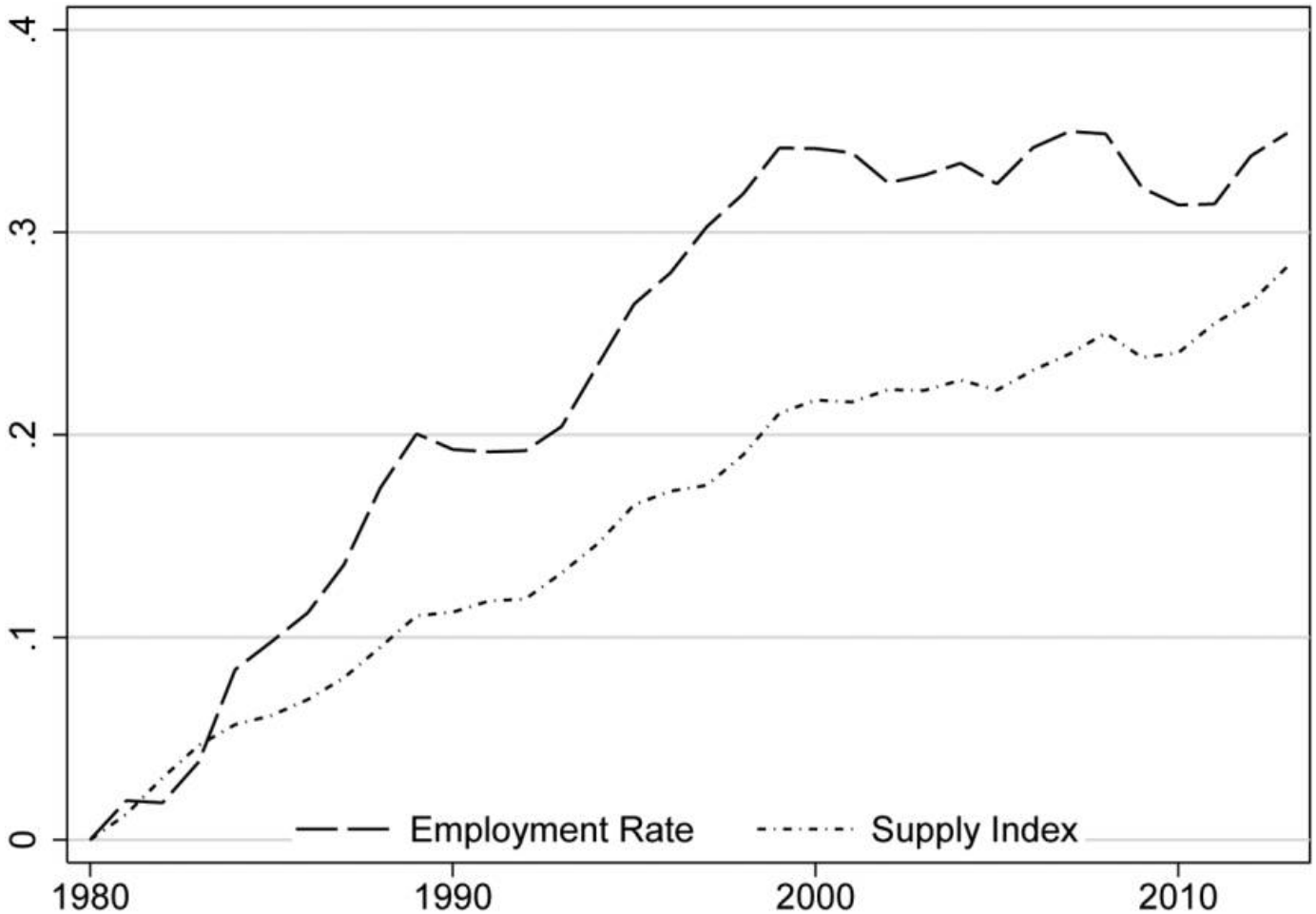
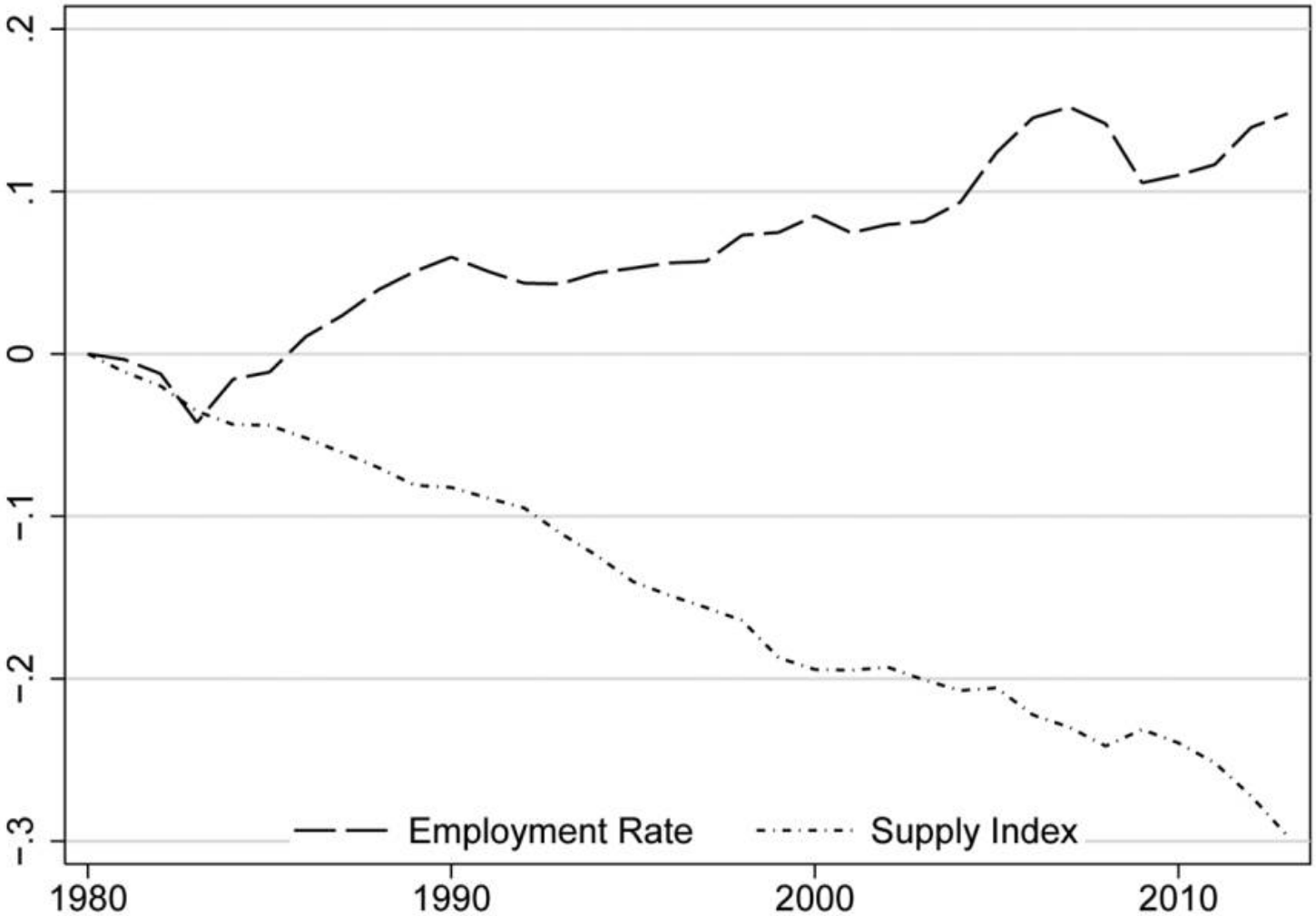


FIG. 6.—Cognitive employment rate and supply index. The employment rate is calculated as the total hours worked in cognitive jobs over the size of the workforce and plotted against the supply index as percentage growth since 1980.

Source: Beaudry, Green and Sand 2016

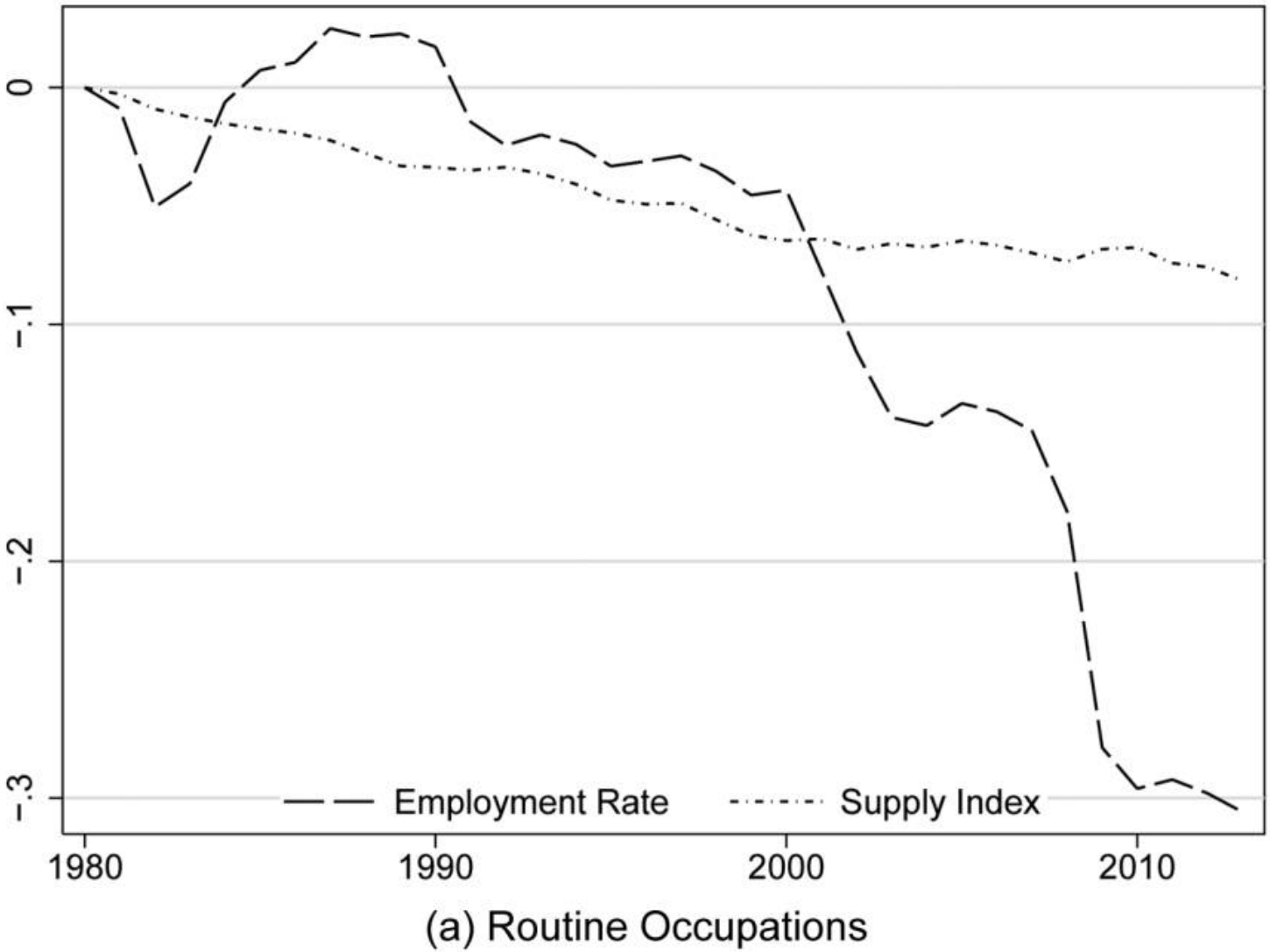
Tasks



(b) Manual Occupations

Source: Beaudry, Green and Sand 2016

Tasks

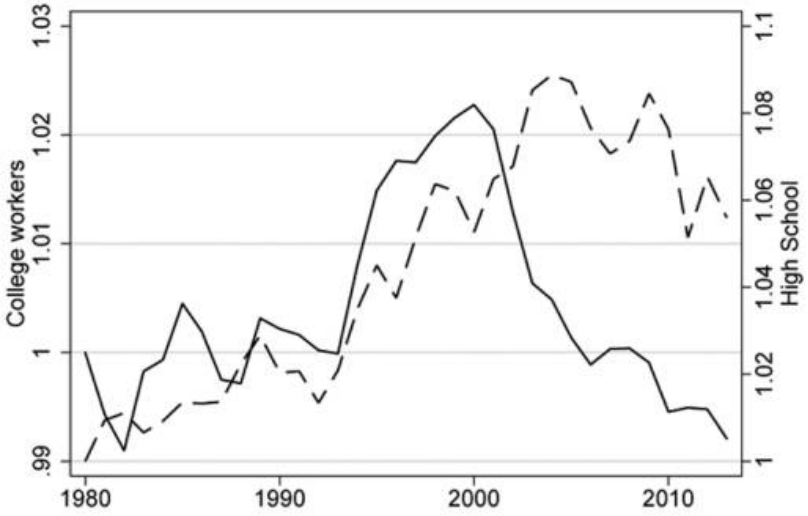


(a) Routine Occupations

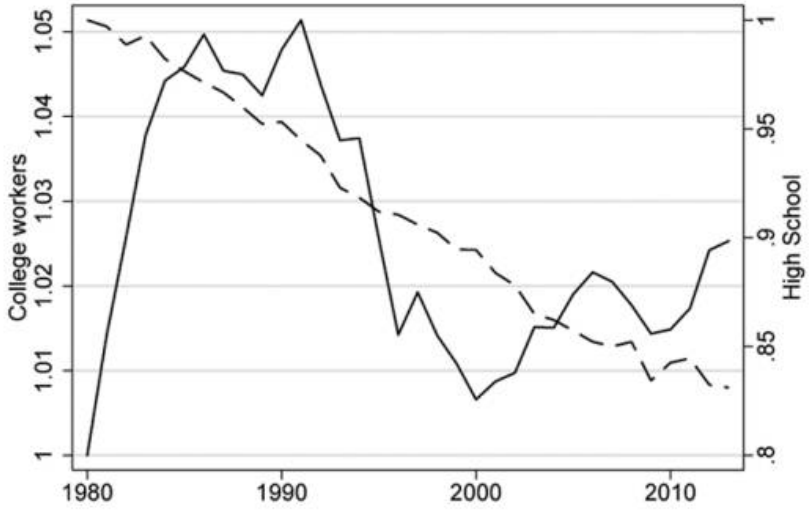
Source: Beaudry, Green and Sand 2016

Return

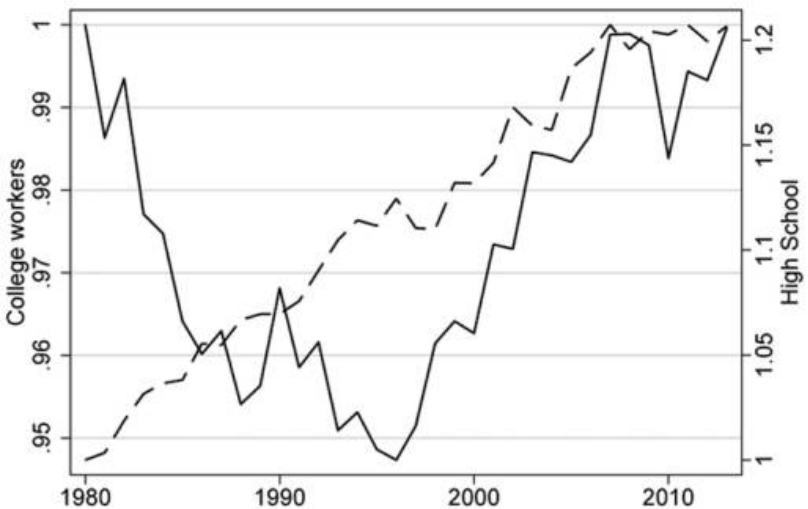
Tasks



(a) Average Cognitive Task



(b) Average Routine Task



(c) Average Manual Task

College workers High School

Source: Beaudry, Green and Sand 2016

Return