# Heterogeneity and the Public Wage Policy

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**Conference**

"*Structural reforms in the wake of the recovery: where do we stand?*"

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# General facts about public employment and wages

- Major components of the labour market and government budget

  [OECD: public employment is 18% of total employment, public sector wage bill is more than 50% of government consumption expenditures]

- The public sector predominantly hires skilled workers

  [UK: 36 percent of college graduates, 16 percent of workers with lower qualifications].

- On average, the public sector pays higher wages.

  [Katz Krueger (1991), Postel-Vinay and Turon (2007), Christofides and Michael (2013), Castro *et al.* (2013), Giordano *et al.* (2011), Dickson, Postel-Vinay and Turon (2014)]

# Other stylized facts about public wages

**Heterogeneity**:

- Wage compression across education groups: more educated workers have lower premium, less educated workers have higher premium.
  [Katz Krueger (1991), Postel-Vinay and Turon (2007), Christofides and Michael (2013), Castro *et al.* (2013), Giordano *et al.* (2011), Dickson, Postel-Vinay and Turon (2014)]

- Wage compression within education groups: bottom quantiles have higher premium, top quantiles have lower or even negative premium
  [Poterba and Rueben (1994), Postel-Vinay and Turon (2007), Disney and Gosling (1998), Mueller (1998), Christofides and Michael (2013)]

# Objective

**Build a quantitative macro model that incorporates these stylized facts and use it to evaluate a reform of public sector wages that strengths the link with private sector.**

- Steady-state (across workers).

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**Why this reform?** Implicit wage policy in a frictionless model (RBC).

# Role of labour market frictions

- Frictionless labour market $\rightarrow$ no role for public sector wages.
- Labour market frictions $\rightarrow$ the market tolerates different wages.
  - High public sector wages induce queues for public sector jobs.
  - Low public sector wages leads to recruitment and retaining problems.
  - Affect both the willingness and the ability of government to hire.

# Why look at heterogeneity?

- Most literature considers homogeneous workers
  - Without frictions [Algan *et al.* (2002), Finn (1998), Ardagna (2007)]
  - With frictions [Quadrini and Trigari (2007), Michaillat (2014), Gomes (2015), Afonso and Gomes (2014)]
  - Wage heterogeneity [Bradley, Postel-Vinay, Turon (2015)]
  - Heterogeneous skills [Domeij and Ljungqvist (2006)]

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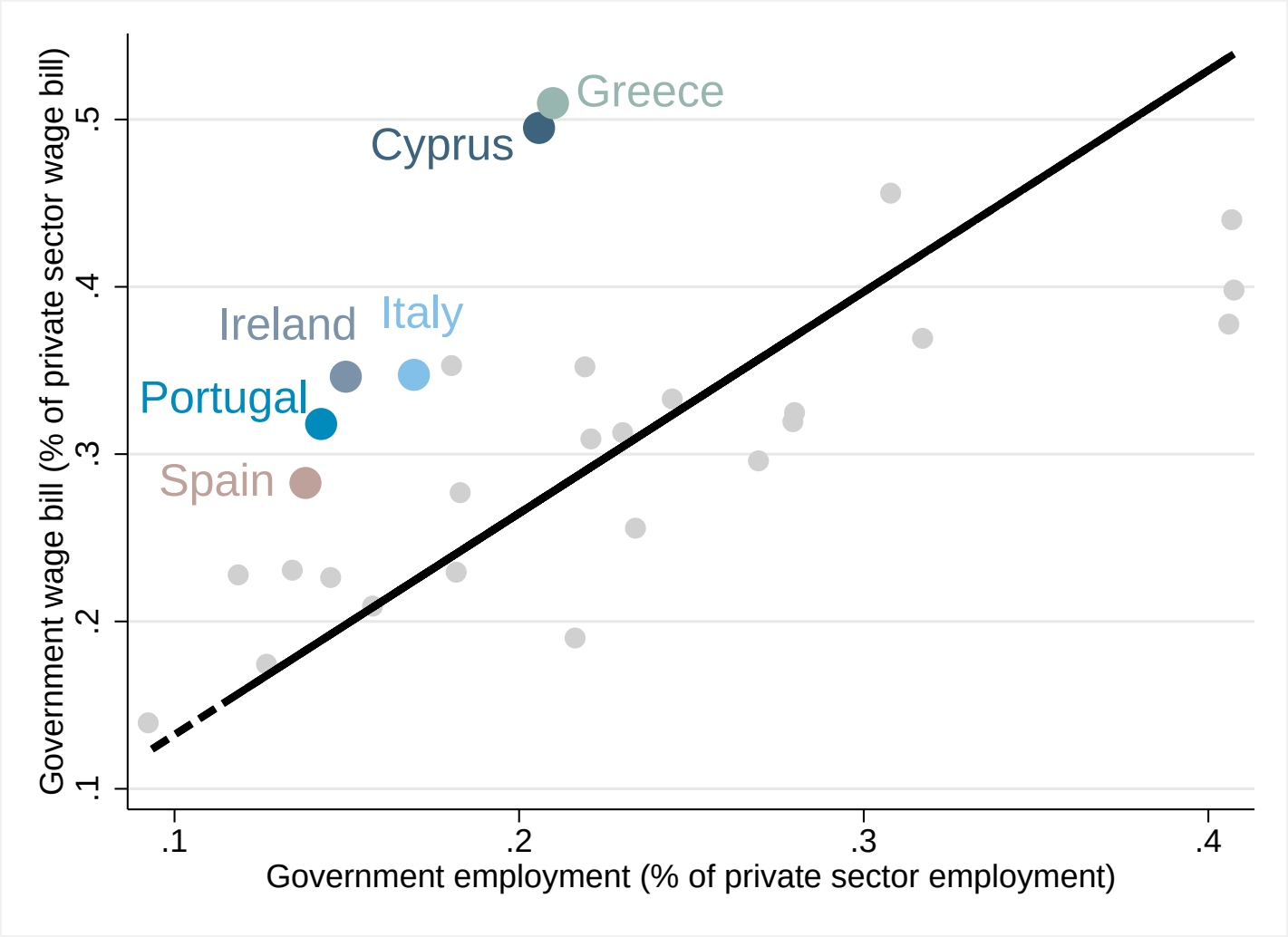
  - Heterogeneous skills [Domeij and Ljungqvist (2006)]
- Different public sector wage premiums imply different distortions.
- Current Euro Area crisis (*one-size-fits-all* policy might not be suitable).

# Government wage bill and employment, 2008

- $\frac{\text{Government wage bill}}{\text{Private wage bill}}$ and $\frac{\textit{Government employment}}{\textit{Private employment}}$



# This paper

**Build an extension of the model of Gomes (2015)**,

- Search and matching frictions and worker heterogeneity (education and ability)
- Given a wage schedule, the government decides how many workers of each type to hire.
- Calibrate the model to the United Kingdom using Labour Force Survey microdata.

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**to guide the discussion of the reform**

- S.S. effects of a reform that links the distribution of wages to the private sector.

# Main results

- Aligning the distribution of public sector wages with the private sector reduces steady-state unemployment rate by 1.9 percentage points, particularly of the low-ability unskilled.
  - Reduces the distortions in the labour market.
  - Gives the incentive for governments to hire more unskilled workers.
  - Gives the ability for governments to hire more skilled workers.
- The reform can increase the labour market value of the less qualified workers and reduce inequality.

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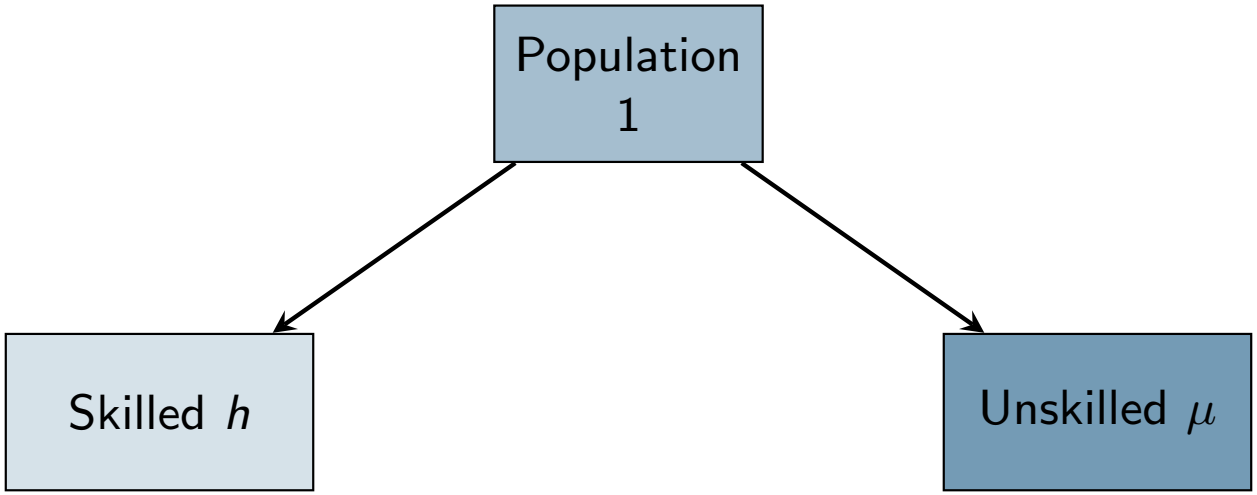
**Similar policy followed by Nordic countries in the 70s and 80s.**

# Model

# Setting



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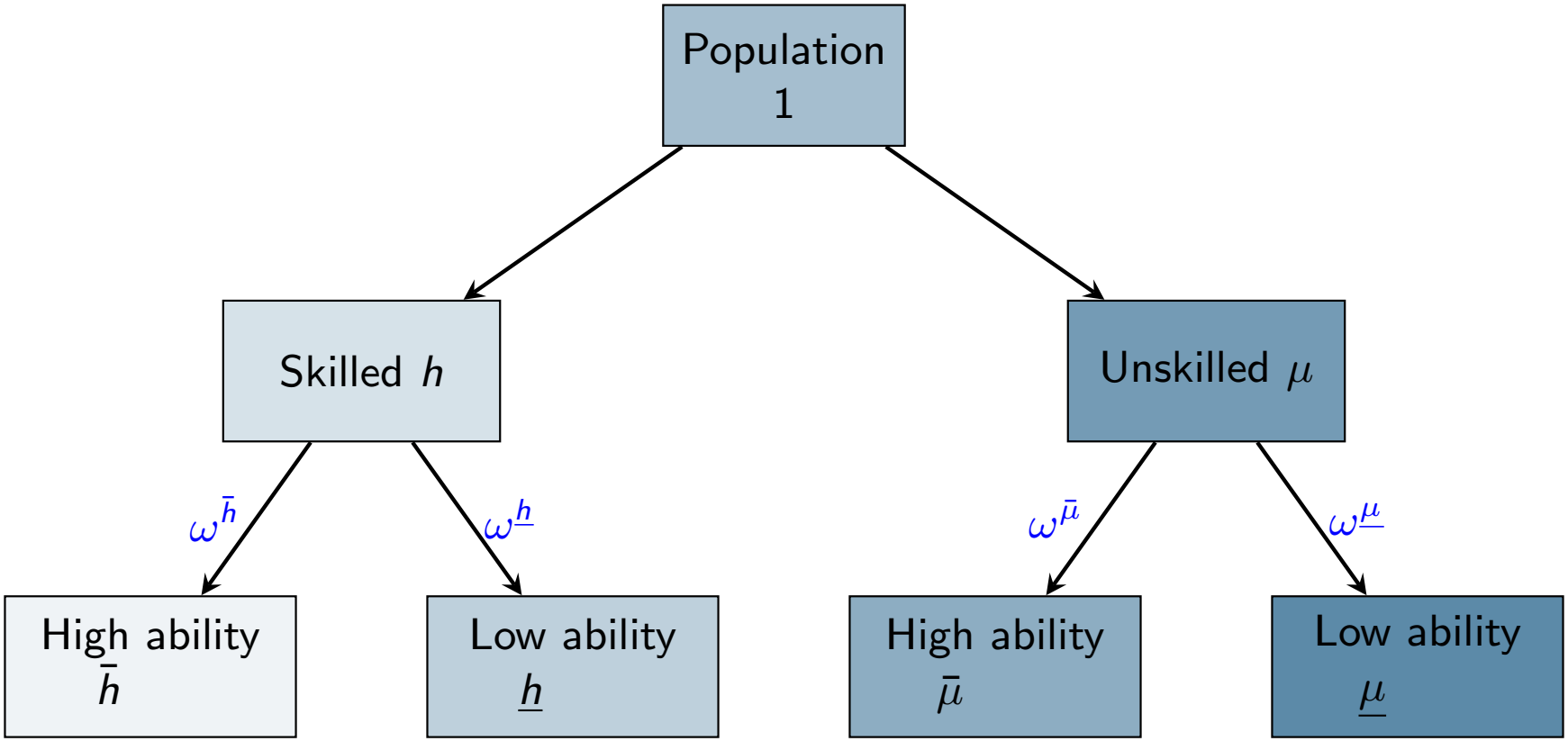
Population
1
Skilled $h$
Unskilled $\mu$
$\omega^{\bar{h}}$
$\omega^{\underline{h}}$
$\omega^{\bar{\mu}}$
$\omega^{\underline{\mu}}$
High ability
$\bar{h}$
Low ability
$\underline{h}$
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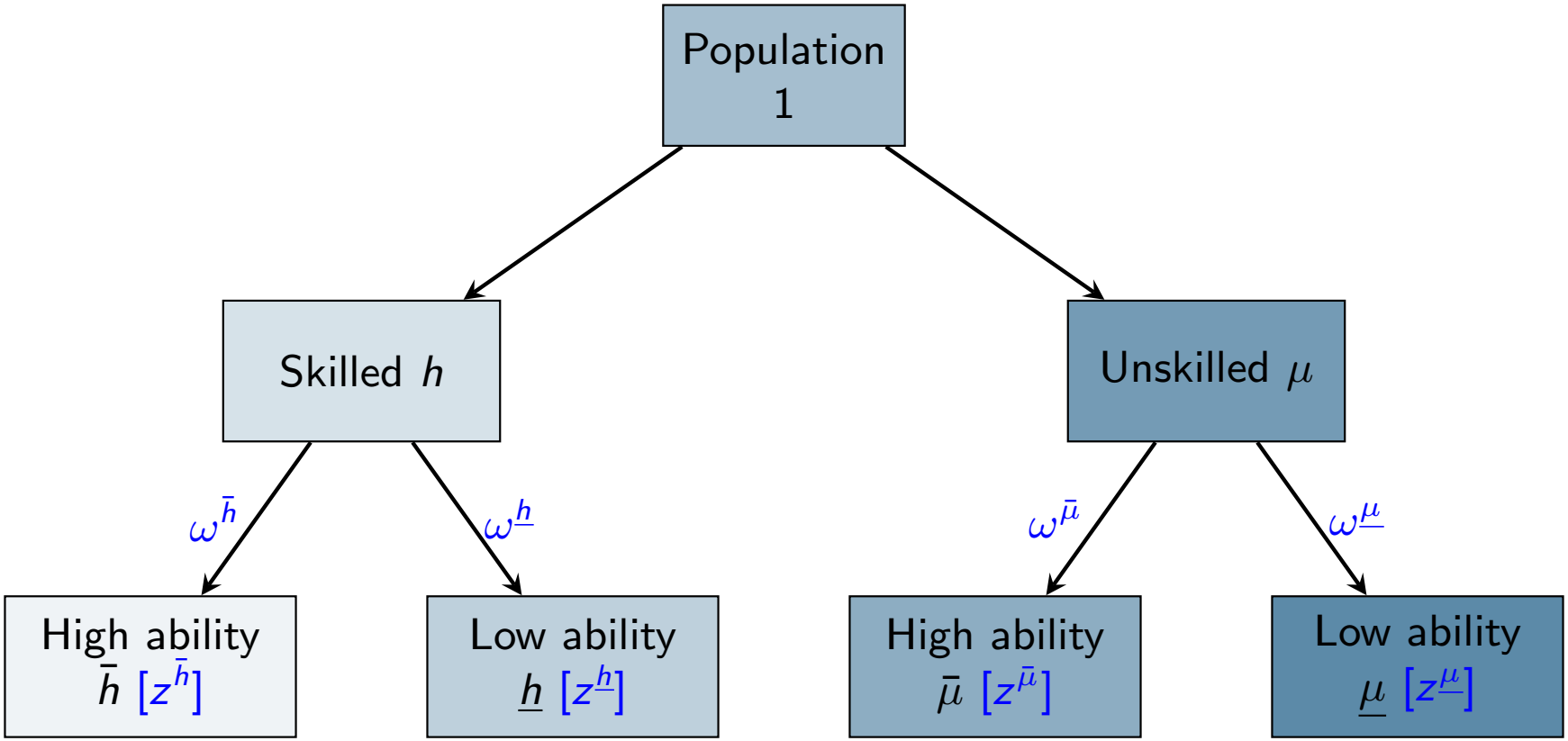
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Skilled $h$
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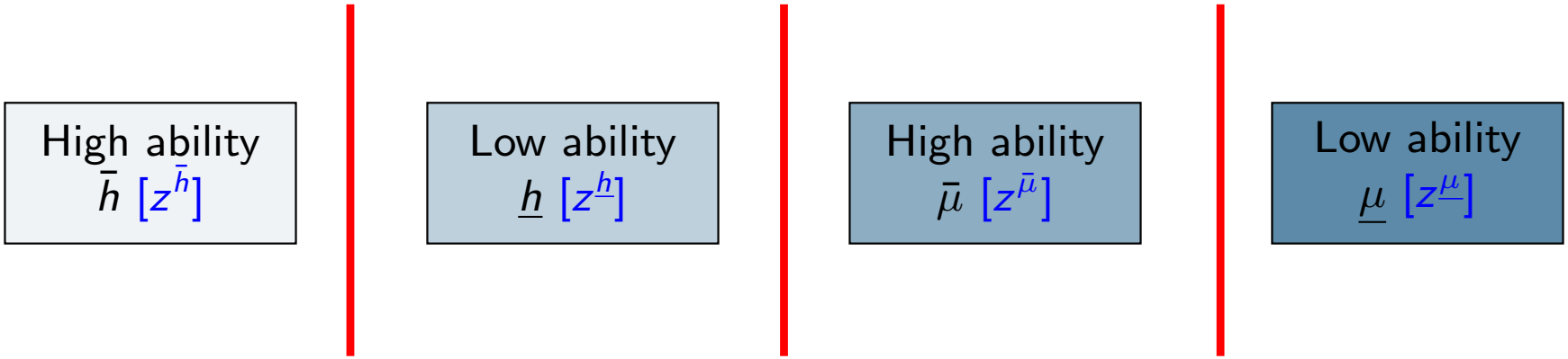


**Assumption 1**: segmented markets ▸ Microfoundations

# Labour market for each type

**Assumption 2**: directed search

Unemployed

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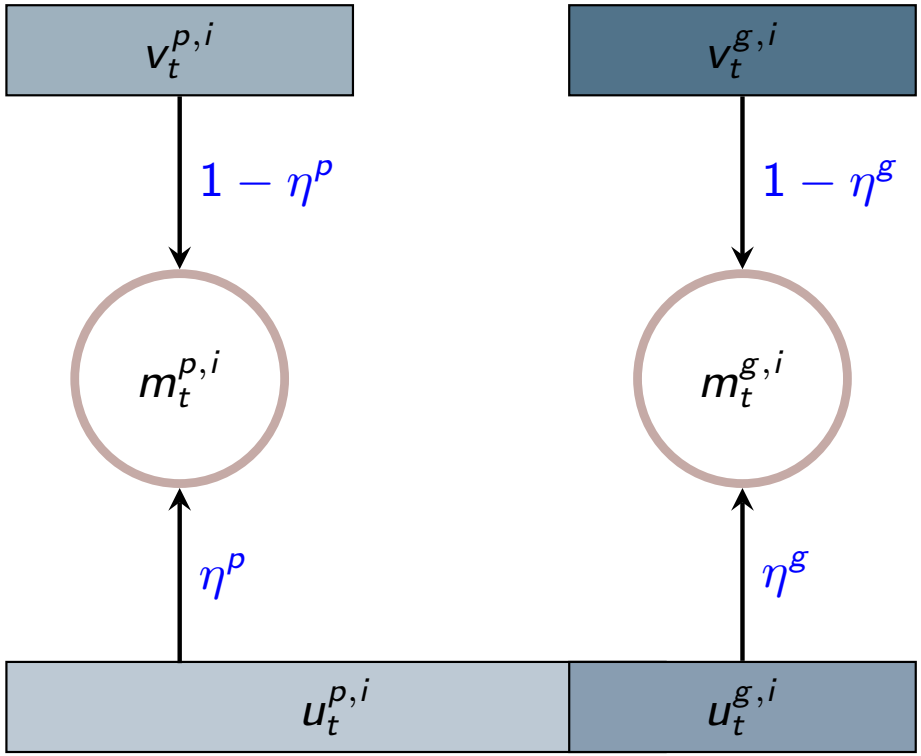

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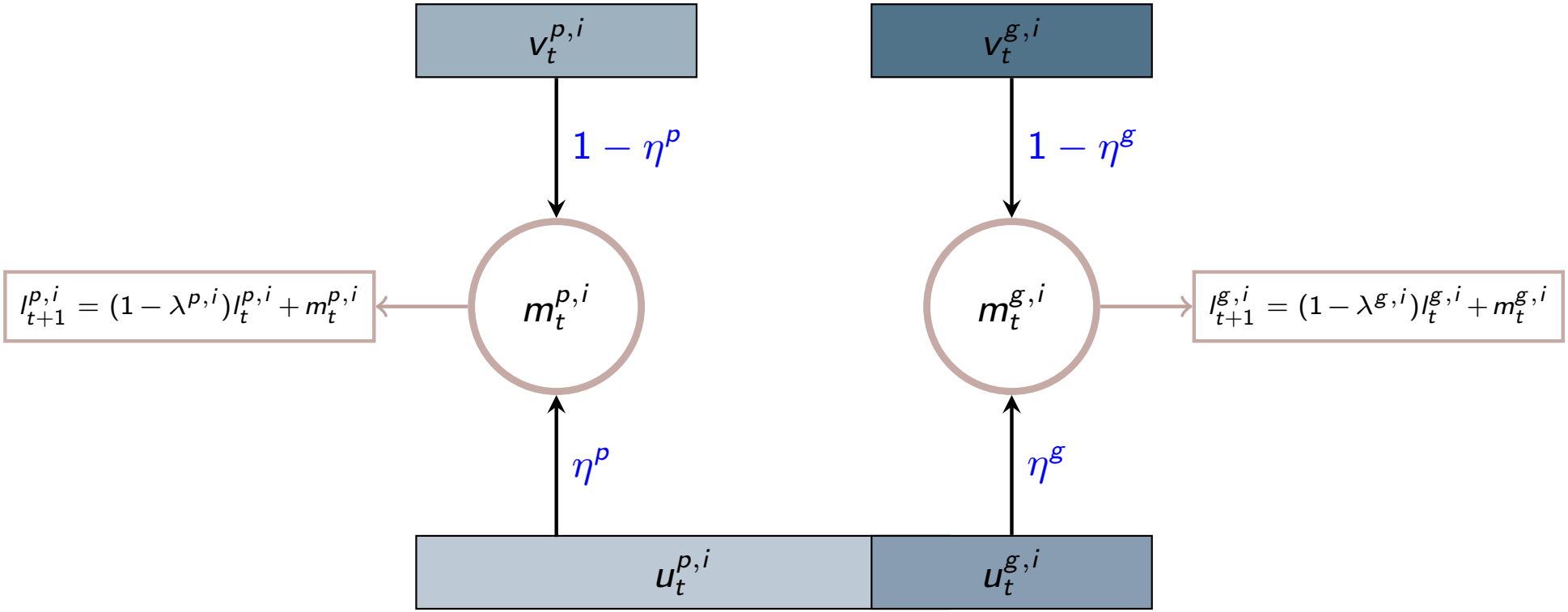
**Assumption 2**: directed search



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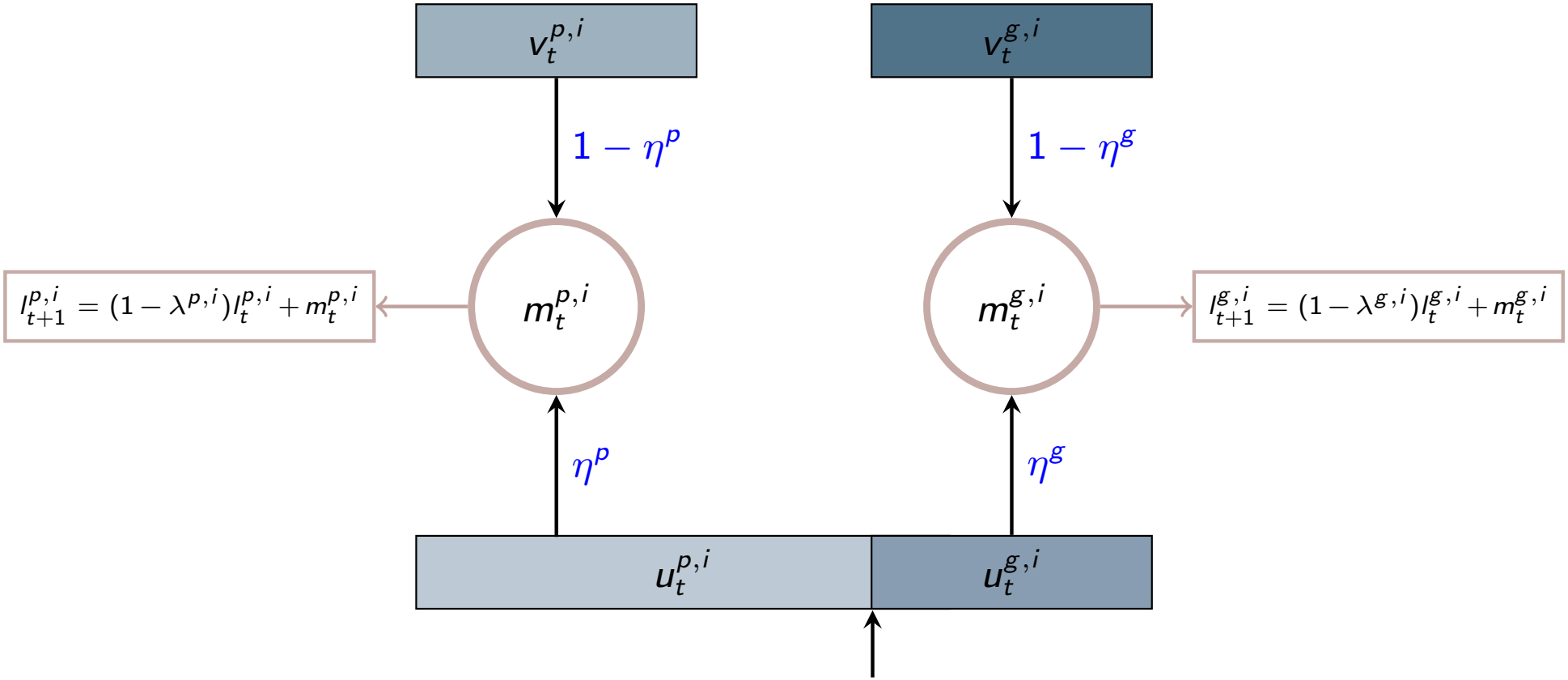

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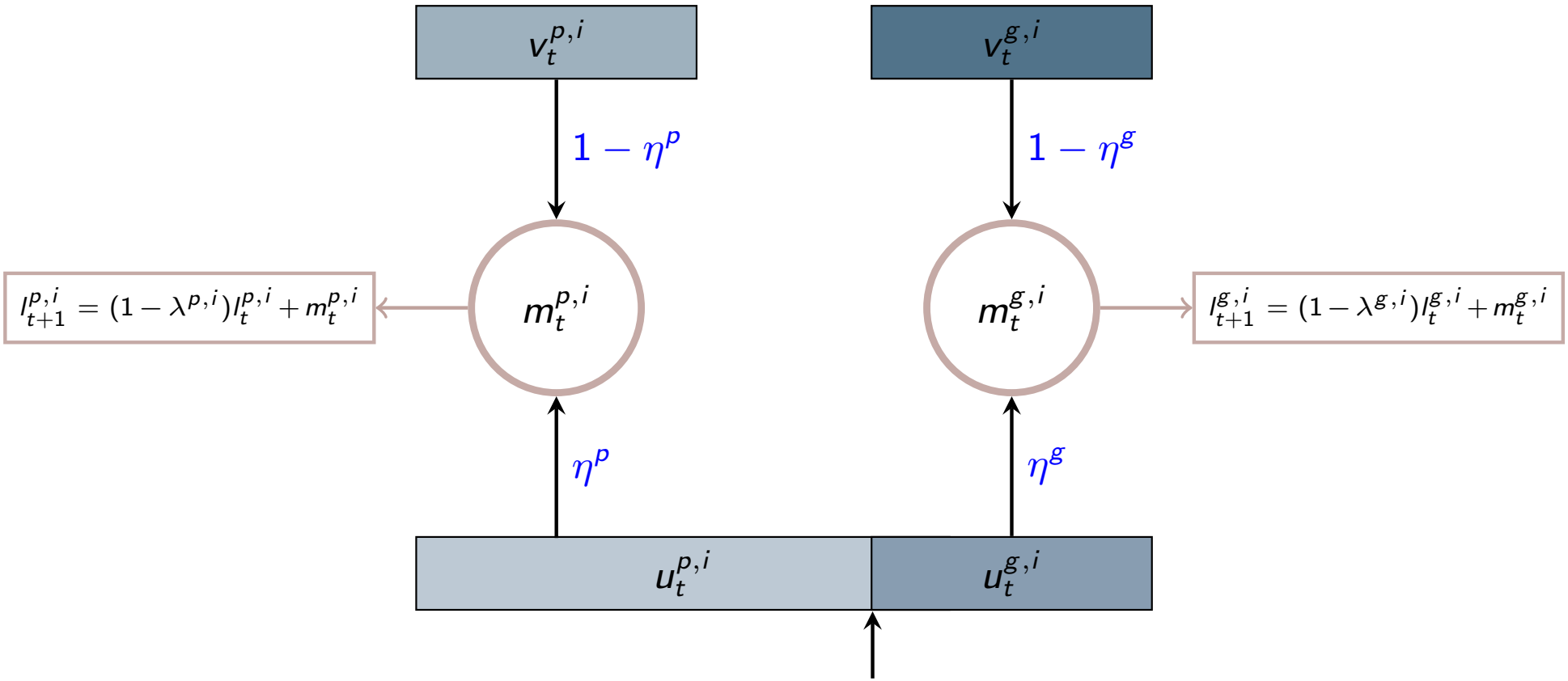


- Value of working in the two sectors ($w_{t+1}^{p,i}$, $w_{t+1}^{g,i}$, $\lambda^{p,i}$, $\lambda^{g,i}$)
- Probability of finding a job ($v_{t+1}^{p,i}$, $v_{t+1}^{g,i}$)
- Idiosyncratic preference for the public sector ($\gamma_t^i \sim \Gamma$)

## Household

- Accumulate capital ($K_t$)
- Choose consumption ($c_t$)
- Search of unemployed members ($s_t^i$)

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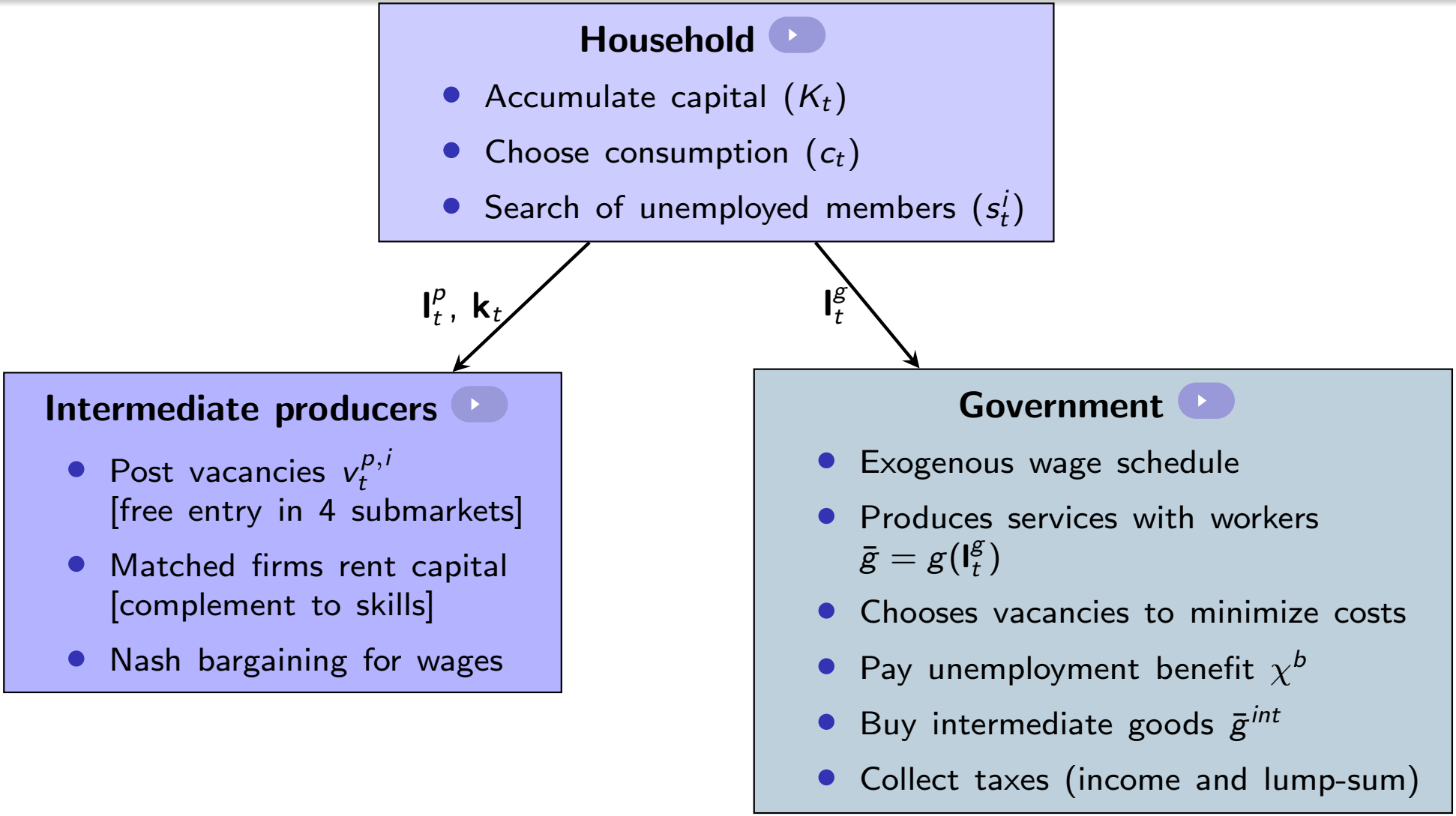
$\mathbf{l}_t^g$

## Government

- Exogenous wage schedule
- Produces services with workers $\bar{g} = g(\mathbf{l}_t^g)$
- Chooses vacancies to minimize costs
- Pay unemployment benefit $\chi^b$
- Buy intermediate goods $\bar{g}^{int}$
- Collect taxes (income and lump-sum)


Household
Accumulate capital ($K_t$)
Choose consumption ($c_t$)
Search of unemployed members ($s_t^i$)
$\mathbf{l}_t^p$, $\mathbf{k}_t$
$\mathbf{l}_t^g$
Intermediate producers
Post vacancies $v_t^{p,i}$ [free entry in 4 submarkets]
Matched firms rent capital [complement to skills]
Nash bargaining for wages
Government
Exogenous wage schedule
Produces services with workers $\bar{g} = g(\mathbf{l}_t^g)$
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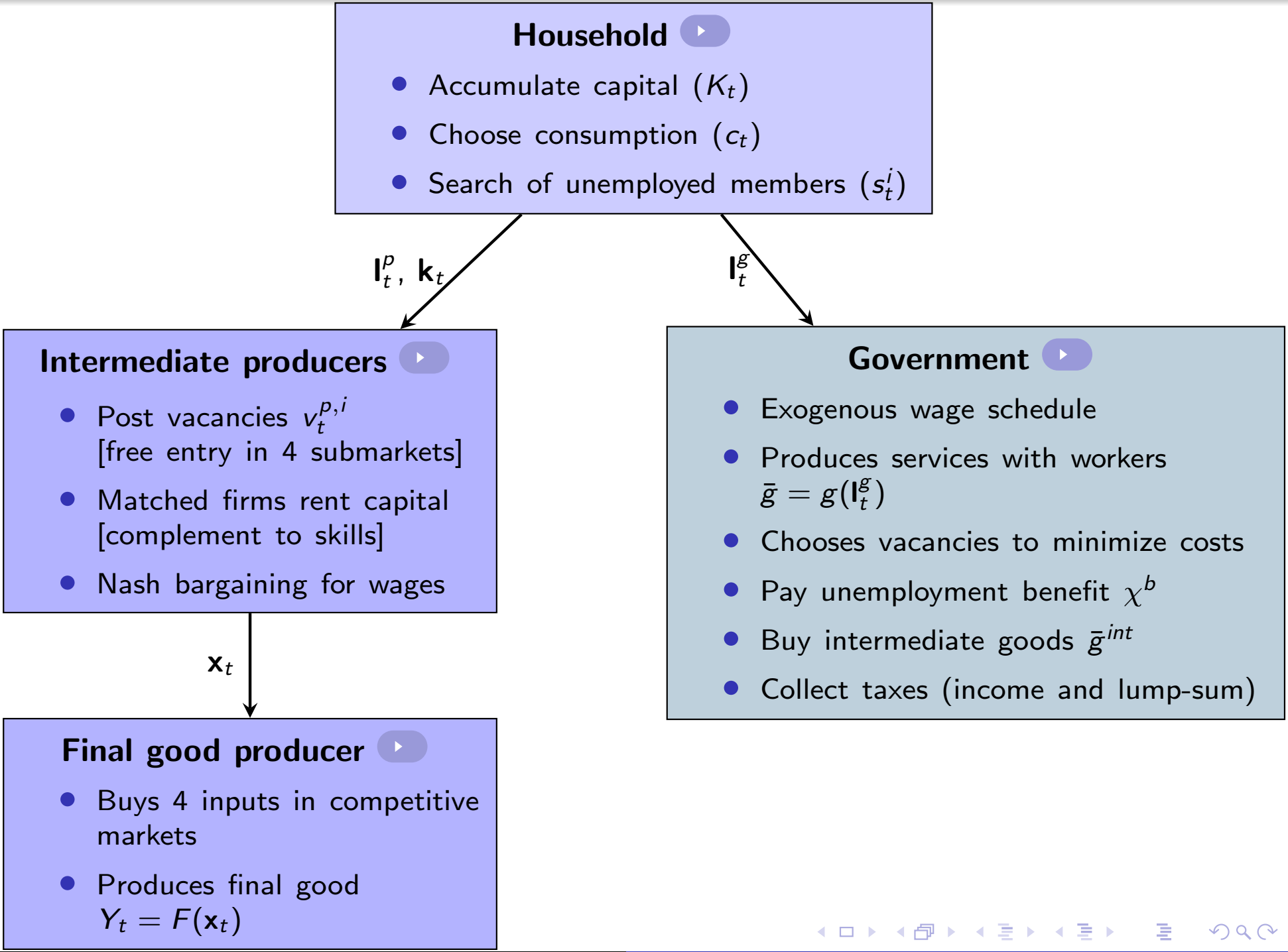
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Post vacancies $v_t^{p,i}$ [free entry in 4 submarkets]
Matched firms rent capital [complement to skills]
Nash bargaining for wages
$\mathbf{x}_t$
Final good producer
Buys 4 inputs in competitive markets
Produces final good $Y_t = F(\mathbf{x}_t)$
Government
Exogenous wage schedule
Produces services with workers $\bar{g} = g(\mathbf{l}_t^g)$
Chooses vacancies to minimize costs
Pay unemployment benefit $\chi^b$
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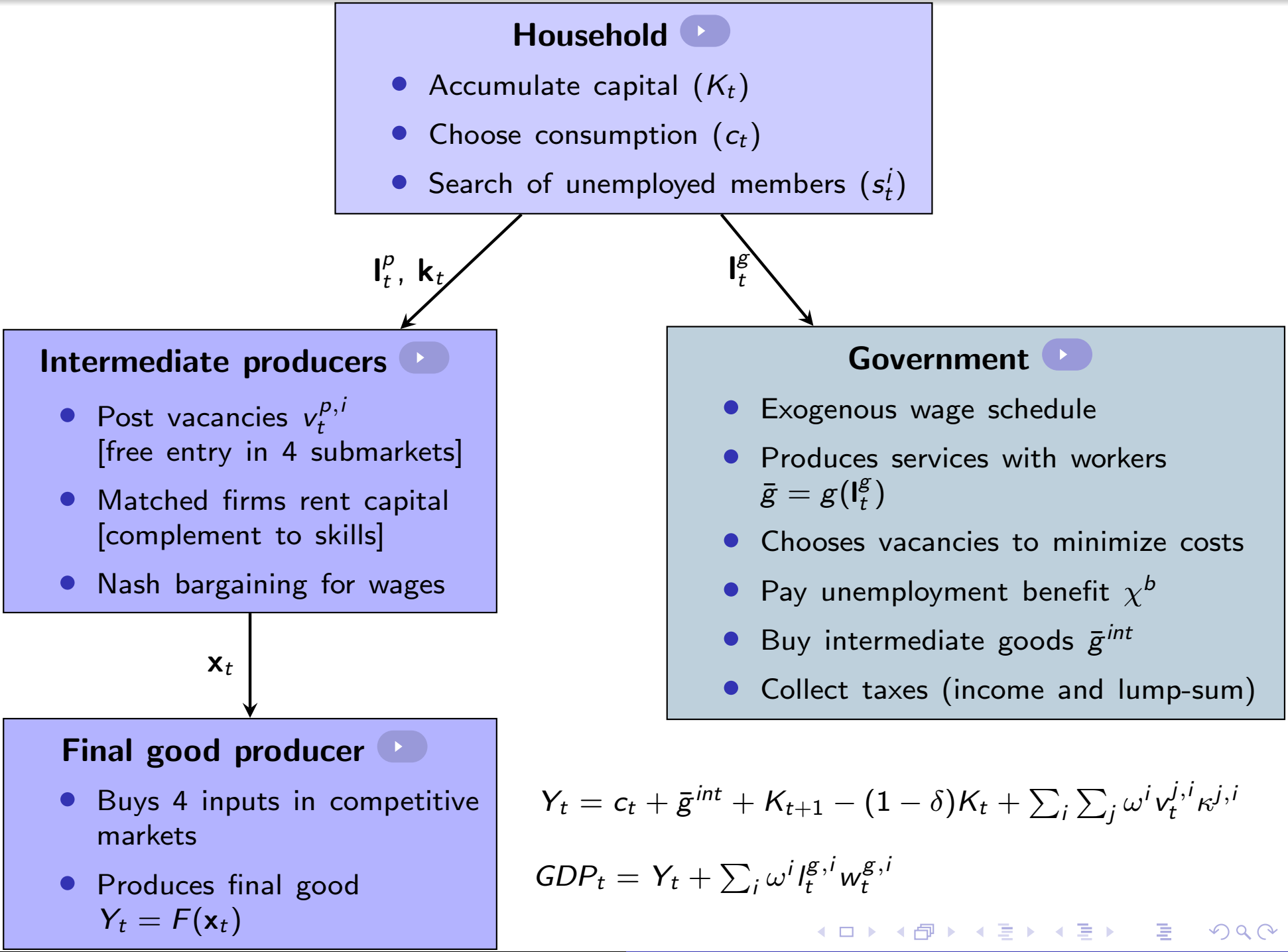



$$Y_t = c_t + \bar{g}^{int} + K_{t+1} - (1-\delta)K_t + \sum_i \sum_j \omega^i v_t^{j,i} \kappa^{j,i}$$

$$GDP_t = Y_t + \sum_i \omega^i l_t^{g,i} w_t^{g,i}$$

# Decentralised Equilibrium

## Definition

Given a sequence of policies of public wages $\{w_t^{g,i},\ \forall i\}_{t=o}^{\infty}$, unemployment benefits $\chi^b$, government services $\bar{g}$, intermediate purchases $\bar{g}^{int}$ and income tax $\bar{\tau}$ and a set of initial conditions $\{K_0, I_0^{p,i}, I_0^{g,i},\ \forall i\}$; a decentralised equilibrium is a sequence of prices $\{r_t, w_t^{p,i}, p_t^{x,i},\ \forall i\}_{t=o}^{\infty}$ and allocations $\{K_{t+1}, C_t, k_t^i, v_t^{p,i}, v_t^{g,i}, s_t^i,\ \forall i\}_{t=o}^{\infty}$ such that:

1-Representative household satisfies the Euler Equation.

2-Unemployed members of type $i$ choose which sector to search.

3-Matched intermediate goods' firms choose optimal capital for each type.

4-Free entry of intermediates goods' firms.

5-Private sector wages are the outcome of Nash bargaining.

6-Wholesale representative firm maximizes profits.

7-Government minimizes the cost of producing services.

8-Lump-sum taxes balance the budget.

9-Intermediate goods, final good and capital markets clear.

# Calibration

# Calibration: United Kingdom

**Frequency:** quarterly

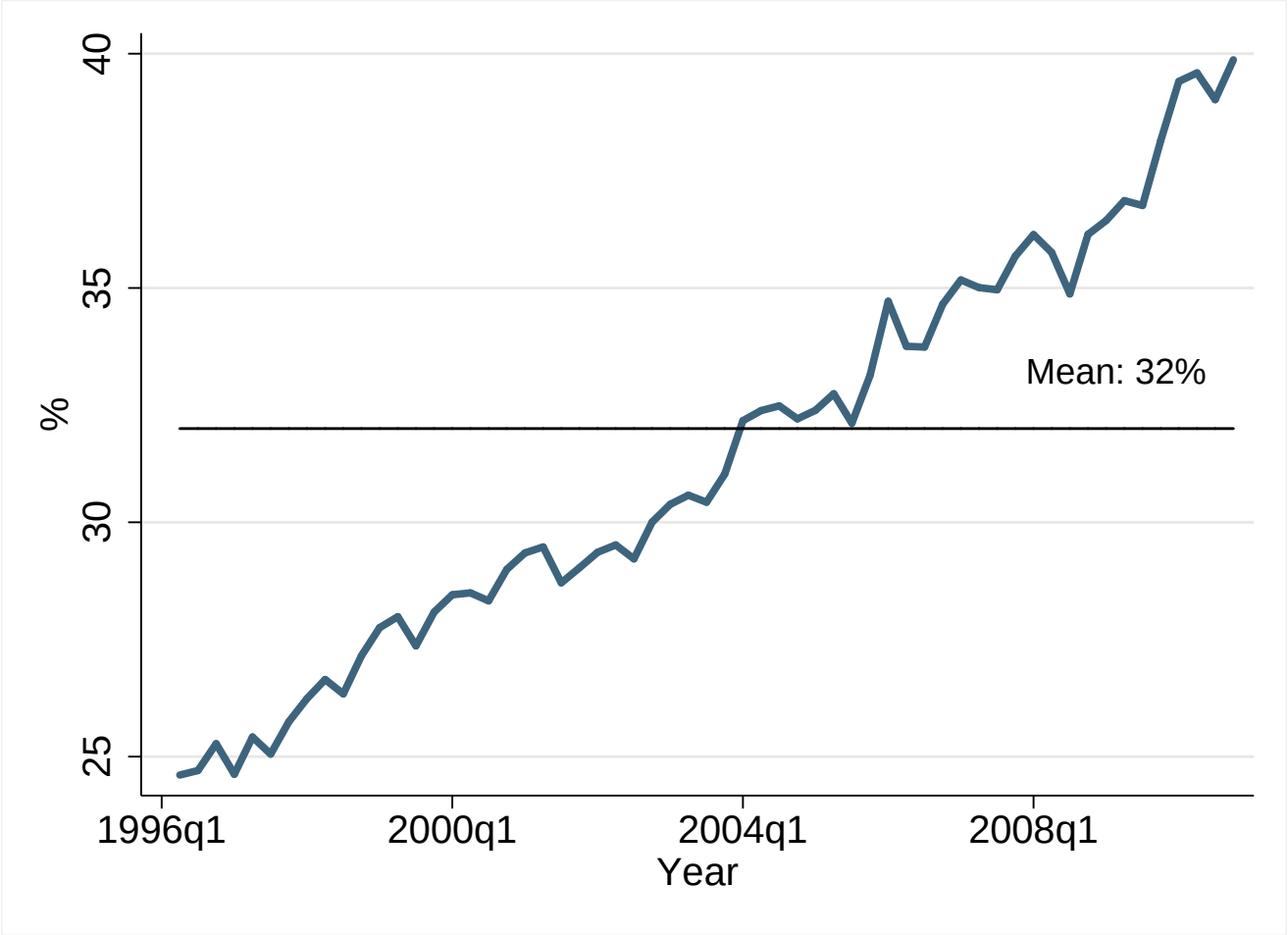
**Main source:** Labour Force Survey, microdata, 1996-2010.

$$F(\mathbf{x}_t) = \left(\Psi((x_t^{\bar{h}})^{\varrho} + (x_t^{\underline{h}})^{\varrho})^{\frac{\varsigma}{\varrho}} + (1-\Psi)((x_t^{\bar{\mu}})^{\varrho} + (x_t^{\underline{\mu}})^{\varrho})^{\frac{\varsigma}{\varrho}}\right)^{\frac{1}{\varsigma}}$$

$$g(\mathbf{l}_{t+1}^{g}) = \left(\Phi((\omega^{\bar{h}} z^{\bar{h}} l_{t+1}^{g,\bar{h}})^{\varrho} + (\omega^{\underline{h}} z^{\underline{h}} l_{t+1}^{g,\underline{h}})^{\varrho})^{\frac{\varsigma}{\varrho}} + (1-\Phi)((\omega^{\bar{\mu}} z^{\bar{\mu}} l_{t+1}^{g,\bar{\mu}})^{\varrho} + (\omega^{\underline{\mu}} z^{\underline{\mu}} l_{t+1}^{g,\underline{\mu}})^{\varrho})^{\frac{\varsigma}{\varrho}}\right)^{\frac{1}{\varsigma}}$$

# Share of educated workers

Figure: Share of college graduates in labour force

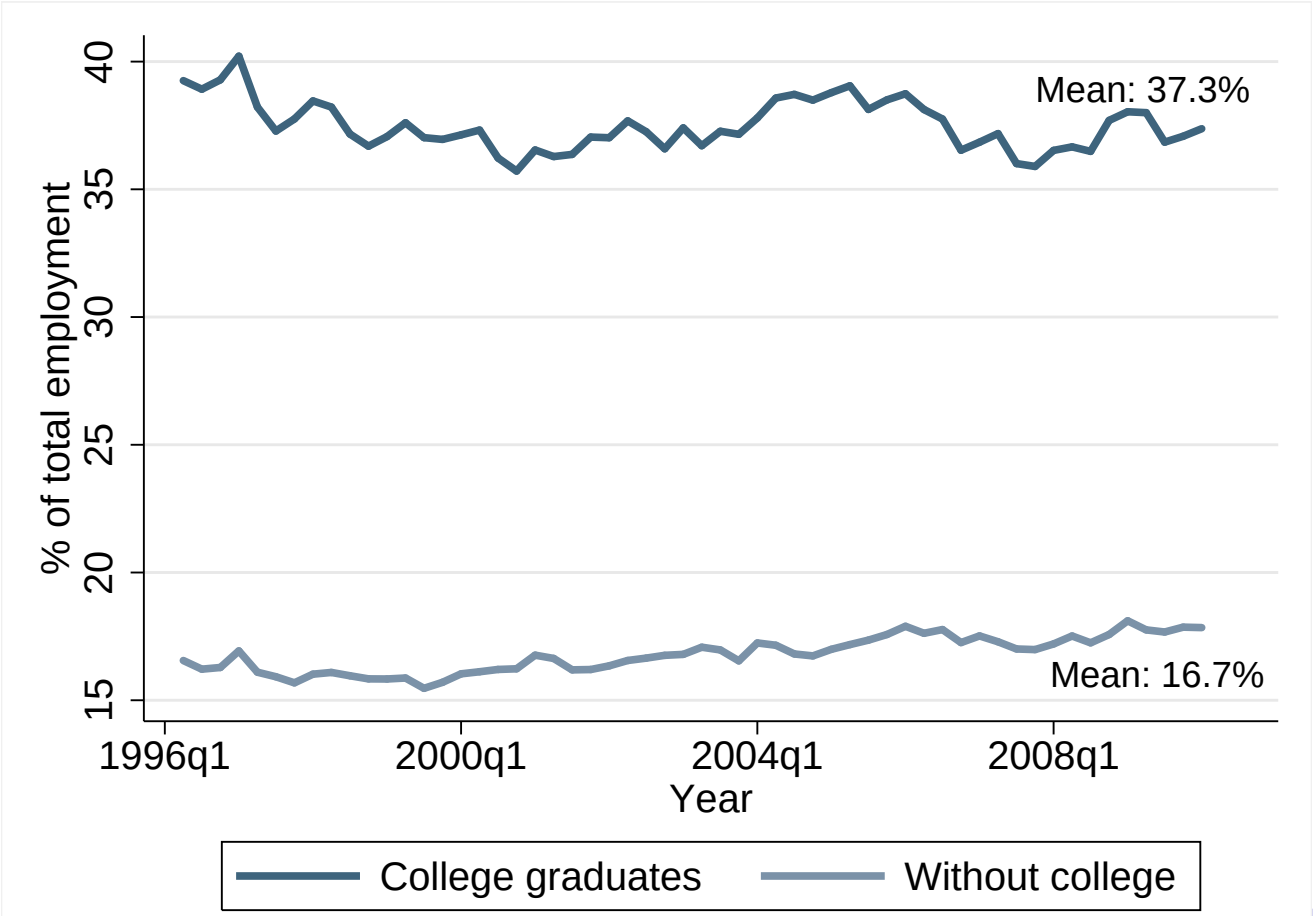



$[\omega^{\bar{h}} = \omega^{\underline{h}} = 0.16$ and $\omega^{\bar{\mu}} = \omega^{\underline{\mu}} = 0.34]$ [Robustness]

# Government production and services

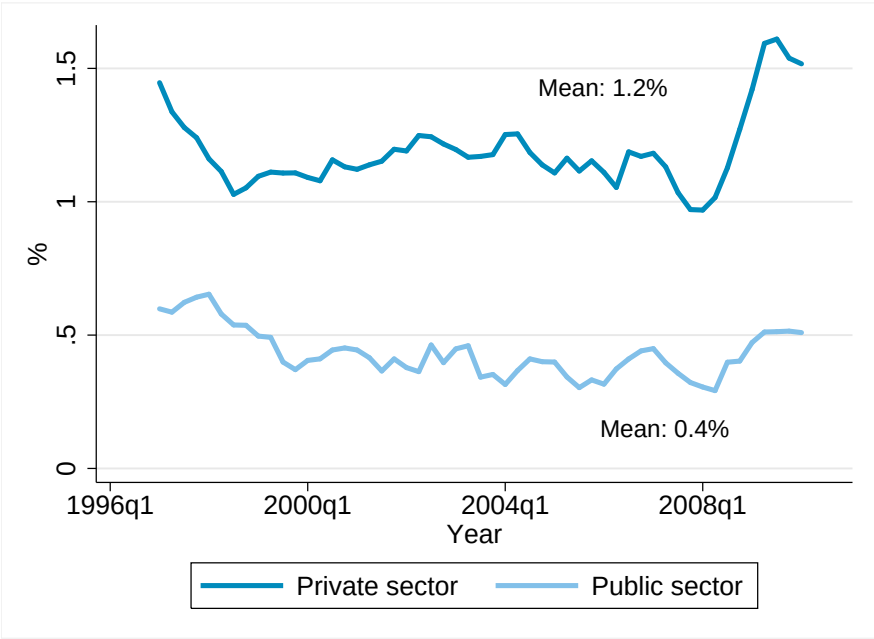
Steady-state level of government services ($\bar{g}$)
Importance of skill in production ($\Phi$)

Figure: Public employment by skill

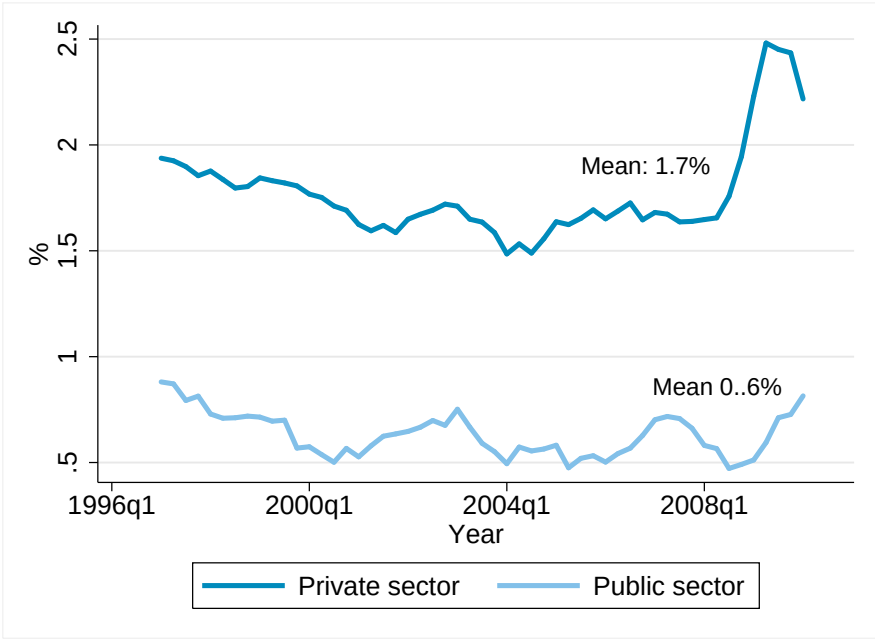


# Separation rates

Figure: Separation rates




(a) College degree




(b) Without college

$$[\lambda^{p,h} = 0.012,\ \lambda^{p,\mu} = 0.017,\ \lambda^{g,h} = 0.004,\ \lambda^{p,\mu} = 0.006.]$$

# Steady-state public sector wage premium

**Method**: quantile regressions of log net wages

Table: Estimation of public sector wage premium

| Education | Percentile | R-squared | Estimated Premium |
|---|---|---|---|
| **College educated** | 75 | 0.375 | 0.016 |
| Obs: 84236 | 25 | 0.456 | 0.039 |
| | | | |
| **Without college degree** | 75 | 0.488 | 0.037 |
| Obs: 209740 | 25 | 0.595 | 0.071 |

*Note: quantile regression of log net wages on several control variables and a dummy for public sector. Controls include: sex, industry and occupation dummies, status in previous quarter, tenure, age and its square, marital status, time and region dummies, average hours worked and its square. The sample from 1996 to 2006.*

$$[\frac{w^{g,\bar{h}}}{w^{p,\bar{h}}} = 1.016,\ \frac{w^{g,\underline{h}}}{w^{p,\underline{h}}} = 1.039,\ \frac{w^{g,\bar{\mu}}}{w^{p,\bar{\mu}}} = 1.037 \text{ and } \frac{w^{g,\underline{\mu}}}{w^{p,\underline{\mu}}} = 1.071]$$

[Robustness]

## Cost of posting vacancies and matching efficiency

Table: Cost per hire and vacancy duration by sector and worker type

| | Cost per hire (£) | | | Vacancy duration | | |
|---|---|---|---|---|---|---|
| Type of worker | Man. | Serv. | Public | Man. | Serv. | Public |
| Senior Managers - Directors | 13396 | 18963 | 10451 | 16.8 | 16.5 | 18 |
| Managers and professionals | 8049 | 12392 | 6066 | 12.1 | 11.8 | 14.3 |
| Administrative, Secretarial and Technical | 3680 | 5628 | 1934 | 6 | 5.2 | 9.1 |
| Services (costumer, personal and sales) | 4564 | 1398 | 2326 | 6.7 | 5.6 | 9.9 |
| Manual, craft workers | 2498 | 2978 | 1898 | 5.2 | 4.5 | 8.3 |

*Source: Chartered Institute of Personal Development, "Recruitment, retention and turnover survey", 2008 (Survey of 800 organizations: Manufacturing, Services and Public sector). Vacancy duration in weeks.*

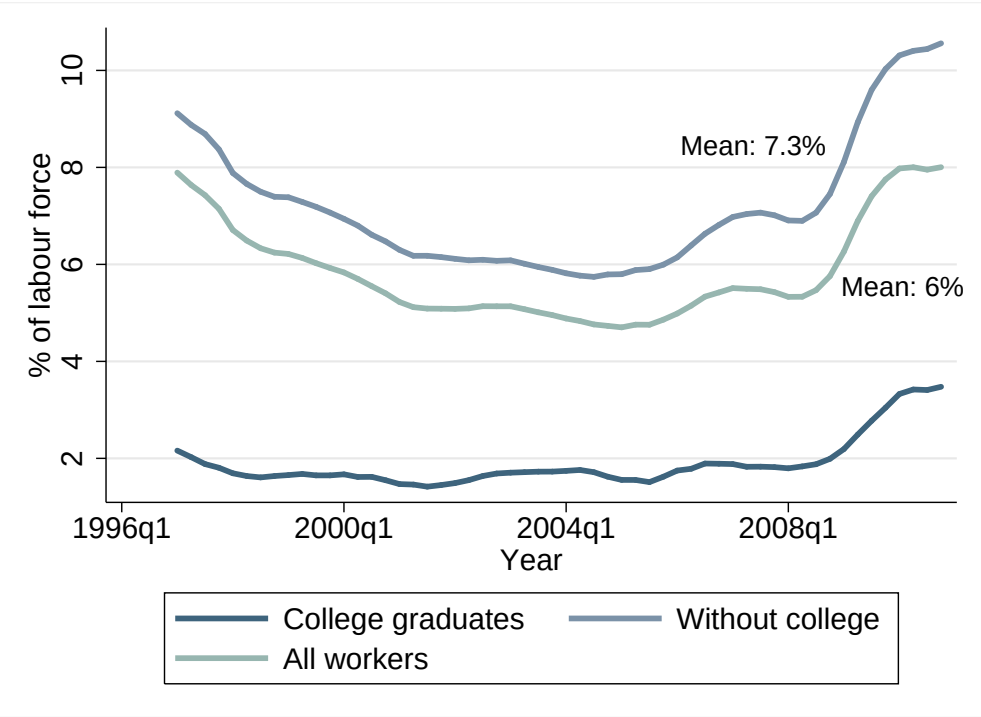
**Matching elasticities**: estimated by Gomes (2014), using JOLTS data.

$$[\kappa^{p,h} = 1.35,\ \kappa^{g,h} = 0.90,\ \kappa^{p,\mu} = 0.14,\ \kappa^{g,\mu} = 0.13]$$
$$[\zeta^{g,h} = 0.73,\ \zeta^{p,h} = 0.56,\ \zeta^{g,\mu} = 0.99 \text{ and } \zeta^{p,\mu} = 0.98]$$
$$[\eta^{p} = 0.4 \text{ and } \eta^{g} = 0.15]$$

# Flow value of unemployment

- Unemployment benefits ($\chi^b = 0.21$) $\rightarrow$ replacement rate of the low ability unskilled worker is 60 percent of the net wage [Salomaki and Munzi (1999)].
- Home production ($\chi^u = 0.37$) $\rightarrow$ unemployment rate of unskill workers.
- Bargaining power of workers ($b = 0.35$) $\rightarrow$ the overall unemployment rate.

Figure: Unemployment rate




Note: the flow value of unemployment is 40, 56-58 and 77 percent of the net wage.

# College premium

The parameter of the private production function $\Psi$ targets a college premium of 40 percent.

Regress log net wages on a dummy for college education, on average hours and its square

- Estimated coefficient: 0.394
- R-squared=0.64
- Observations=312070

# Wage dispersion

$z^{\underline{h}} = z^{\bar{\mu}} = 1$: Normalization.
$z^{\underline{\mu}}, z^{\bar{h}} \rightarrow$ measure of wage dispersion.

Table: Estimation of inter-quantile wage residual

| Education | R-squared | Obs. | 25-75 percentile residual difference Total (100%) |
|---|---|---|---|
| College educated | 0.600 | 44133 | 0.461 |
| Without college degree | 0.595 | 209740 | 0.416 |

*Note: regression of the log of net wages on several control variables: sex, industry and occupation dummies, status in previous quarter, tenure, age and its square, marital status, time and region dummies, average hours worked and its square. The sample from 1996 to 2006. The fourth column reports the 25-75 percentile difference of wage residuals.*

Is all wage dispersion due to unobserved heterogeneity?

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Table: Estimation of inter-quantile wage residual

| Education | R-squared | Obs. | 25-75 percentile residual difference | | |
|---|---|---|---|---|---|
| | | | Total (100%) | Adjusted (80%) | Adjusted (20%) |
| College educated | 0.600 | 44133 | 0.461 | 0.368 | 0.092 |
| Without college degree | 0.595 | 209740 | 0.416 | 0.332 | 0.083 |

*Note: regression of the log of net wages on several control variables: sex, industry and occupation dummies, status in previous quarter, tenure, age and its square, marital status, time and region dummies, average hours worked and its square. The sample from 1996 to 2006. The fourth column reports the 25-75 percentile difference of wage residuals.*

Is all wage dispersion due to unobserved heterogeneity?

- Benchmark: 80% of difference is due to unobserved heterogeneity.

stness : 100% and 20%

# Remaining parameters

## Technology parameters

- Elasticity of output w.r.t capital ($\alpha = 0.34$) $\rightarrow$ labour share of 61.8%.

- Elasticity of substitution
  - 1 between skilled and unskilled input. [Robustness]
  - 2 between high and low ability. [Robustness]

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## Standard parameters

- Discount factor ($\beta = 0.99$).
- Risk aversion ($\sigma = 2$).
- Depreciation rate ($\delta = 0.02$).
- Income tax ($\bar{\tau} = 0.2$).
- Purchase of intermediate inputs ($\bar{g}^{int} = 0.034$) $\rightarrow$ gov. consumption is 20 % of GDP

# Distribution of preferences for public sector

Benchmark: $\Gamma$ has a uniform distribution $[\nu_1, \nu_2]$

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*Google Trends*: Indexes of of keyword searches ▸ Other studies

- Index of "Jobs"
- Compound index for the public sector.

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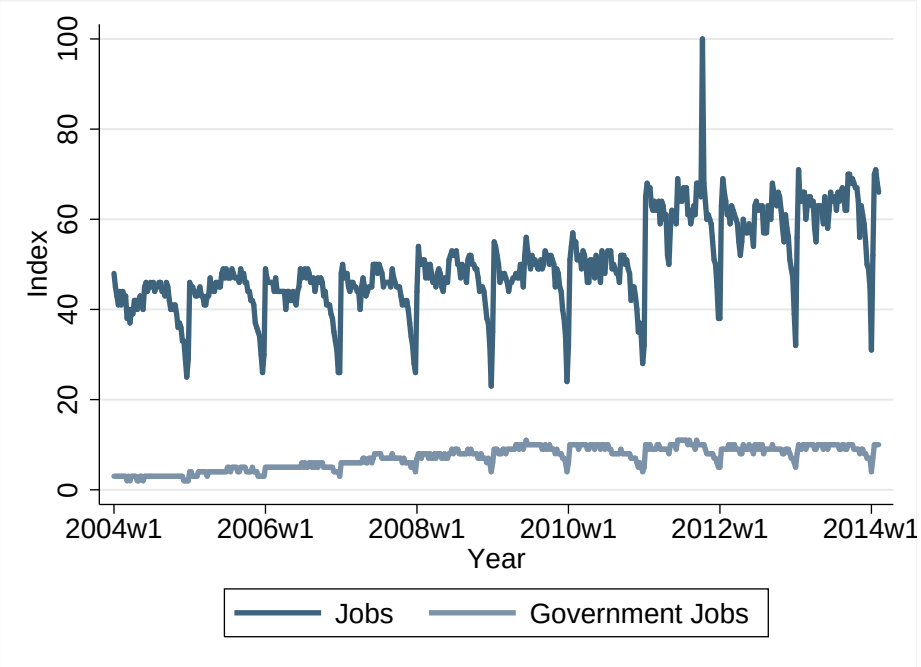
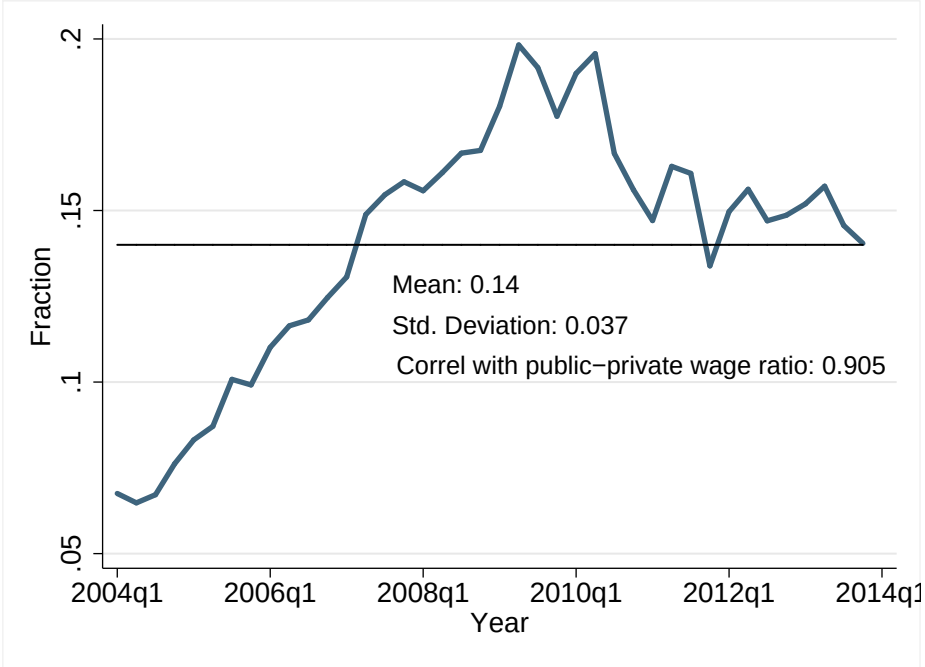
| **Keyword** | **Relative importance in index** |
|---|---|
| *nhs jobs* | 46% |
| *council jobs* | 32% |
| *jobs in nhs* | 5% |
| *gov jobs* | 4% |
| *public jobs* | 4% |
| *direct gov jobs* | 2% |
| *government jobs* | 2% |
| *army jobs* | 2% |
| *local government jobs* | 1% |
| *raf jobs* | 1% |

# Distribution of preferences for public sector

Figure: Google indexes




(a) Original indexes



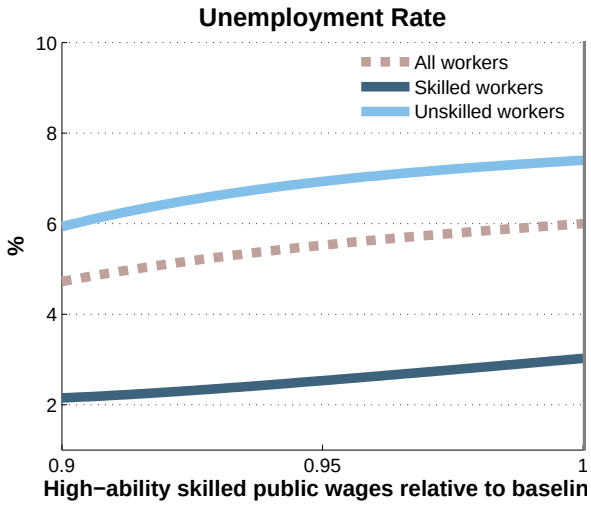

(b) Search in public sector

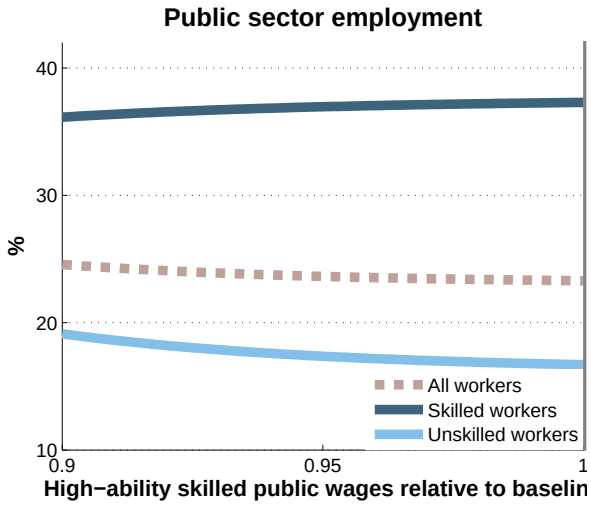
Benchmark: $\bar{s} = 0.14$ and $\nu_2 - \nu_1 = 2 \times \bar{w}$

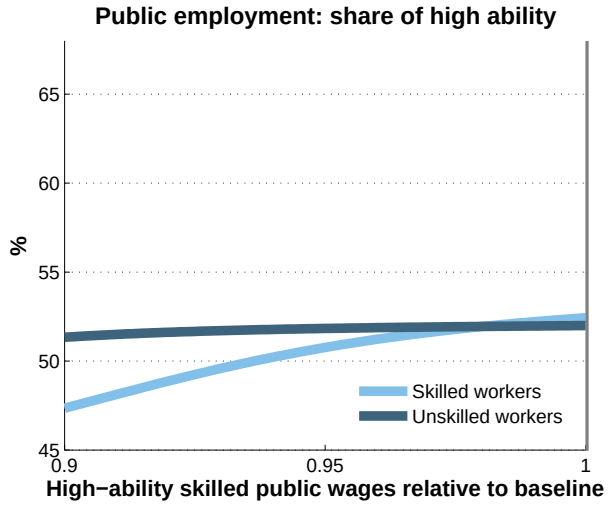
Robustness:

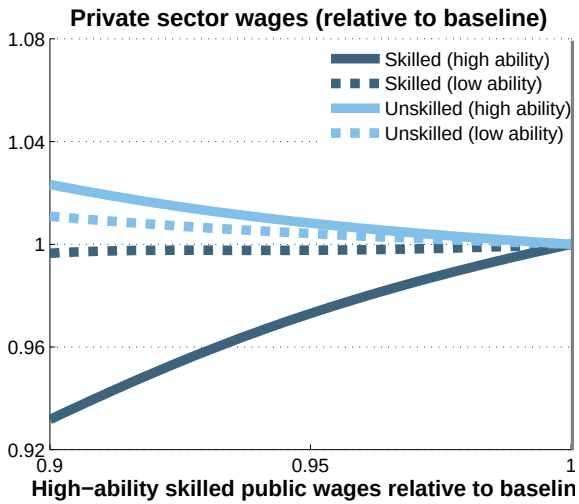
# Results

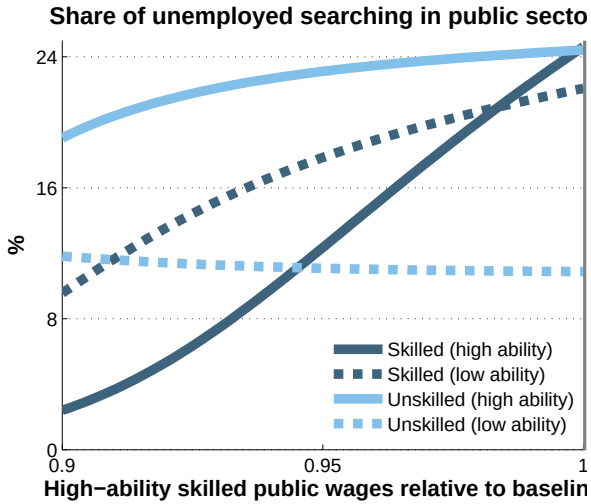
# S.S. Effects of skilled public sector wages

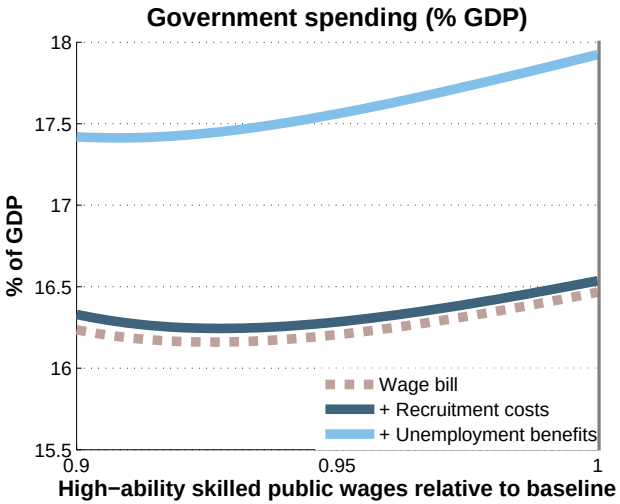


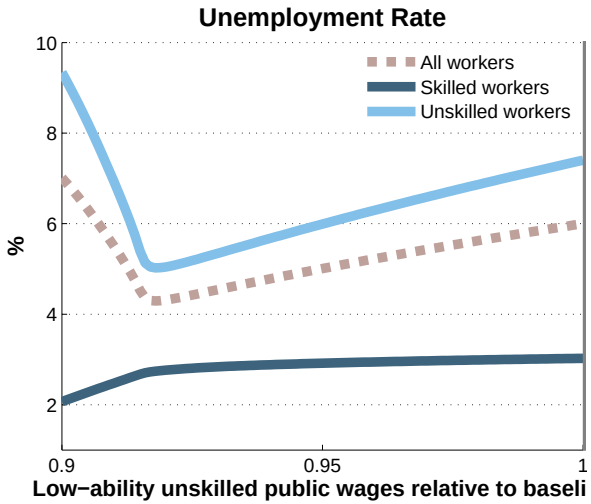



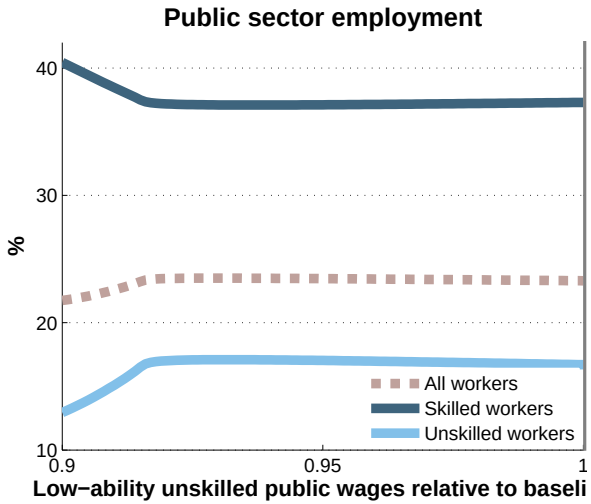



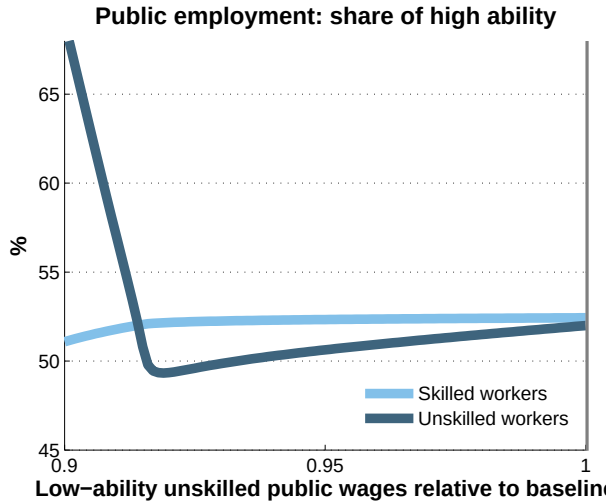



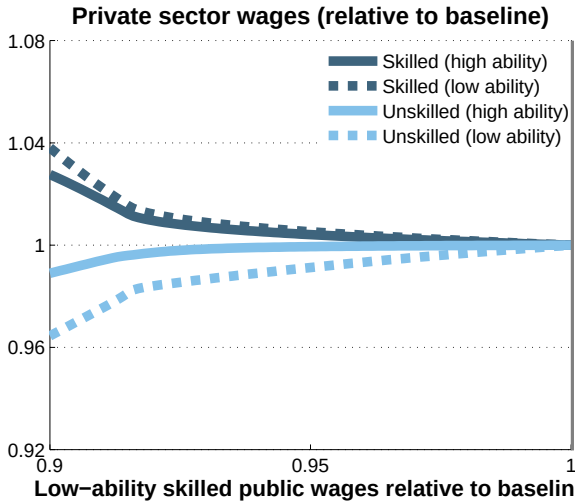



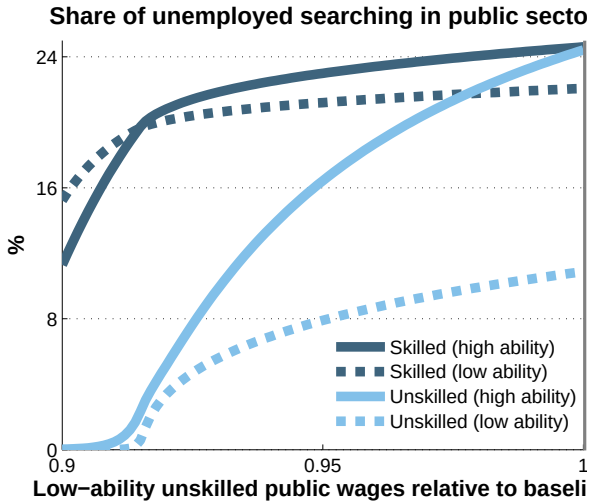
# S.S. Effects of unskilled public sector wages

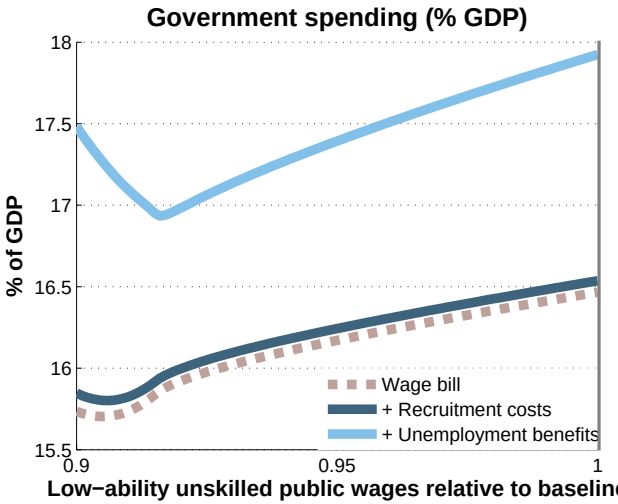


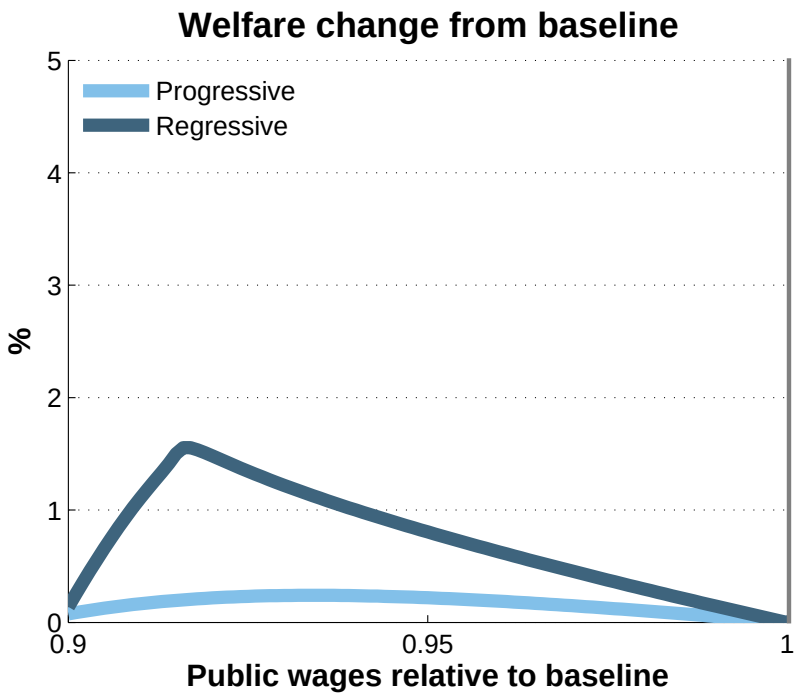



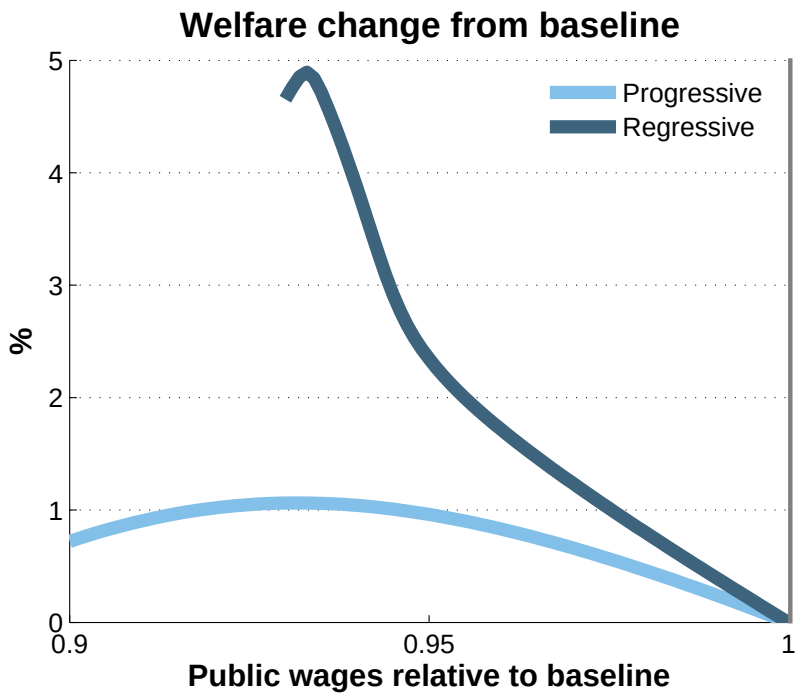



# Welfare effects

Figure: Welfare effects of public sector wages adjustments




(a) Lump-sum taxes




(b) Distortionary taxes

# Steady-state effects of a reform of public sector wages

| | | *Lump-Sum Taxes* | *Distortionary Taxes* |
|---|---|---|---|
| Public-private wage premium | Baseline | 0% | 0% |
| **Variables** | | | |
| Unemployment rate | **0.060** | **0.041** | **0.033** |
| Skilled | 0.030 | 0.024 | 0.023 |
| High-ability | 0.021 | 0.018 | 0.017 |
| Low-ability | 0.040 | 0.031 | 0.030 |
| Unskilled | 0.074 | 0.048 | 0.038 |
| High-ability | 0.015 | 0.008 | 0.008 |
| Low-ability | 0.133 | 0.088 | 0.067 |
| Consumption | - | +1.94% | +3.79% |
| Welfare Gains | - | 1.47% | 3.11% |

*Note: model simulations under the baseline calibration.* ** *given in percent of GDP.*

# Steady-state effects of a reform of public sector wages

| | | *Lump-Sum Taxes* | *Distortionary Taxes* |
|---|---|---|---|
| Public-private wage premium | Baseline | 0% | 0% |
| **Variables** | | | |
| Public employment | 0.233 | 0.236 | 0.236 |
| Skilled | 0.373 | 0.368 | 0.368 |
| High-ability | **0.391** | **0.394** | 0.394 |
| Low-ability | 0.355 | 0.342 | 0.342 |
| Unskilled | 0.167 | 0.174 | 0.174 |
| High-ability | 0.174 | 0.174 | 0.173 |
| Low-ability | **0.160** | **0.174** | 0.175 |

# Steady-state effects of a reform of public sector wages

| | | *Lump-Sum Taxes* | *Distortionary Taxes* |
|---|---|---|---|
| Public-private wage premium | Baseline | 0% | 0% |
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| High-ability | **0.391** | **0.394** | 0.394 |
| Low-ability | 0.355 | 0.342 | 0.342 |
| Unskilled | 0.167 | 0.174 | 0.174 |
| High-ability | 0.174 | 0.174 | 0.173 |
| Low-ability | **0.160** | **0.174** | 0.175 |
| Government* | | | |
| Wage bill | 0.165 | 0.158 | 0.158 |
| + recruitment costs | 0.165 | 0.159 | 0.158 |
| + unemployment benefits | 0.179 | 0.168 | 0.166 |
| Income taxes | 0.2 | 0.2 | 0.186 |
| Implied public [private] sector wage change | | | |
| Skilled (high-ability) | - | 0.5% [1.1%] | 1.7% [3.4%] |
| Skilled (low-ability) | - | -5.1% [-1.4%] | -3.1% [0.7%] |
| Unskilled (high-ability) | - | -3.1% [0.4%] | -1.5% [2.2%] |
| Unskilled (low-ability) | - | -8.1% [-1.6%] | -8.1% [-1.5%] |

# Robustness

- Elasticity of substitution between abilities [both sectors, only public sector]
  ($\rho = 0.8$,$\rho = 0.3$)
- Elasticity of substitution between skills [both sectors, only public sector]
  ($\varsigma = -0.4$,$\varsigma = 0.4$)
- Search in public sector
  ($s = 0.07$,$s = 0.21$)
- Dispersion in preferences for public sector
  ($\nu_2 - \nu_1 = 3 \times \bar{w}$, $\nu_2 - \nu_1 = 0.2 \times \bar{w}$)
- Share of skilled in economy
  ($\omega^{\bar{h}} = \omega^{\underline{h}} = 0.12.5$, $\omega^{\bar{h}} = \omega^{\underline{h}} = 0.20$)
- Heterogeneity in ability
  ($\bar{w}^{p,\bar{h}}/\bar{w}^{p,\underline{h}} = 1.09$, $\bar{w}^{p,\bar{\mu}}/\bar{w}^{p,\underline{\mu}} = 1.08$, $\bar{w}^{p,\bar{h}}/\bar{w}^{p,\underline{h}} = 1.46$, $\bar{w}^{p,\bar{\mu}}/\bar{w}^{p,\underline{\mu}} = 1.42$)
- Lower baseline premium
  ($\bar{w}^{g,\bar{h}}/\bar{w}^{p,\bar{h}} = 0.986$, $\bar{w}^{g,\underline{h}}/\bar{w}^{p,\underline{h}} = 1.009$, $\bar{w}^{g,\bar{\mu}}/\bar{w}^{p,\bar{\mu}} = 1.007$, $\bar{w}^{g,\underline{\mu}}/\bar{w}^{p,\underline{\mu}} = 1.041$)
- No dispersion in premium
  ($\bar{w}^{g,\bar{h}}/\bar{w}^{p,\bar{h}} = 1.03$, $\bar{w}^{g,\underline{h}}/\bar{w}^{p,\underline{h}} = 1.03$, $\bar{w}^{g,\bar{\mu}}/\bar{w}^{p,\bar{\mu}} = 1.03$, $\bar{w}^{g,\underline{\mu}}/\bar{w}^{p,\underline{\mu}} = 1.03$)

# Robustness

| Scenario | Lump-sum taxes | | | Distortionary taxes | | |
|---|---|---|---|---|---|---|
| | Unemployment rate | Consumption | Welfare | Unemployment rate | Consumption | Welfare |
| *Elasticity of substitution between abilities [both sectors]* | | | | | | |
| $\varsigma = 0.4$ | -2.0pp | 1.9% | 1.4% | -2.8pp | 3.8% | 3.1% |
| $\varsigma = -0.4$ | -1.8pp | 1.9% | 1.5% | -2.6pp | 3.7% | 3.1% |
| *Elasticity of substitution between abilities [only public sector]* | | | | | | |
| $\varsigma^g = 0.4$ | -2.0pp | 1.9% | 1.4% | -2.8pp | 3.7% | 3.0% |
| $\varsigma^g = -0.4$ | -1.8pp | 1.9% | 1.5% | -2.6pp | 3.8% | 3.1% |
| *Elasticity of substitution between skills [both sectors]* | | | | | | |
| $\varrho = 0.8$ | -2.3pp | 2.3% | 1.8% | -3.2pp | 4.5% | 3.7% |
| $\varrho = 0.3$ | -1.7pp | 1.8% | 1.3% | -2.4pp | 3.5% | 2.9% |
| *Elasticity of substitution between skills [only public sector]* | | | | | | |
| $\varrho^g = 0.8$ | -1.9pp | 1.9% | 1.5% | -2.7pp | 3.7% | 3.0% |
| $\varrho^g = 0.3$ | -1.9pp | 1.9% | 1.5% | -2.7pp | 3.8% | 3.1% |
| *Search in the public sector* | | | | | | |
| $\bar{s} = 0.07$ | -1.3pp | 1.3% | 1.0% | -2.0pp | 3.0% | 2.5% |
| $\bar{s} = 0.21$ | -2.1pp | 2.1% | 1.6% | -2.9pp | 4.0% | 3.3% |

*Note: model simulations under alternative calibrations. For each scenario the model was re-calibrated according to Section 3. The table reports the steady-state change of implementing a zero public sector wage premium for all workers relative to baseline of: unemployment rate (percentage points), consumption (percent) and welfare (percent of consumption equivalent*

# Robustness

| Scenario | Lump-sum taxes | | | Distortionary taxes | | |
|---|---|---|---|---|---|---|
| | Unemployment rate | Consumption | Welfare | Unemployment rate | Consumption | Welfare |
| *Dispersion in preferences for public sector* | | | | | | |
| $\nu_2 - \nu_1 = 3 \times \bar{w}$ | -2.0pp | 2.0% | 1.5% | -2.8pp | 3.9% | 3.2% |
| $\nu_2 - \nu_1 = 0.2 \times \bar{w}$ | -1.4pp | 1.5% | 1.1% | -2.2pp | 3.2% | 2.7% |
| *Share of skilled workers* | | | | | | |
| $\omega^{\bar{h}} = \omega^{\underline{h}} = 0.125$ | -2.3pp | 2.2% | 1.6% | -3.3pp | 4.4% | 3.6% |
| $\omega^{\bar{h}} = \omega^{\underline{h}} = 0.20$ | -1.6pp | 1.7% | 1.3% | -2.2pp | 3.2% | 2.7% |
| *Heterogeneity in ability* | | | | | | |
| $\frac{\bar{w}^{p,\bar{i}}}{\bar{w}^{p,\underline{i}}} = 1.09 - 1.08$ | -2.2pp | 2.6% | 2.0% | -3.2pp | 5.0% | 4.1% |
| $\frac{\bar{w}^{p,\bar{i}}}{\bar{w}^{p,\underline{i}}} = 1.46 - 1.42$ | -1.9pp | 1.8% | 1.4% | -2.6pp | 3.5% | 2.9% |
| *Lower average premium* | | | | | | |
| Baseline-3% | -0.7pp | 0.8% | 0.6% | -1.0pp | 1.4% | 1.1% |
| *No dispersion in premium* | | | | | | |
| Premium=3% | -1.3pp | 1.3% | 0.9% | -1.9pp | 2.7% | 2.2% |

*Note: model simulations under alternative calibrations. For each scenario the model was re-calibrated according to Section 3. The table reports the steady-state change of implementing a zero public sector wage premium for all workers relative to baseline of: unemployment rate (percentage points), consumption (percent) and welfare (percent of consumption equivalent variation).*

# How about inequality?

*Why is the public sector wage distribution so distorted?*

*Why is it hard to defend cutting the lowest public sector wages ?*

**Key insight:**

- The government has a redistributive role, but not all instruments have to be redistributive (Mirlees report).
- If the government wants to fight inequality, it should use the income tax system, or potentially, other regulatory policy (minimum wage).
- Using public sector wages does not solve the problem, and creates inefficiencies in the labour market.

$$\Omega_t^i = l_t^{p,i} W_t^{p,i} + l_t^{g,i} W_t^{g,i} + u_t^i U_t^i, \quad \forall i. \tag{1}$$

# Effects of reform on labour market value

| | | *Alternative tax scenarios* | | |
|---|---|---|---|---|
| Public-private wage premium | Baseline | (1) | (2) | (3) |
| **Variables** | | | | |
| Taxation | | | | |
| Capital tax rate | 0.200 | 0.186 | 0.200 | 0.200 |
| Income tax rate | | | | |
| Skilled (high-ability) | 0.200 | 0.186 | 0.177 | 0.200 |
| Skilled (low-ability) | 0.200 | 0.186 | 0.177 | 0.200 |
| Unskilled (high-ability) | 0.200 | 0.186 | 0.177 | 0.200 |
| Unskilled (low-ability) | 0.200 | 0.186 | 0.177 | 0.074 |
| Unemployment rate | 0.060 | 0.033 | 0.032 | 0.018 |
| Consumption | 3.854 | +3.8% | +2.9% | +4.4% |
| Welfare Gains | - | 3.1% | 2.2% | 3.3% |
| Labour market value of type | | | | |
| Skilled (high-ability) | 642 | +5.1% | +4.6% | +3.1% |
| Skilled (low-ability) | 457 | +0.5% | +0.0% | -1.1% |
| Unskilled (high-ability) | 410 | +3.5% | +3.2% | +1.0% |
| Unskilled (low-ability) | 303 | +1.5% | +1.0% | +10.3% |

# Conclusion

I propose a reform of public sector wage:

- Aligning the distribution of public sector wages with the private sector reduces steady-state unemployment rate by 1.9 percentage points, particularly of the low-ability unskilled.
  - Reduces the distortions in the labour market.
  - Gives the incentive for governments to hire more unskilled workers.
  - Gives the ability for governments to hire more skilled workers.

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  - Reduces the distortions in the labour market.
  - Gives the incentive for governments to hire more unskilled workers.
  - Gives the ability for governments to hire more skilled workers.
- With such substantial gains, why don't governments implement it?
  - Worry about inequality.
  - Political economy issues.

# Additional material

# Adverse selection with labour market friction

- Guerrieri, Shimer and Wright (2010), use hours worked as the self-selection mechanism (disutility of work).
- Michelacci and Suarez (2006), use the wage setting (wage posting attracts the low type and wage bargaining attract the high type)
- Fernandez-Blanco and Gomes (2013) use capital as the self-selection mechanism.

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# Households

Consumption is pooled between the members of the household (Merz, 1995). Preferences are:

$$E_0 \sum_{t=0}^{\infty} \beta^t [\frac{c_t^{1-\sigma}}{1-\sigma} + \chi^u u_t],$$

Budget constraint:

$$c_t + K_{t+1} = (1-\delta)K_t + (1-\tau_t)\left(r_t K_t + \sum_j \sum_i \omega^i w_t^{j,i} l_t^{j,i}\right) + \sum_i \omega^i \chi^g u_t + \Pi_t,$$

Optimality conditions:

$$u_c(c_t) = \beta E_t[u_c(c_{t+1})(1-\delta + r_{t+1}(1-\tau_{t+1})], \tag{2}$$

$$\chi_t^u = \frac{\chi^u}{u_c(c_t)} \tag{3}$$

# Households members: value functions

$$W_t^{j,i} = (1-\tau_t)w_t^{j,i} + E_t\beta_{t,t+1}[(1-\lambda^{j,i})W_{t+1}^{j,i} + \lambda^{j,i}U_{t+1}^i], \quad \forall i,j, \tag{4}$$

$$U_t^{j,i} = \chi_t^u + \chi^b + E_t\beta_{t,t+1}[f_t^{j,i}W_{t+1}^{j,i} + (1-f_t^{j,i})U_{t+1}^i], \quad \forall i,j, \tag{5}$$

(6)

# Households members: value functions

$$W_t^{j,i} = (1-\tau_t)w_t^{j,i} + E_t\beta_{t,t+1}[(1-\lambda^{j,i})W_{t+1}^{j,i} + \lambda^{j,i}U_{t+1}^i], \quad \forall i,j, \tag{4}$$

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**Unemployed choose which sector to search**

$$U_t^{p,i} = U_t^{g,i} \tag{6}$$

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$$U_t^{j,i} = \chi_t^u + \chi^b + E_t\beta_{t,t+1}[f_t^{j,i}W_{t+1}^{j,i} + (1-f_t^{j,i})U_{t+1}^i], \quad \forall i,j, \tag{5}$$

**Unemployed choose which sector to search**

$$U_t^{p,i} = U_t^{g,i} + \gamma_t^i, \quad \forall i. \tag{6}$$

$\gamma_t^i$: random variable with cumulative distribution $\Gamma$ (idiosyncratic preference for the public sector).

**Shortcut**: without it search is too responsive.

# Households members

$\gamma_t^{i,*}$: the cut-off point of the distribution given by;

$$\gamma_t^{i,*} = f_t^{p,i} E_t \beta_{t,t+1} [W_{t+1}^{p,i} - U_{t+1}^i] - f_t^{g,i} E_t \beta_{t,t+1} [W_{t+1}^{g,i} - U_{t+1}^i], \quad \forall i. \quad (7)$$

The fraction on unemployed searching in the public sector $s_t^i$ is:

$$s_t^i \equiv \frac{u_t^{g,i}}{u_t^i} = 1 - \Gamma(\gamma_t^{i,*}), \quad \forall i, \quad (8)$$

The ex-ante value of unemployment:

$$U_{t+1}^i = s_{t+1}^i U_{t+1}^{g,i} + (1 - s_{t+1}^i) U_{t+1}^{p,i}, \quad \forall i, \quad (9)$$

Go Back

# Intermediate good producers

- Large continuum of firms.
- Produce one of four types of intermediate goods $x_t^i$ that is sold at price $p_t^{x,i}$.
- Pay a cost $\kappa^{p,i}$ to open vacancies $v_t^{p,i}$, in a given sub-market $i$.
- If the vacancy is filled, the firm is matched to a type-$i$ worker, chooses capital, and produces $f(a, z^i, k_t^i)$ .
- $f(a, z^i, k_t^i)$ is increasing and concave in all its arguments with a positive cross partial derivative of capital and skill (there is an optimal capital for each worker).
- Surplus is shared: wages $(w_t^{p,i})$ are determined by Nash Bargaining.

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- If the vacancy is filled, the firm is matched to a type-$i$ worker, chooses capital, and produces $f(a, z^i, k_t^i) = az^i(k_t^i)^\alpha$.
- $f(a, z^i, k_t^i)$ is increasing and concave in all its arguments with a positive cross partial derivative of capital and skill (there is an optimal capital for each worker).
- Surplus is shared: wages ($w_t^{p,i}$) are determined by Nash Bargaining.

# Intermediate good producers

$$V_t^i = -\kappa^{p,i} + E_t \beta_{t,t+1}[q_t^{p,i} J_{t+1}^i + (1 - q_t^{p,i}) V_{t+1}^i], \quad \forall i. \tag{10}$$

$$J_t^i = \max_{k_t^i}[p_t^{x,i} f^i(a_t, z^i, k_t^i) - w_t^{p,i} - r_t k_t^i + E_t \beta_{t,t+1}[(1-\lambda^{p,i}) J_{t+1}^i], \quad \forall i. \tag{11}$$

Optimal capital:

$$p_t^{x,i} f_k^i(a_t, z^i, k_t^{*i}) = r_t, \quad \forall i. \tag{12}$$

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$$J_t^i = p_t^{x,i} f^i(a_t, z^i, k_t^{*i}) - w_t^{p,i} - r_t k_t^{*i} + E_t \beta_{t,t+1}[(1 - \lambda^{p,i}) J_{t+1}^i, \quad \forall i. \tag{14}$$

Optimal capital:

$$p_t^{x,i} f_k^i(a_t, z^i, k_t^{*i}) = r_t, \quad \forall i. \tag{15}$$

# Intermediate good producers

**Private sector vacancies satisfy the free entry condition:** $V_t = 0, \quad \forall i.$

**Nash wage bargaining between workers and firms**:

$$(W_t^{p,i} - U_t^i) = \frac{b(1-\tau_t^l)}{1-b\tau_t^l}(W_t^{p,i} - U_t^i + J_t^i), \quad \forall i. \tag{16}$$

▸ Go Back

# Wholesale firm

- Buys the 4 intermediate goods to produce a wholesale good

$$\max_{\mathbf{x}_t}[F(\mathbf{x}_t) - \sum_i \tilde{p}_t^{x,i} x_t^i], \tag{17}$$

$$F'_{x^i} = \tilde{p}_t^{x,i}, \quad \forall i. \tag{18}$$

Go Back

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$$\max_{\mathbf{x}_t}[F(\mathbf{x}_t) - \sum_i \tilde{p}_t^{x,i} x_t^i], \tag{17}$$

$$F'_{x^i} = \tilde{p}_t^{x,i}, \quad \forall i. \tag{18}$$

$$F(\mathbf{x}_t) = \left( \underbrace{\Psi((x_t^{\bar{h}})^{\varrho} + (x_t^{\underline{h}})^{\varrho})^{\frac{\varsigma}{\varrho}}}_{\text{Skilled}} + \underbrace{(1-\Psi)((x_t^{\bar{\mu}})^{\varrho} + (x_t^{\underline{\mu}})^{\varrho})^{\frac{\varsigma}{\varrho}}}_{\text{Unskilled}} \right)^{\frac{1}{\varsigma}}$$

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# Government

- Needs to produce a minimum level of services $\bar{g}$.
- Wages $w^{g,i}$ are the exogenous policy variables.
- Chooses the vacancies of each type of worker at time $t$ to minimize the total cost of providing the government services.

$$\min_{v_t^{g,i}} \sum_i \omega^i \kappa^i v_t^{g,i} + \beta_{t,t+1} \left[ \sum_i \omega^i w_{t+1}^{g,i} l_{t+1}^{g,i} \right]$$

$$s.t.$$

$$\bar{g} = g(\mathbf{l}_{t+1}^{g})$$

$$l_{t+1}^{g,i} = (1 - \lambda^{j,i}) l_t^{g,i} + q_t^{g,i} v_t^{g,i}, \quad \forall i.$$

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Two opposite effects of public wages

- Wage bill effect.
- Recruitment effect.

# Government

First-order conditions:

$$\frac{\omega^i \kappa^{g,i}}{q_t^{g,i}} + E_t \beta_{t,t+1} [\omega^i w_{t+1}^{g,i}] = \zeta_t E_t g'_{i,t+1}, \quad \forall i \tag{19}$$

**Spending**: wage bill, recruitment costs, unemployment benefits and exogenous purchases of goods.

**Revenue**: income taxes (distort the wage bargaining and capital accumulation) and lump-sum taxes (balance the budget).

$$\underbrace{\tau_t \left( \sum_j \sum_i \omega^i l_t^{j,i} w_t^{j,i} + r_t K_t \right) + T_t}_{\text{Income taxes + Lump-sum}} = \underbrace{\sum_i \omega^i l_t^{g,i} w_t^{g,i}}_{\text{Wage bill}} + \underbrace{\sum_i \omega^i v_t^{g,i} \kappa^{g,i}}_{\text{Recruitment costs}} + \underbrace{\sum_i \chi^b \omega^i u_t^i}_{\text{U Benefits}} + \underbrace{\bar{g}^{int}}_{\text{Int. goods}}, \tag{20}$$

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# Market Clearing

**Intermediate goods**

$$x_t^i = \omega^i l_t^{p,i} f^i(a_t, z^i, k_t^i), \quad \forall i, \tag{21}$$

**Final good**

$$Y_t = F(\mathbf{x}_t) = c_t + \bar{g}^{int} + K_{t+1} - (1-\delta)K_t + \sum_i \sum_j \omega^i v_t^{j,i} \kappa^{j,i}. \tag{22}$$

**Capital**

$$K_t = \sum_i \omega^i k_t^i l_t^{p,i}. \tag{23}$$

# Decentralized equilibrium

## Definition

Given a sequence of policies of public wages $\{w_t^{g,i},\ \forall i\}_{t=o}^{\infty}$, unemployment benefits $\chi^b$, government services $\bar{g}$, intermediate purchases $\bar{g}^{int}$ and income tax $\bar{\tau}$ and a set on initial conditions $\{K_0, l_0^{p,i}, l_0^{g,i},\ \forall i\}$; a decentralised equilibrium is a sequence of prices $\{r_t, w_t^{p,i}, p_t^{x,i},\ \forall i\}_{t=o}^{\infty}$ and quantities $\{K_{t+1}, C_t, k_t^i, v_t^{p,i}, v_t^{g,i}, s_t^i,\ \forall i\}_{t=o}^{\infty}$ such that

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1-Household satisfies EE [eq. 19];
2-Unemployed members of type $i$ choose where to to search [eq. 3];
3-Matched firms choose optimal $k$ for each type [eq. 9];
4-Free entry in intermediates goods;
5-Nash bargaining [eq. 14];
6-Wholesale firm maximizes profits [eq. 16]
7-Gov. minimizes the cost of producing services [eq. 17]
8-Lump-sum taxes balance the budget [eq. 18]
9-Markets clear [eq. 21-23].

# Previous studies using google trends data

Google data is able to forecast:

- labor markets [ Askitas and Zimmermann (2009), D'Amuri (2009), D'Amuri and Marcucci (2010), and Choi and Varian (2009), Choi and Varian (2012)]
- housing markets [Wu and Brynjolfsson (2013) ]
- inflation expectations[Guzman (2010)]
- private consumption [Vosen and Schmidt (2011) Kholodolin et al. (2010) and Della-Penna and Huang (2009)].

Google data has been used by central banks

- McLaren and Shanbhogue (2011) predict changes in unemployment rate and housing prices in the UK
- Carrière-Swallow and Labbé (2013) on automobile sales in Chile.
- Suhoy (2009) forecast unemployment in Israel.

Finance

- Da et al. (2011) create a measure of investor inattention
- Latoeiro et al. (2013)
- Gomes and Taamouti (2014) predict covariance of asset returns

Other fields: detect influenza epidemics [Ginsberg et al. (2009)].

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# Evolution of the ratio