Aggregate Employment, Job Polarization and Inequalities: A Transatlantic Comparison

Julien Albertini
Humboldt University (Berlin)
Jean-Olivier Hairault
Université de Paris I (CES) & PSE
François Langot
Université du Mans (GAINS-TEPP, IRA) & PSE
Thepthida Sopraseuth
Université de Cergy-Pontoise (Thema) & IUF

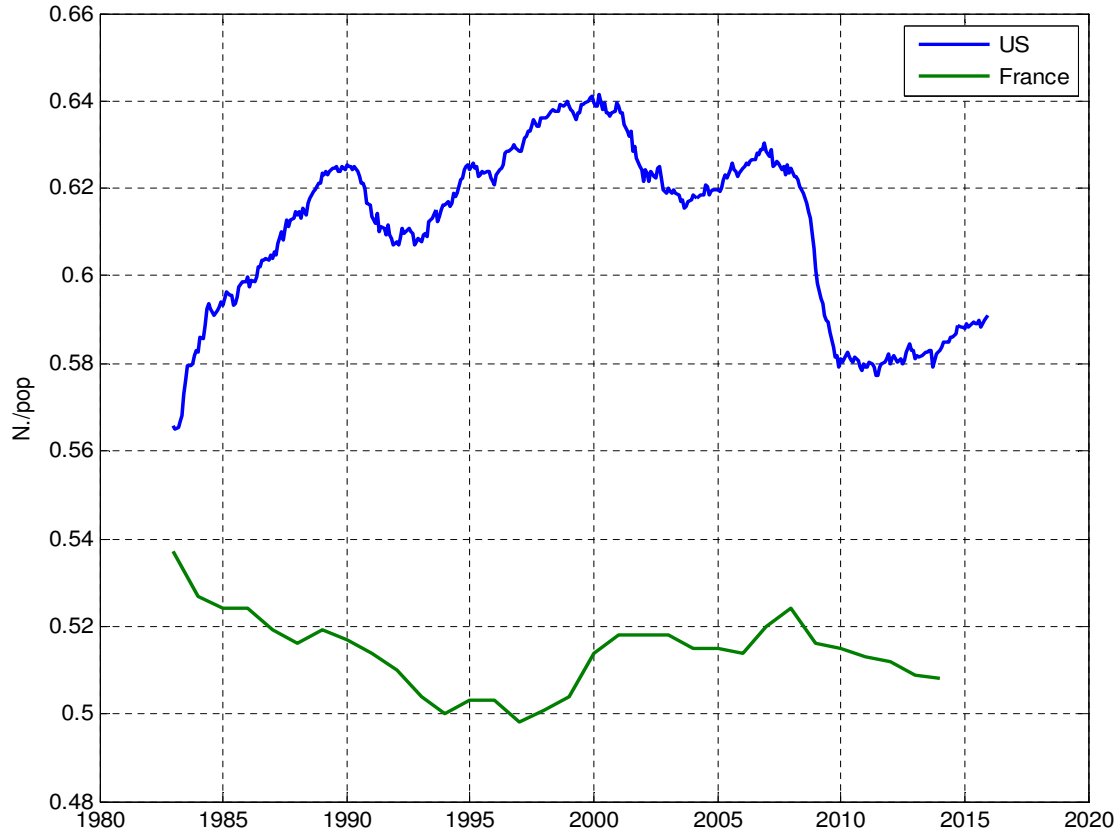
October 2016 - In progress

The paper

The paper attempts to bridge the gap between

- the literature on European employment problem
- the literature on job polarization

Employment rates in the US and France



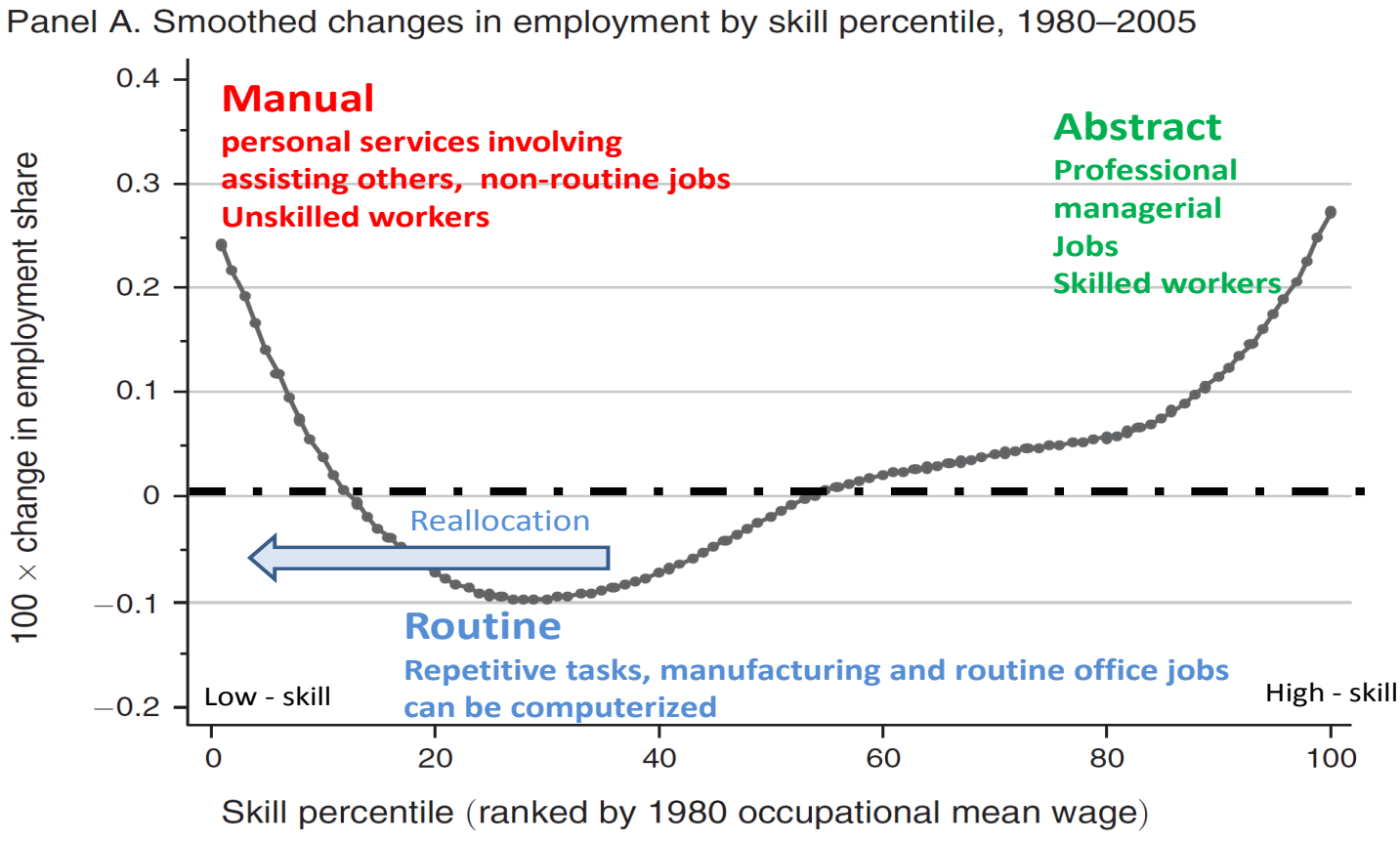
US : BLS data. France : INSEE. Employment rate (Employment/population 16+)

Job polarization

- **structural technological changes.**
  $\Leftrightarrow$ a permanent supply shock.
- $\Rightarrow$ **employment reallocation.** technological changes can destroy jobs, but can also create new activities : "Job polarization"

Job polarization

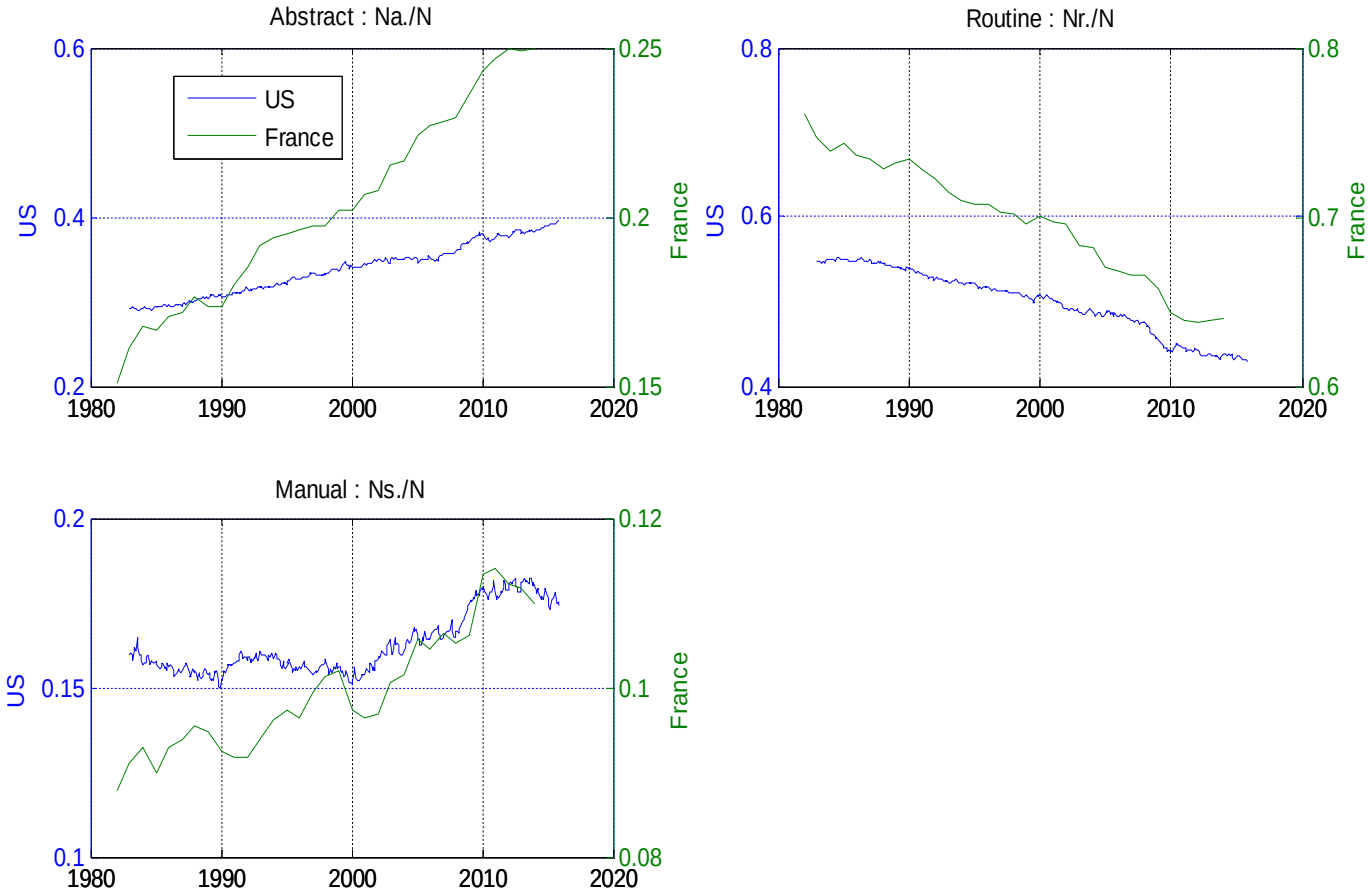
The disappearance of routine jobs relative to those at the bottom and top of the wage distribution.



Source : Autor and Dorn (2013)

"manual" or "service" jobs

Job polarization in the data : employment shares by task



Authors' calculations. Based on BLS and French LFS.

▸ US data ▸ French data

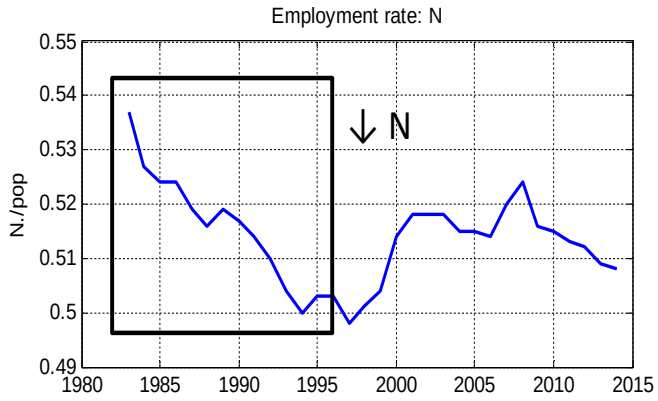
Our paper

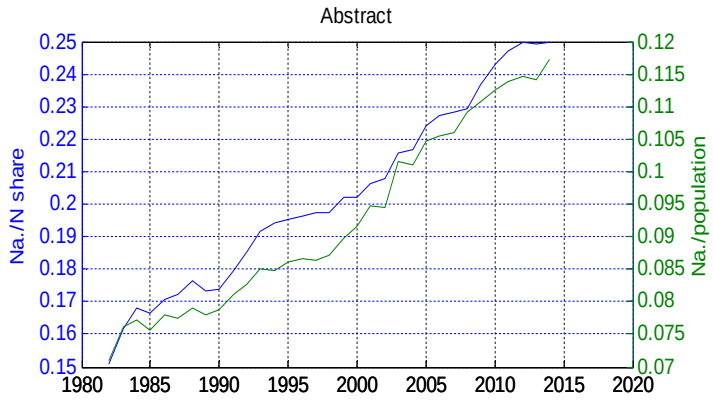
Based on the evolution of employment shares by tasks, it seems that Autor and Dorn's story is also relevant in France.

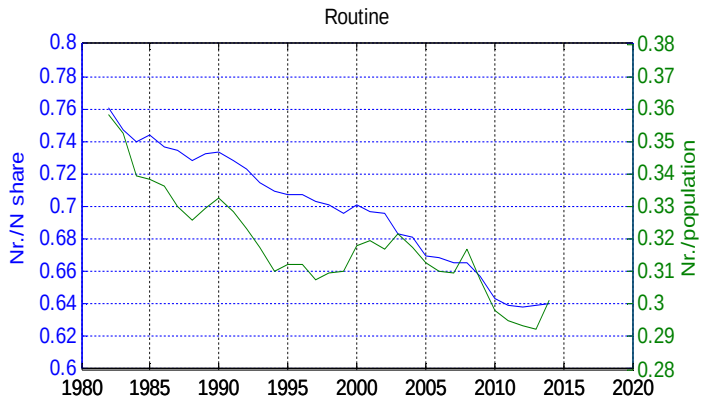
Our paper : it is not the case. Why ?

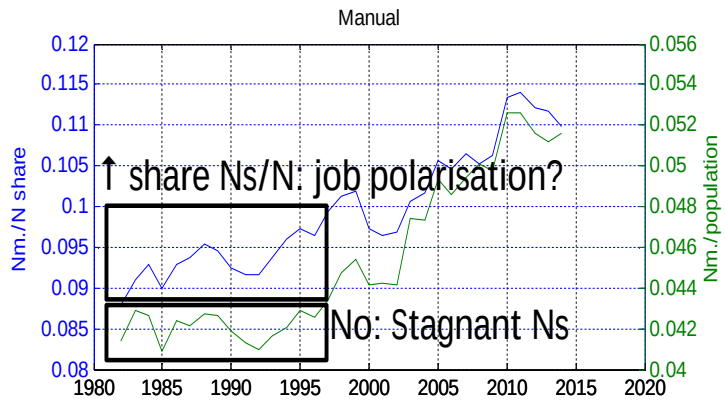
1. When studying impact of technological change, one shall focus on employment shares (job polarization) *and* employment levels

Employment shares (job polarization) *and* employment levels : France









Authors' calculations. French Labor Force Survey.

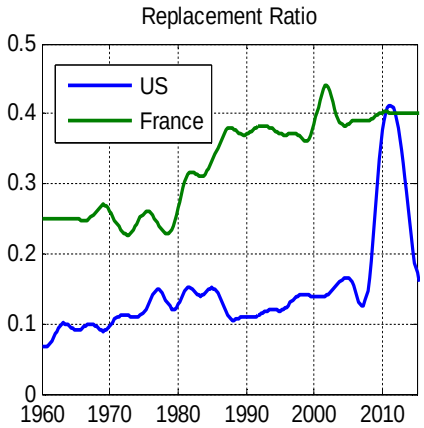
Our paper

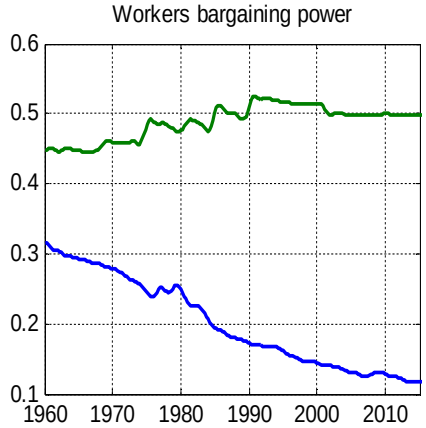
Based on the evolution of employment shares by tasks, it seems that Autor and Dorn's story is also relevant in France.

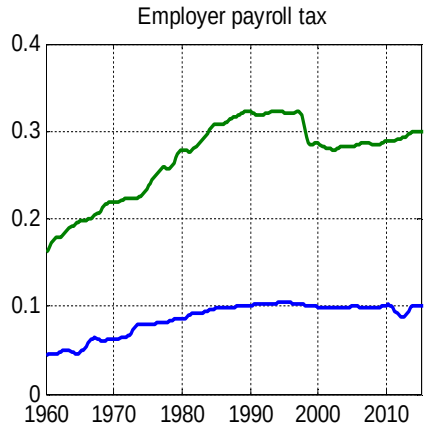
Our paper : it is not the case. Why ?

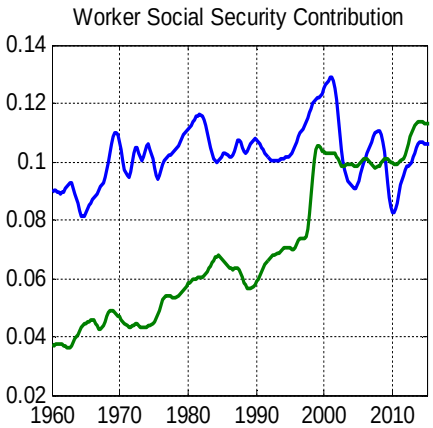
2. Impact of Task-Biased Technological Change (TBTC) on employment level and employment shares by task in conjunction with 2 neglected elements in the literature on job polarization
   - Labor Market Institutions
   - Supply of skilled labor

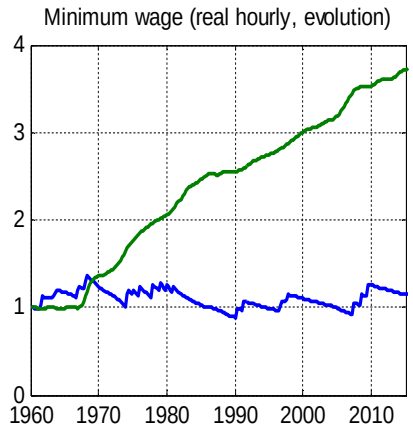
Contrasting evolutions of Labor Market Institutions (LMIs)











Questions

- What is the respective role of 3 exogenous trends
  1. TBTC (Task-Biaised Technological change)
  2. labor market institutions
  3. the rise of share of high skill workers in the labor supply

  in shaping the transitional dynamics of the occupational structure of employment ?
- How do labor market reallocations affect inequalities in the context of the structural change ?

$\Longrightarrow$ Need a dynamic model able to account for the evolution of *shares* and *levels* of employment.

Methodology

Multi-sectorial model with search and matching frictions and endogenous occupational choices

- Exogenous trends : in the US, and France
  - Fall in price of capital
    - to be estimated
    - argue that they are close to data on price of technology (measurement error)
  - Evolution of LMIs
    - figure shown in the introduction
  - Growth in supply of skilled labor
    - to be estimated
    - argue that they are close to data on educational attainment (measurement error)

Methodology

- Non-stationary, non-linear, general equilibrium environment with heterogeneous-agents (no savings, deterministic environment)
- Model predictions : in each country, the dynamics of
  - Employment level, employment shares by tasks
  - Wage and income inequality, inequality in job opportunities (in progress)

Preview of results : What do we learn from counterfactuals ?

- Is TBTC key in the understanding of employment levels and polarization since the early 1980s ?
- Role of LMI and supply of educated workers ?

US

Exogenous trends

- LMIs : more and more flexible
- Supply of skilled labor : high at the beginning of TBTC and increasing

Counterfactuals : understanding the contribution of each element in the increase in aggregate employment

- TBTC : increases employment at the top and bottom of the wage distribution, job polarization at work
- employment growth is due to TBTC and evolution of LMIs (50 :50 split)
- Strong interaction between the 3 elements
  - TBTC matters because LMIs are more and more flexible $\Rightarrow$ jobs are created at the bottom of the wage distribution
  - TBTC matters because supply of skilled labor increases $\Rightarrow$ jobs are created at the top of the wage distribution

France

Exogenous trends

- LMIs : more and more rigid
- Supply of skilled labor : low at the beginning of TBTC and increasing

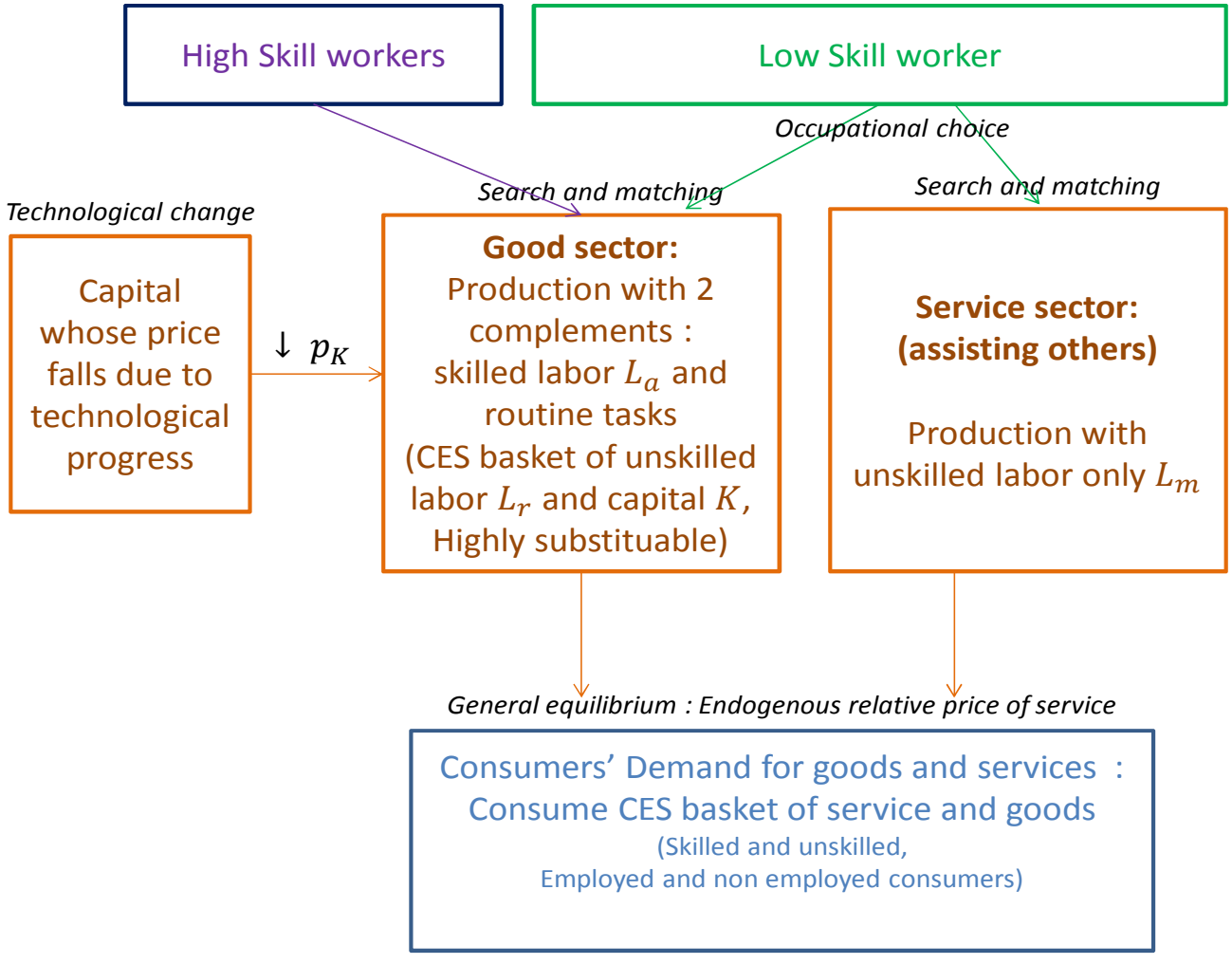
Counterfactuals : understanding the contribution of each element in the evolution of aggregate employment

- $\uparrow$ supply of skilled labor : matters for increase in French employment
- Strong interaction between the 3 elements
  - TBTC destroys routine jobs
  - LMIs are more and more rigid $\Rightarrow$ jobs are not created at the bottom of the wage distribution

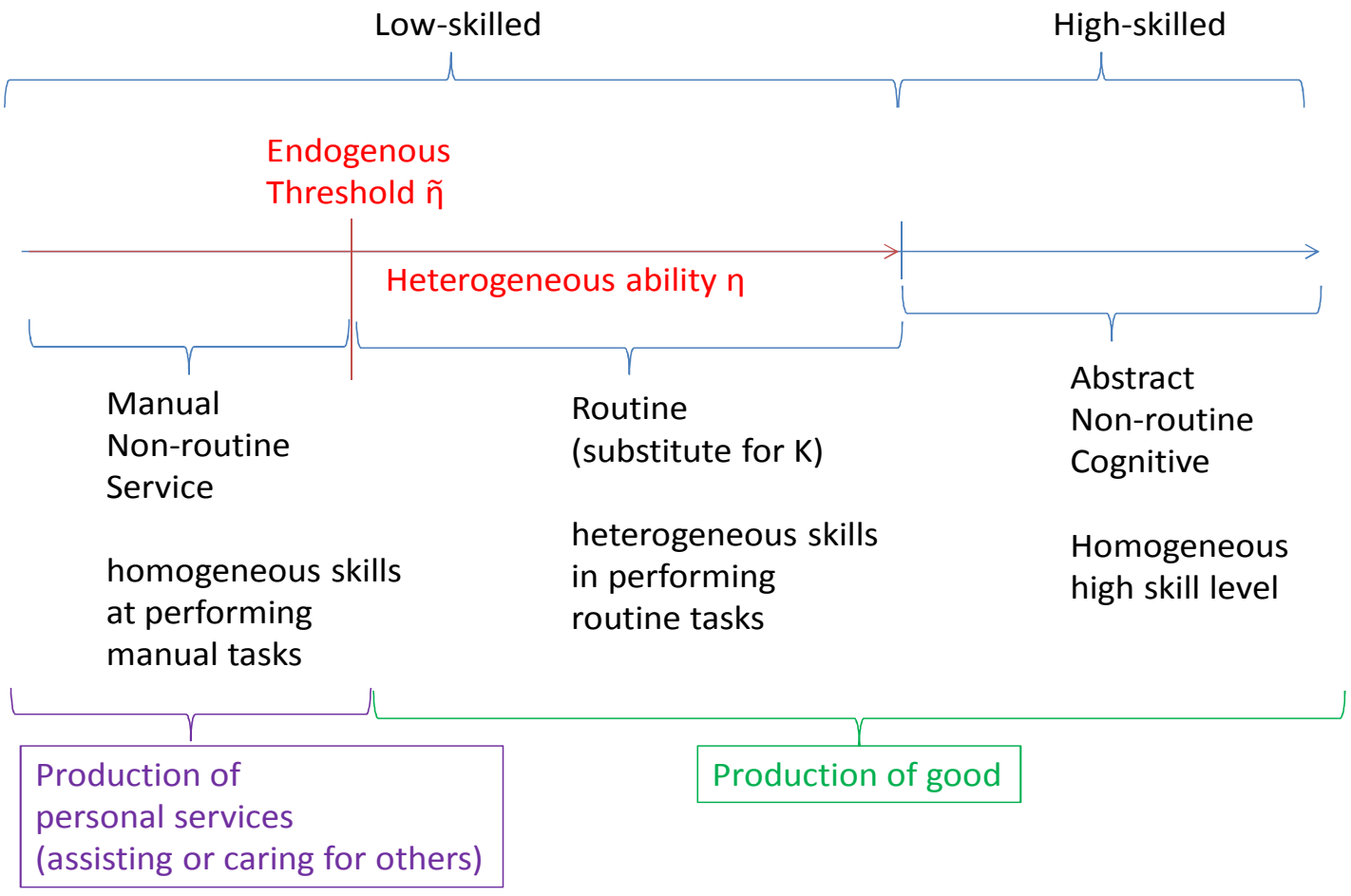
Part I

A Dynamic General Equilibrium model
with endogenous aggregate employment and job polarization

Building blocks of the model



Heterogeneous workers



TBTC $\Rightarrow \eta$ gradually $\uparrow$

Goods sector : Complementarity and substitutability

▸ Model : details Goods

$$Y^g \geq AL_a^{\alpha}\left[\left((1-\mu)\sum_{\eta^S}^{\overline{\eta}}\eta L_r(\eta)\right)^{\sigma}+(\mu K)^{\sigma}\right]^{\frac{1-\alpha}{\sigma}}$$

Service sector ▸ Model : details Services

$$Y^s \geq A_s\left(L_s+\delta\sum_{\eta}L_m^n(\eta)\right)$$

Preferences : complementarities ▸ Model : details Households

$$C=\left[\nu C_g^{\rho}+(1-\nu)C_s^{\rho}\right]^{\frac{1}{\rho}}$$

Impact of TBTC ? Economic mechanisms

- The supply shock : $\downarrow$ price of *computer* capital.
  - New technologies require more "Abstract tasks".
  - TBTC reduces the demand for "Routine tasks" (computerized)
  - Routine workers may move to "Manual tasks" (unskilled)
- The feed back : a demand shock on the other sector
  - Workers (richer and more numerous) consume more.
  - More "services" $=\uparrow$ demand for "Manual tasks" workers.
  - Relative price of service $\uparrow$: signal for occupational switching from routine to manual jobs

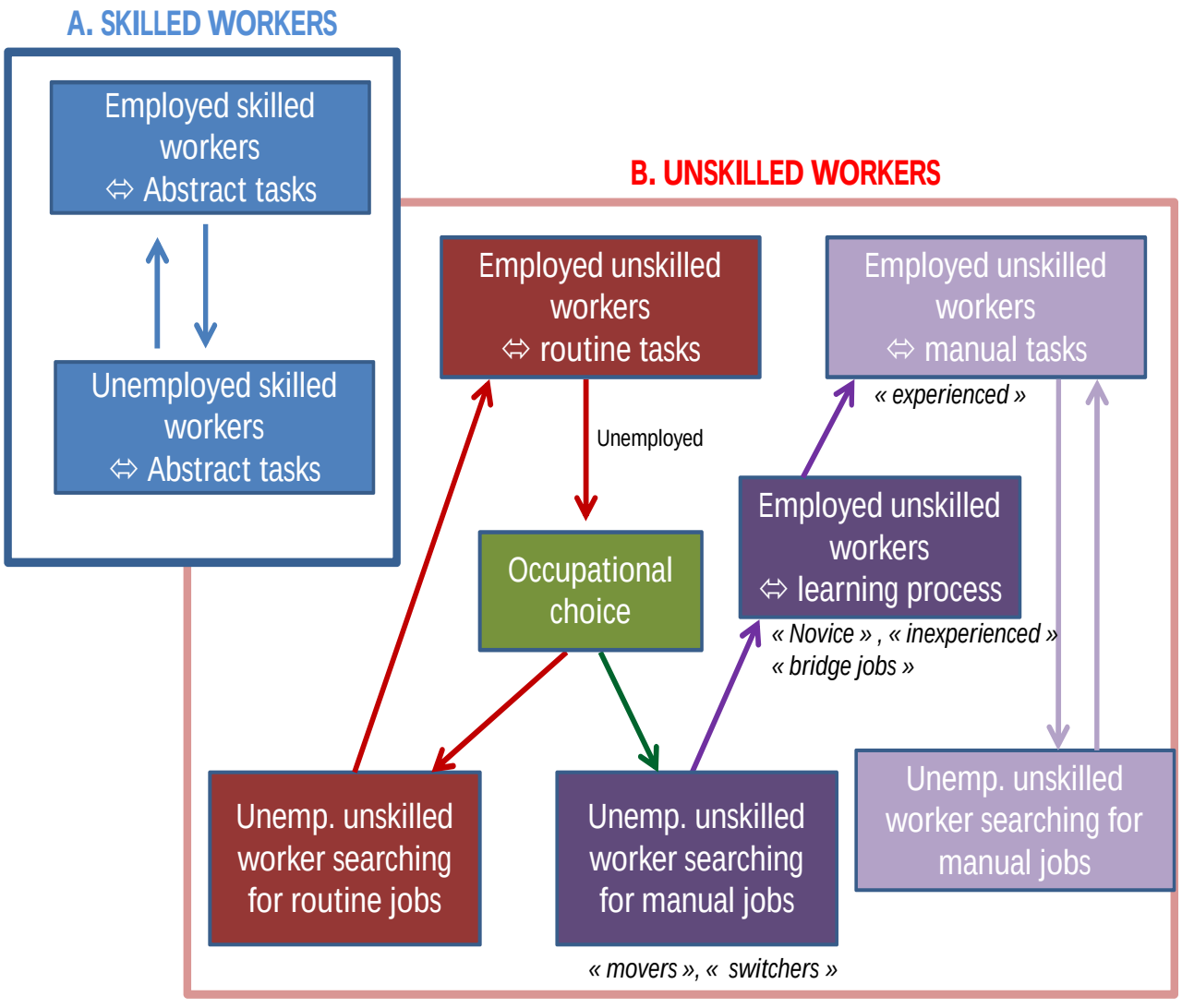
In our model, as in Autor and Dorn (2013)

Impact of TBTC ? Economic mechanisms

Originality of our work :

- Labor market frictions : time consuming process of labor reallocation = short-run and medium term dynamics.
- Is Autor and Dorn's story relevant elsewhere ? Not in France,
  - The evolution of employment shares by tasks suggest that Autor and Dorn's story might be relevant
  - Actually, it is not
    - Rigid Labor Market Institutions can freeze job polarization
    - $\Rightarrow$ Supply of skilled labor becomes important

Labor market stocks and flows



Search and Matching Model

- Random matching in separate markets :
  - One sub-market for each occupation ("abstract" /"routine" /"manual")
  - Routine occupations : sub-markets for each ability level η
- Hirings take time (matching function) : large distortions (LMIs) reduce job surplus and thus increase unemployment duration
- Job destruction and LMIs
  - Exogenous job destruction s
  - Endogenous job separation : Worker mobilities and real wage rigidity can lead to scrap or to quit job ▸ More

Occupational choices and LMIs

- Mobility cost = a market for "movers/switcher".
- For those who choose to move from routine to manual occupations,
  - the *instantaneous* cost is the acceptance of a **bridge job** (minijob) in the service sector.
  - the *long-run* gains : a improvement in their future career $\Leftrightarrow$ Learning process. (Cortes, 2015)
  - human capital is occupation-specific (Kambourov and Manovskii, 2009)
- LMI can create 2 types of switchers :
  - The first are eligible to an UB indexed on their previous "routine" job wage : new mover/switcher.
  - The second have past employment experience in manual jobs and have lost their eligibility on this routine UB.
- The LMIs can lead to non-existence of these bridge jobs, hence stalling the labor reallocation

Wages

- In the DMP model, a Nash bargaining gives the *WS* (wage setting) curve : the wage w_{Nash} is highly flexible and follows both productivity and labor market tightness.
- A "Minimum wage" mw that can disconnect wage from productivity.

For all jobs, we have the following WS rule : $w = Max(mw, w_{Nash})$

▸ More

Employed : for each ability level η

$$W_r = \underbrace{w_r(1-\tau_w)}_{Wage} + \beta\left[(1-s)W_{r,+1} + s\underbrace{\max\{U_{r,+1}, U^n_{m,+1}\}}_{Occupational\ \ choice}\right]$$

$$W^n_m = w^n_m(1-\tau_w) + \lambda[(1-s)\beta W_{m,+1} + s\beta U_{m,+1}] + (1-\lambda)[(1-s)\beta W^n_{m,+1} + s\beta U^o_{m,+1}]$$

Unemployed : for each ability level η

$$U_r = z_r + \beta\left[(1-f_r)\max\{U_{r,+1}, U^n_{m,+1}\} + f_r W_{r,+1}\right]$$

$$U^n_m = \underbrace{z_r}_{\substack{Unemployment \\ benefits}} + \beta\left[(1-f^n_m)U^n_{m,+1} + f^n_m W^n_{m,+1}\right]$$

f_i : job finding rate, s : separation rate, λ : learning parameter

Value functions : ▸ Employees ▸ Unemployed workers

Occupational choices, LMIs and GE effects

In Autor and Dorn (2013) : No labor market frictions, Mobility choice based on wage comparison :

- ability threshold $\tilde{\eta}$ such that $\eta > \tilde{\eta} =$ routine
- $w_r = w_s$

$$\left.\begin{array}{rcl} \text{Mobility} : \tilde{\eta} y_r & = & A_s p_s \\ \text{Demand} : p_s & = & MRS(C_g, C_s) \end{array}\right\} \Rightarrow \quad \tilde{\eta} = \phi_w(\{\sigma, \alpha, \rho\})$$

- Good production function : σ, α (technological parameters), $\downarrow p_k \Rightarrow \downarrow$ cost of routine tasks and $\uparrow$ capital.
- ρ (consumer preference, must favor variety) : so that demand for service $\uparrow$

General equilibrium effect through p_s : $\uparrow p_s$ is a signal that routine workers shall switch to manual jobs

In our model, mobility choice

- "search unemployment"

$$\left.\begin{array}{ll} \text{Mobility :} & U(\theta_r(\tilde{\eta}), LMI) = U(\theta_m, LMI) \\ \text{Demand :} & \left\{\begin{array}{rcl} \theta_r(\eta) & = & \varphi_r(\eta y_r, LMI) \\ \theta_m & = & \varphi_m(A_s p_s, LMI) \end{array}\right. \end{array}\right\}$$

$$\Rightarrow \quad \tilde{\eta} = \phi_{SaM}(\{\sigma, \alpha, \rho\}, LMI)$$

$$\text{where : } LMI = \{\underbrace{r, h}_{w^r}, \underbrace{\gamma, c}_{w_{Nash}}, \underbrace{MW}_{\substack{wage \\ rigidity}}, taxes\}$$

General equilibrium effect through p_s

LMI on both sides of equations but does not go away because of capitalization effect (on divergent evolution of productivity across sectors)

- "Rest unemployment" : $\theta_m = 0$. Reallocations are stalled.

Part II

A Dynamic General Equilibrium model
Quantitative Analysis : in progress

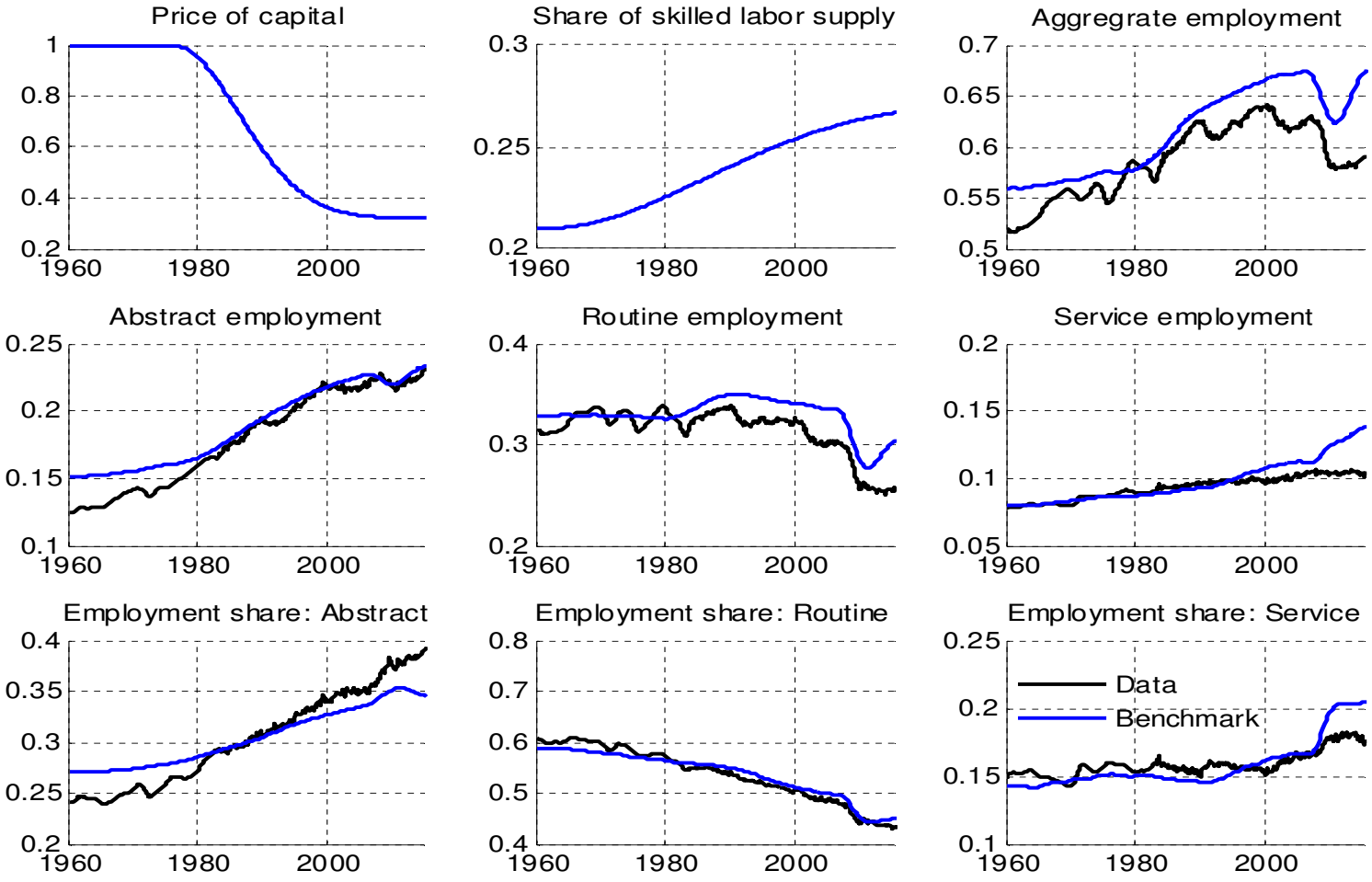
Quantitative Analysis : in progress

- Parameter values
  - Calibration of standard parameters
  - Estimation (in progress)
  - Today : calibration only
- Counterfactuels :
  - Employment levels and shares
  - inequalities (in progress)

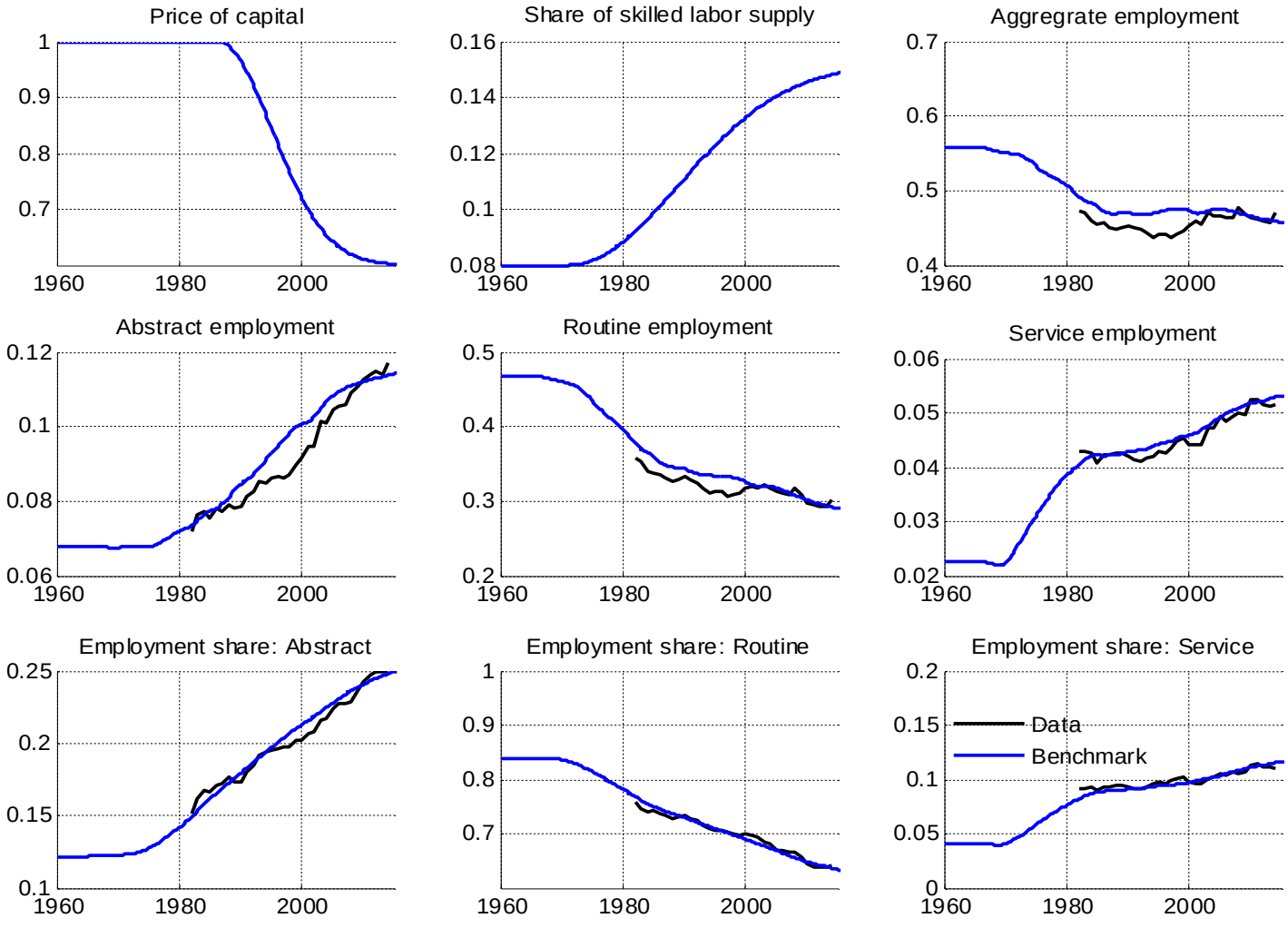
The scenario for the shifts of exogenous variables : common features

- Common parameters across countries (production function and preferences)
- TBTC : To be estimated ▸ Data on p_k
  - Fall in the price of capital : deterministic trend
  - US : starts in 1975 (IBM PC), France : starts in 1985 (IBM PC goes on mass market)
  - same speed.
- Skills :
  - The share of skilled workers increases at the same pace, even if the levels in 1980 are not the same. To be estimated ▸ Data on L_a
  - Within the population of unskilled workers, ability-grid (71 η, normal distribution)
- LMI : country-specific levels and dynamics shown in the introduction

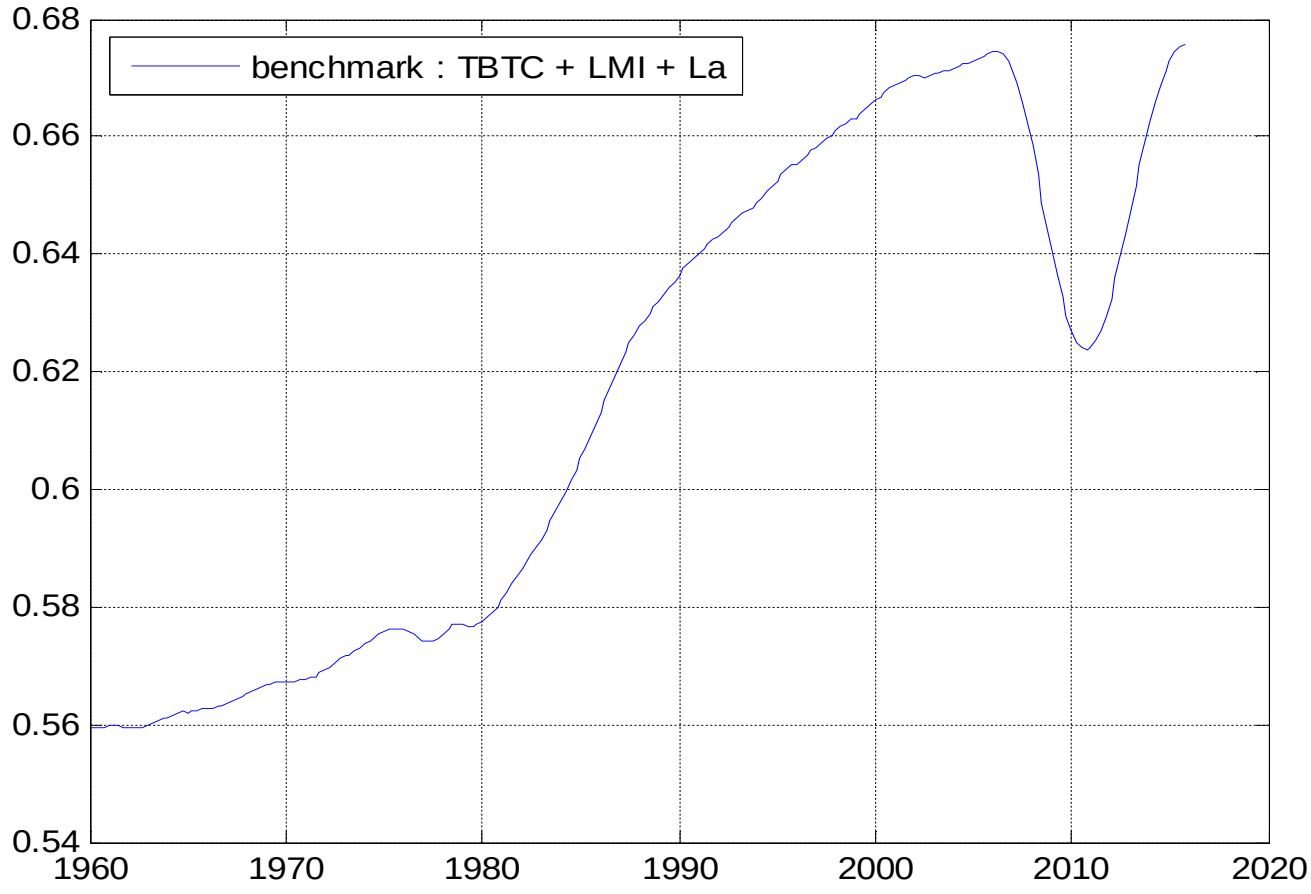
US : model versus data



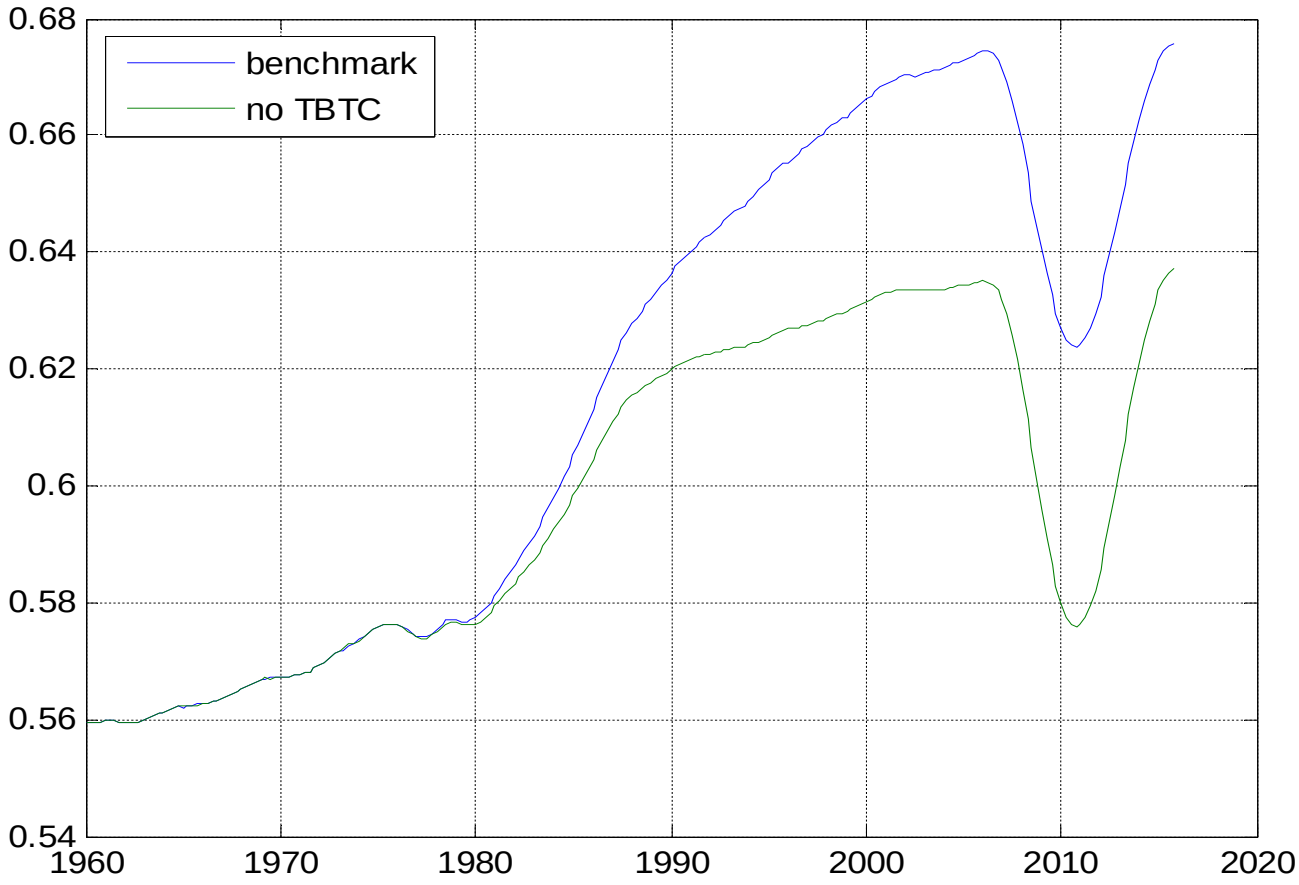
France : model versus data



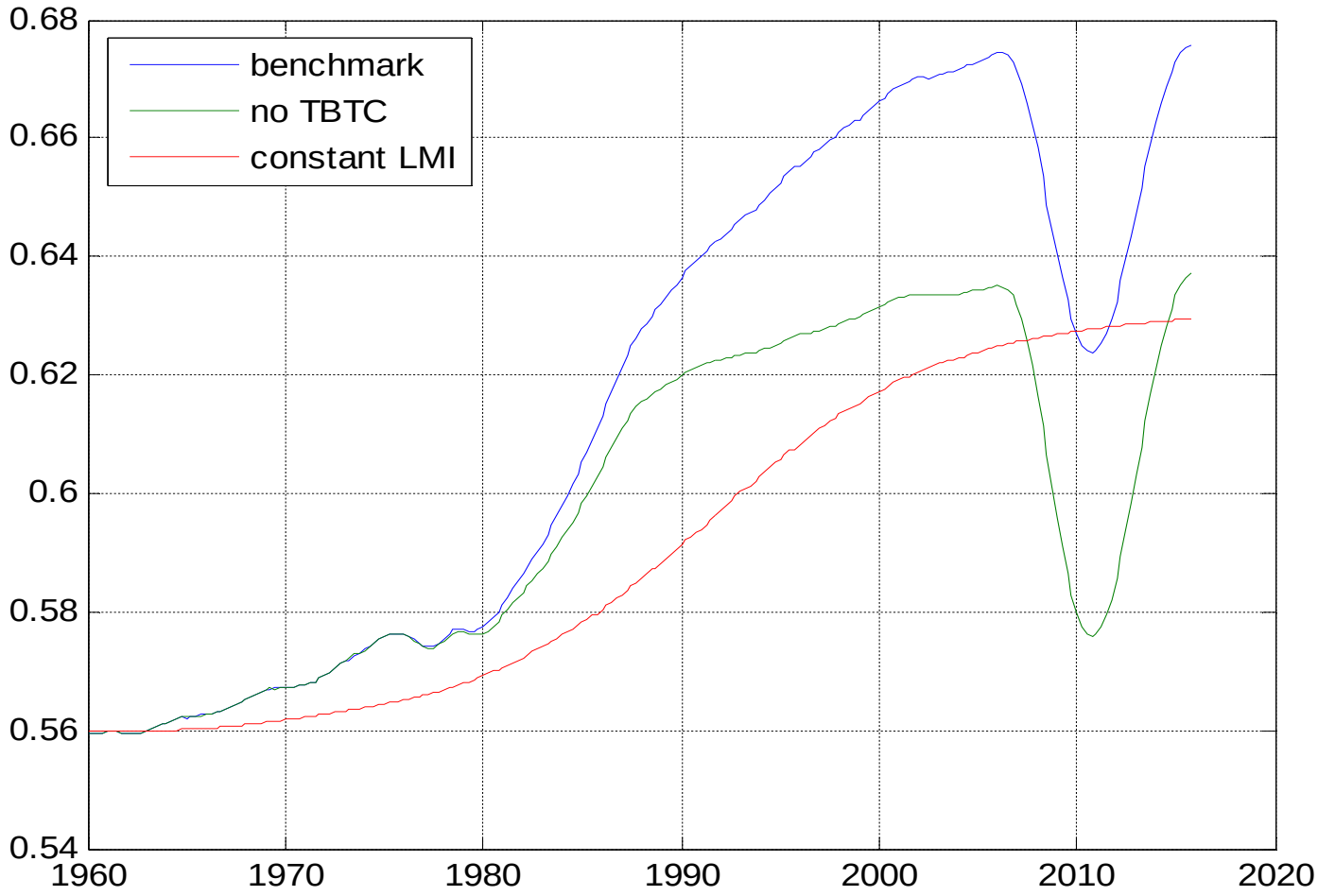
Counterfactual - TBTC/Labor supply/LMI : US



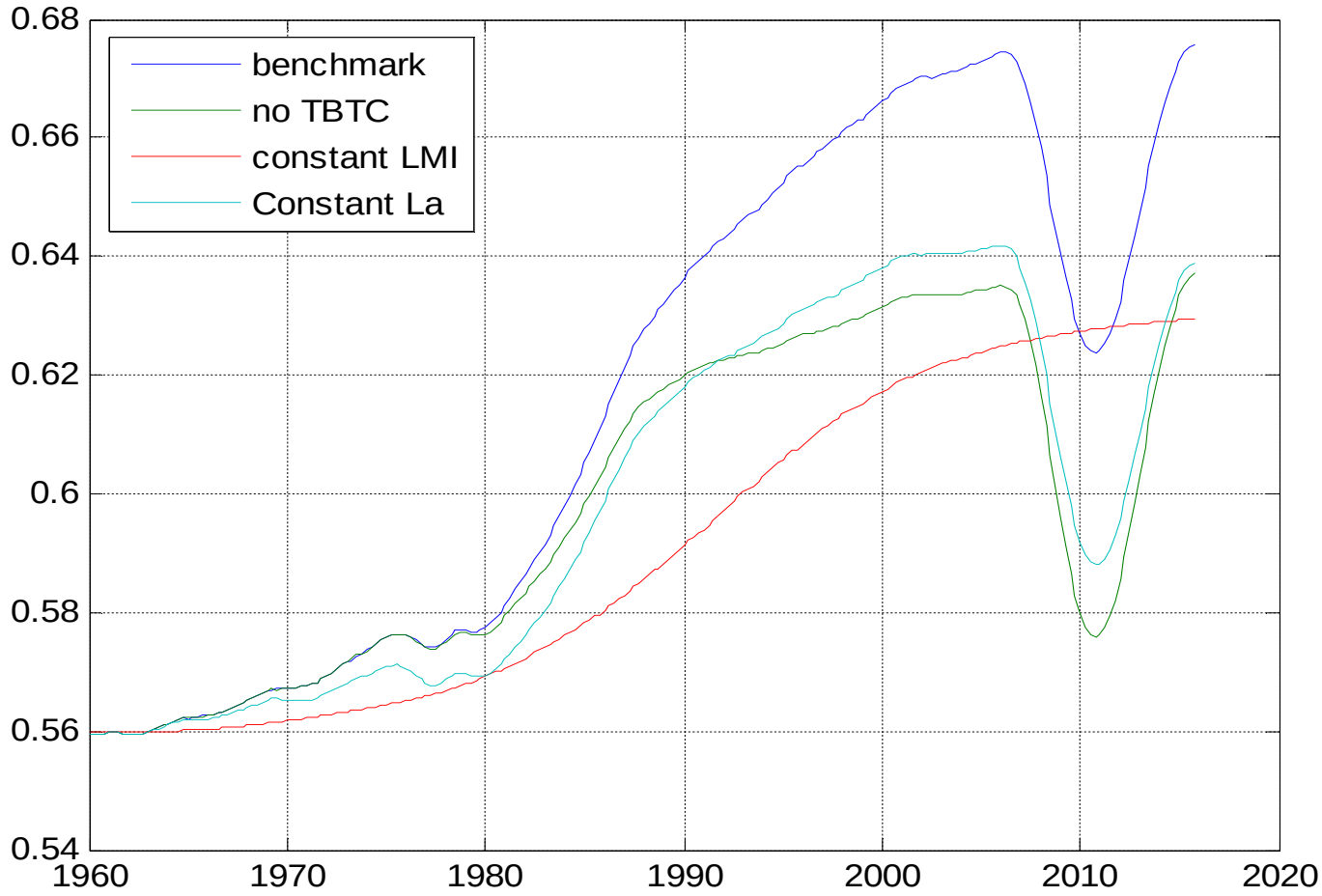
Counterfactual - TBTC/Labor supply/LMI : US



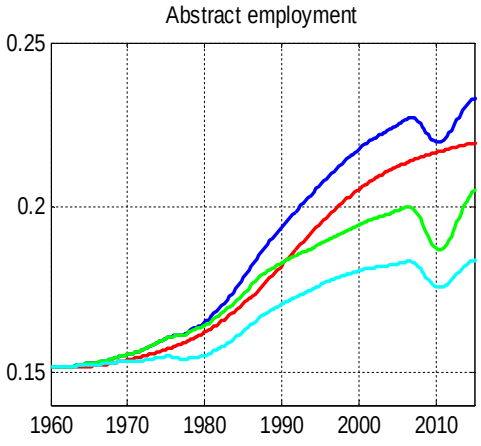
Counterfactual - TBTC/Labor supply/LMI : US

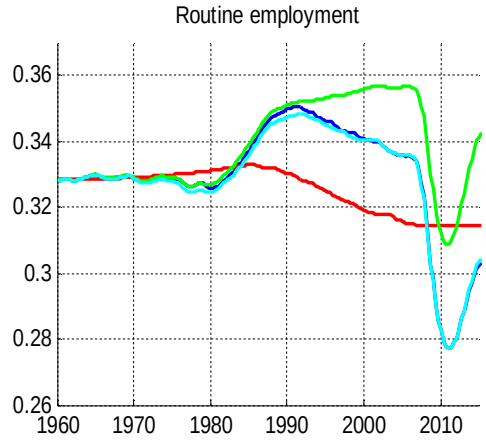


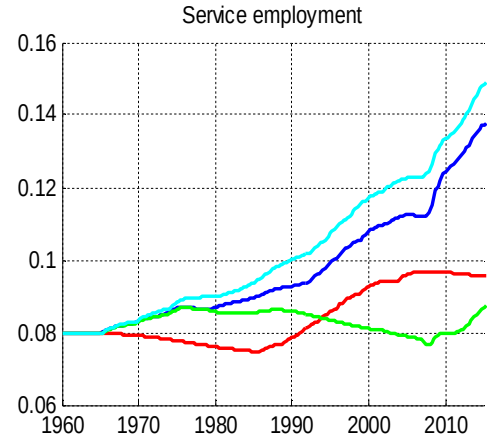
Counterfactual - TBTC/Labor supply/LMI : US

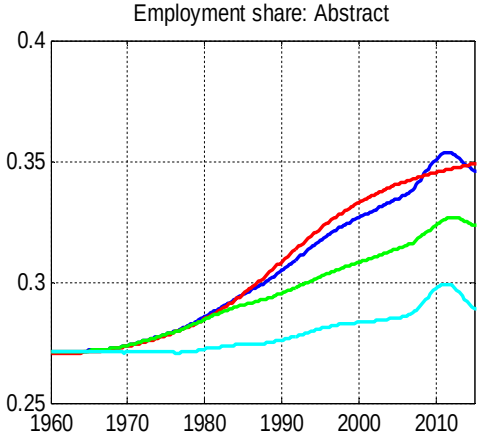


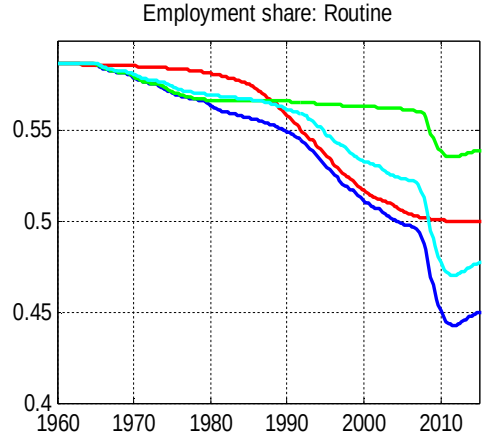
Counterfactual - TBTC/Labor supply/LMI : US

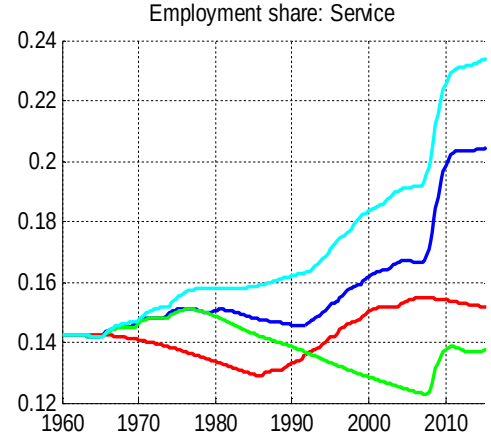












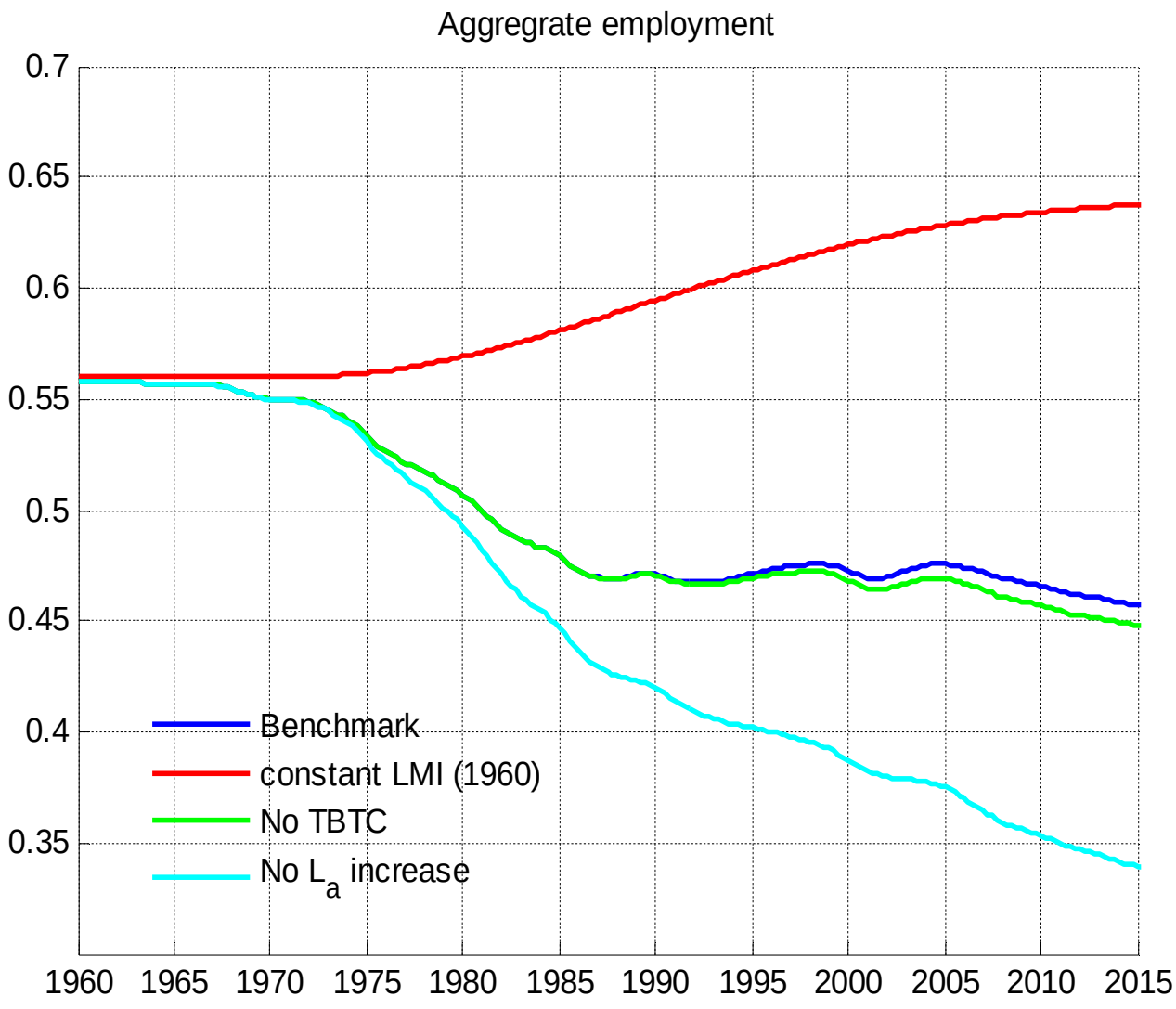
Counterfactual - TBTC/Labor supply/LMI : US

- without TBTC : no polarization, lower employment
- without LMI : lower employment
- without increase in supply of skilled labor : not much impact on aggregate employment

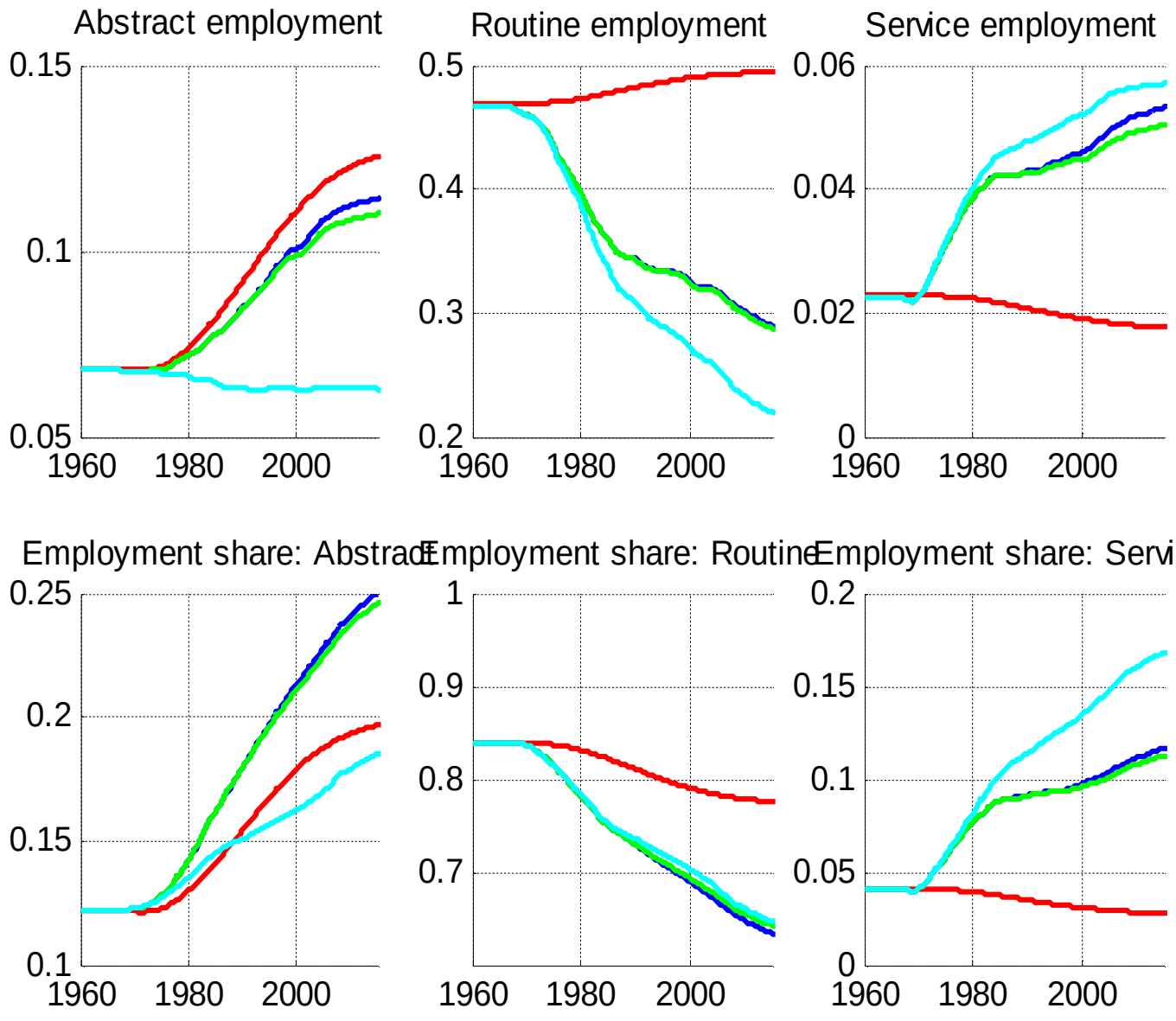
US employment :

- gradually more flexible LMIs foster employment growth
- TBTC matters because (gradually more) flexible LMIs ▸ More

Counterfactual - TBTC/Labor supply/LMI : France



Counterfactual - TBTC/Labor supply/LMI : France



Counterfactual - TBTC/Labor supply/LMI : France

- without TBTC : no impact on employment
- without LMI : higher employment
- without increase in supply of skilled labor : fall in employment would have been worse

French employment :

- Rigid LMIs stops reallocation process $\Rightarrow$ TBTC does not matter for employment dynamics ▸ More
- Employment is responsive to growth in labor supply of skilled workers : in a rigid labor market, the only way to get a job is to be educated $\Rightarrow$ this also sustains the productivity of routine jobs

Conclusion

- Multi-sectorial model with search and matching frictions and endogenous occupational choices, in a context of task-biased technological change
- Understanding the evolution of employment growth and inequalities by quantifying the specific impact of LMI, TBTC, and labor supply
  - US : employment growth is due to TBTC and evolution of LMIs (50 :50 split)
  - France :
    - TBTC does not matter because LMI stalls labor reallocation $\Rightarrow$ French employment is responsive to growth in number of educated workers.
    - Without the rise in the number of educated workers, French employment fall would have been twice bigger
- Research agenda :
  - structural estimation
  - wage inequality, income inequality (model versus data)

Appendix

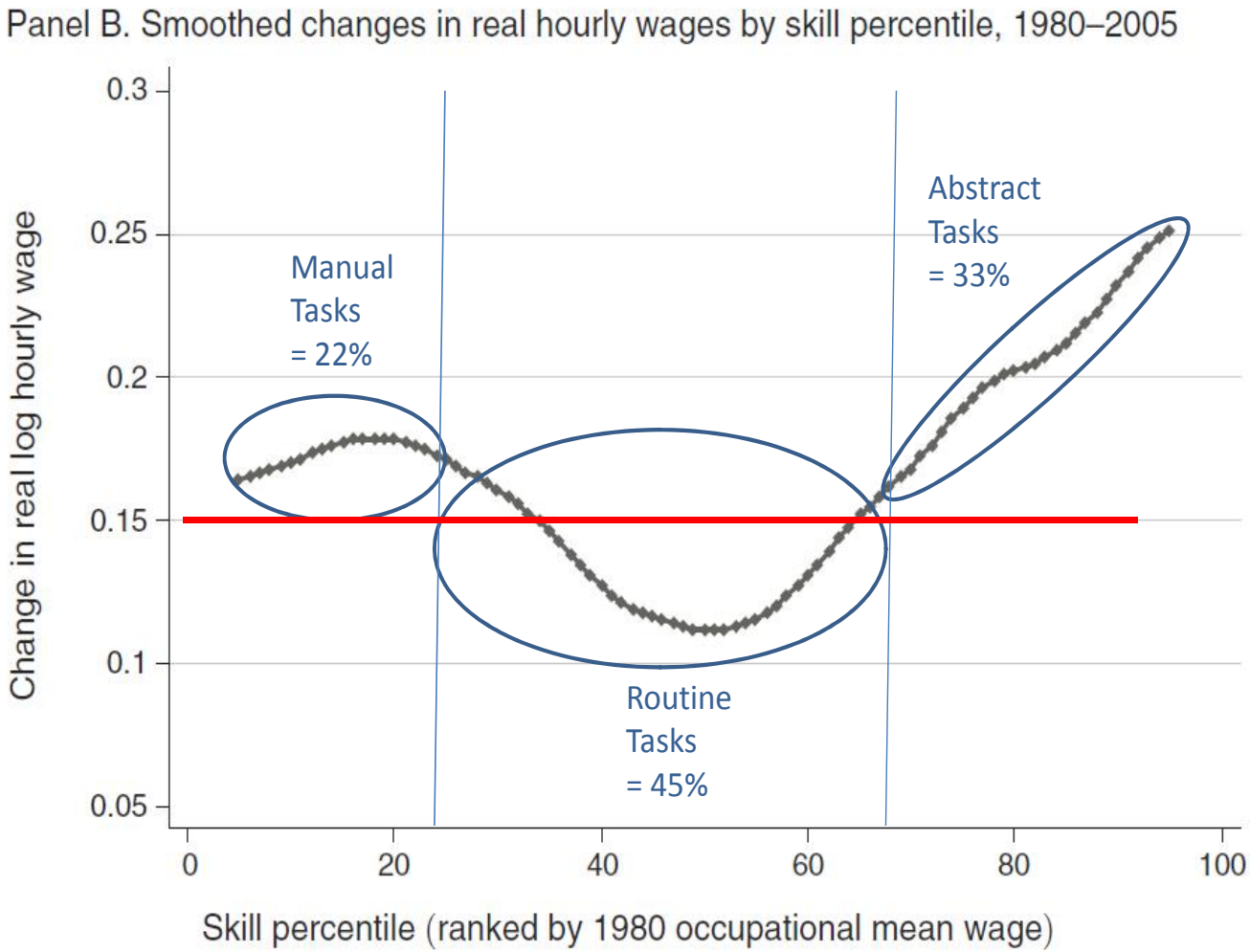
Carrillo-Tuleda, Hobjin, She, Visschers, EER 2016
quarterly data for the U.K. from 1993 through 2012

- Abstract $\rightarrow$ Abstract : 65% to 80%
- Routine or Manual jobs $\rightarrow$ Abstract $<$ 10%

quarterly

Polarization in the US : Autor & Dorn (2013)

Back to slide intro



Related literature

Our contribution : labor reallocation with occupational changes in a non-stationary environment, within unskilled workers (from the middle towards the bottom of the wage distribution), outside steady state

- Job polarization as an outcome of the structural change : Autor and Dorn (2013)
- Search and matching, technological changes : Mortensen and Pissarides (1998,1999), Horstein and al. (2004)
- Occupational choice - search vs rest unemployment : Alvarez and Shimer (2011)
- "European employment problem" and the interaction between structural change and LMI : Ljungqvist and Sargent (1998, 2008), Blanchard and Wolfers (1999)

Links with the "TC-LMI interaction" literature

Ljungqvist and Sargent (1998 & 2008), Mortensen and Pissarides (1999), Hornstein, Krussel & Violante (2007). Originality of our paper w.r.t this literature :

- Perfect mobility versus mobility costs $\rightarrow$ LMI
- Steady-state versus transitional dynamics (the *path* of LMI matters)
- In our paper,
  - Mobility towards less productive jobs (job polarization)
  - A more comprehensive view on labor market dynamics : aggregate employment, employment by task, wage dynamics and inequalities
  - Understanding employment growth by *quantifying* the relative contribution of LMI, TC and Labor supply of skilled labor
  - Reform packages : stress on interaction between LMI

US Data, as in Jaimovich and Siu (2015) Back to slides

- Employment Data by Occupation from BLS
- Abstract : Non-routine cognitive workers. Management, business, and financial operations occupations. Professional and related occupations.
- Routine : sales and related occupations. office and administrative support occupations. production occupations, transportation and material moving occupations, construction and extraction occupations, and installation, maintenance, and repair occupations.
- Manual : service occupations : ... Ushers, Lobby Attendants, and Ticket Takers ; Amusement and Recreation Attendants ; Embalmers ; Funeral Attendants ; Morticians, Undertakers, and Funeral Directors ; Barbers ; Hairdressers, Hairstylists, and Cosmetologists ; Makeup Artists, Theatrical and Performance ; Manicurists and Pedicurists ; Shampooers ; Skincare Specialists ; Baggage Porters and Bellhops ; Concierges ; Travel Guides ; Childcare Workers ; Personal Care Aides ; Fitness Trainers and Aerobics Instructors ; Recreation Workers ; Residential Advisors ; Personal Care and Service Workers, All Other

Back to slides

US Data, as in Jaimovich and Siu (2015)

- Consistent with Autor and Dorn's classification
- Consistent with Routine-Task Intensity index based on DOT

Back to slides

French data :

- Annual French Labor surveys (1983-2014)
- Compute employment by occupation
- Abstract, Routine and Manual workers are identified in the same way as in Jaimovich and Siu (2015)
- classification using wages is not possible in the early 1980s (wage is not a continuous variable in the early 1980s)

Firms : Goods sector

The representative firm's problem

$$\Pi^g = \max \left\{ \begin{array}{l} Y^g - p_k K - \sum_{\eta^s}^{\overline{\eta}} w_r(\eta)\eta L_r(\eta) - w_a L_a \\ -cV_a - c\sum_{\eta^s}^{\overline{\eta}} V_r(\eta) + \beta \Pi^g_{+1} \end{array} \right\}$$

$$\begin{aligned} \text{s.t.} \quad Y^g &\geq AL_a^{\alpha} \left[\left((1-\mu) \sum_{\eta^s}^{\overline{\eta}} \eta L_r(\eta) \right)^{\sigma} + (\mu K)^{\sigma} \right]^{\frac{1-\alpha}{\sigma}} \\ L_{r,+1}(\eta) &= (1-s)L_r(\eta) + q_r(\eta)V_r(\eta) \\ L_{a,+1} &= (1-s)L_a + q_a V_a \\ \Pi^g &= \max \left\{ \Pi^g_{(L_r(\eta)>0)}, -FC \times L_r(\eta) + \Pi^g_{(L_r(\eta)=0)} \right\} \end{aligned}$$

Back to slide model

Firms : Service sector

The representative firm's problem

$$\Pi^s = \max \left\{ \begin{array}{l} p_s Y^s - w_m L_m - \sum_\eta w_m^n(\eta) L_m^n(\eta) - w_m^o L_m^o \\ -cV_m - c\sum_\eta V_m^n(\eta) - cV_m^o + \beta \Pi_{+1}^s \end{array} \right\}$$

$$\begin{aligned} \text{s.t.} \quad Y^s &\geq A_s \left(L_s + \delta \sum_\eta L_m^n(\eta) + \delta L_m^o \right) \\ L_{m,+1} &= (1-s)L_m + q_m V_m + (1-s)\lambda \sum_\eta L_m^n(\eta) + (1-s)\lambda L_m^o \\ L_{m,+1}^o &= (1-s)(1-\lambda)L_m^o + q_m^o V_m^o \\ L_{m,+1}^n(\eta) &= (1-s)(1-\lambda)L_m^n(\eta) + q_m^n(\eta) V_m^n(\eta) \end{aligned}$$

with $\delta \in (0,1)$ the loss of efficiency due to the "movers"' learning process.

▸ Back to slide model

Households : Demand

For each worker, the budgetary constraint is

$$PC = I \quad \text{with } I \in \{w_a, w_r(\eta), w_s, w_m, z_a, z_s, z_r\}$$

Given that all workers, we have

$$C = \left[\nu C_g^{\rho} + (1-\nu) C_s^{\rho}\right]^{\frac{1}{\rho}} \qquad P = \left[\nu^{\frac{1}{1-\rho}} + (1-\nu)^{\frac{1}{1-\rho}} p_s^{\frac{\rho}{\rho-1}}\right]^{\frac{\rho-1}{\rho}}$$

the optimal sharing of the basket good C is given by :

$$p_s = \frac{1-\nu}{\nu}\left(\frac{C_g}{C_s}\right)^{1-\rho}$$

$$\Rightarrow \begin{cases} C_g &= \nu^{\frac{1}{1-\rho}} \left(\frac{1}{P}\right)^{\frac{1}{\rho-1}} \frac{I}{P} \\ C_s &= (1-\nu)^{\frac{1}{1-\rho}} \left(\frac{p_s}{P}\right)^{\frac{1}{\rho-1}} \frac{I}{P} \end{cases}$$

which are the demand functions.

▸ Back to slide model

Model Assumptions : labor reallocation across sectors

Back to slides

- A mobility cost = a market for "movers/switcher" (s) :
  - Some l-skill workers, unemployed on a "routine" labor market, can choose to move to search for a "manual" job.
  - For them, the cost is the acceptance of a **bad job** in the "manual" sector
- Learning process : the duration of the transformation of a bad job into a good job in the manual sector is stochastic with a Poisson parameter λ.
- There is potentially 2 types of switchers :
  - The first are eligible to an UB indexed on their previous "routine" job wage : new mover/switcher.
  - The second have a longer experience on this segment of the labor market and have lost their eligibility on this UB.

Employees' Opportunities

The worker's value functions are

$$
\begin{aligned}
W_a &= w_a(1-\tau^{wa}) + (1-s)\beta W_{a,+1} + s\beta U_{a,+1} \\
W_m &= w_m(1-\tau^{w}) + (1-s)\beta W_{m,+1} + s\beta U_{m,+1} \\
W_r(\eta) &= \eta w_r(\eta) + (1-s)\beta W_{r,+1}(\eta) + s\beta \max\{U_{r,+1}(\eta), U^n_{m,+1}(\eta)\} \\
W^o_m &= w^o_m(1-\tau^{w}) + \lambda[(1-s)\beta W_{m,+1} + s\beta U_{m,+1}] \\
&\quad +(1-\lambda)[(1-s)\beta W^o_{m,+1} + s\beta U^o_{m,+1}] \\
W^n_m(\eta) &= w^n_m(\eta)(1-\tau^{w}) + \lambda[(1-s)\beta W_{m,+1} + s\beta U_{m,+1}] \\
&\quad +(1-\lambda)[(1-s)\beta W^n_{m,+1}(\eta) + s\beta U^o_{m,+1}]
\end{aligned}
$$

- "Movers" can obtain a good "manual" job with a $Proba = \lambda$
- For workers previously occupied on a "Routine" task, the reallocation is an option $\Leftrightarrow \max\{U_{r,+1}(\eta), U^n_{m,+1}(\eta)\}$.

Back to slide model

Unemployed workers Opportunities

For the unemployed worker,

$$
\begin{aligned}
U_a &= z_a + (1 - f_a)\beta U_{a,+1} + f_a \beta W_{a,+1} \\
U_m &= z_m + (1 - f_m)\beta U_{m,+1} + f_m \beta W_{m,+1} \\
U_r(\eta) &= z_r(\eta) + (1 - f_r(\eta))\beta \max\{U_{r,+1}(\eta), U^n_{m,+1}(\eta)\} \\
&\quad + f_r(\eta)\beta W_{r,+1}(\eta) \\
U^o_m &= z_m + (1 - \chi f^o_m)\beta U^o_{m,+1} + \chi f^o_m \beta W^o_{m,+1} \\
U^n_m(\eta) &= z_r(\eta) + (1 - \chi f^n_m(\eta))\beta U^n_{m,+1}(\eta) + \chi f^n_m(\eta)\beta W^n_{m,+1}(\eta)
\end{aligned}
$$

with $\chi \in (0; 1)$ the efficiency loss in the matching process when the worker chooses to change occupation. The UB, z_i, are indexed to the wage of the previous job i.

▸ Back to slide model

Back to slide model

Routine :

$$
\begin{aligned}
w^r(\eta) \quad = \quad & \frac{\gamma}{1+\tau^f}\left(y_r(\eta)+\Gamma(\tau^f_{+1},\tau^w_{+1})\frac{\phi_{+1}}{\phi}\left(c\theta_r(\eta)+f_r(\eta)k_r\right)\right) \\
& +\frac{\gamma}{1+\tau^f}\left(\frac{c}{q_r(\eta)}+k_r\right)(1-s)\left(1-\Gamma(\tau^f_{+1},\tau^w_{+1})\frac{\phi_{+1}}{\phi}\right) \\
& +\frac{1-\gamma}{1-\tau^w}\left(p_s h+z_r(\eta)+(1-s-f_r)\beta\max\{0,U^n_{m,+1}(\eta)-U_{r,+1}(\eta)\}\right)
\end{aligned}
$$

Manual (new movers) :

$$
\begin{aligned}
w^n_m(\eta) \quad = \quad & \frac{\gamma}{1+\tau^f}\left[p_s\delta A_s+\Gamma(\tau^f_{+1},\tau^w_{+1})\frac{\phi_{+1}}{\phi}\left(c\theta^n_m(\eta)+f^n_m(\eta)k_m\right)\right] \\
& +\frac{\gamma}{1+\tau^f}\left(\frac{c(1-\lambda)}{q^n_m(\eta)}+\frac{c\lambda}{q_m}+k_m\right)(1-s)\left[1-\Gamma(\tau^f_{+1},\tau^w_{+1})\frac{\phi_{+1}}{\phi}\right] \\
& +\frac{1-\gamma}{1-\tau^w}\left[p_s h+z_r(\eta)+\beta\left(\lambda(U^n_{m,+1}(\eta)-U_{m,+1})+s(1-\lambda)(U^n_{m,+1}(\eta)-U^o_{m,+1})\right)\right]
\end{aligned}
$$

with

$$
\phi \quad = \quad \frac{\gamma}{1-\gamma} \tag{1}
$$

$$
\Gamma(\tau^f_{+1},\tau^w_{+1}) \quad = \quad \frac{1+\tau^f}{1+\tau^f_{+1}}\frac{1-\tau^w_{+1}}{1-\tau^w} \tag{2}
$$

A complex numerical algorithm

- A non-stationary problem : a structural change of the economy

  $\Rightarrow$ standard methods of approximation of the dynamics around a unique SS are not implementable here.

- There are several regimes

  $\Rightarrow$ Even if we know the initial and the final steady states, the dynamics takes into account the transitional labor reallocations (non-linear problem of occupational choice) and the MW, which can binds or not, depending on the evolution of the economy.

- There are heterogeneous workers, and this heterogeneity matters or not depending on the occupation of the worker. $\Rightarrow$ The size of the model is very large (more than 1500 dynamic equations).

- General equilibrium model : labor re-allocation affects relative production, hence relative price of good, hence feed-back effects on labor re-allocation

- **A time-consuming process to solve this new type of problem**

The expected interest of the analysis at the GE

- Our contribution
  - There is an impact of the growth on aggregate employment

  $\Rightarrow$ An unbalanced growth path leads to capitalization effects for the favored jobs (skilled workers) and to reallocation phenomena (unskilled workers)

  $\Leftrightarrow$ First general equilibrium effect.
  - There are consumers, and thus interaction between worker groups through the utility function.

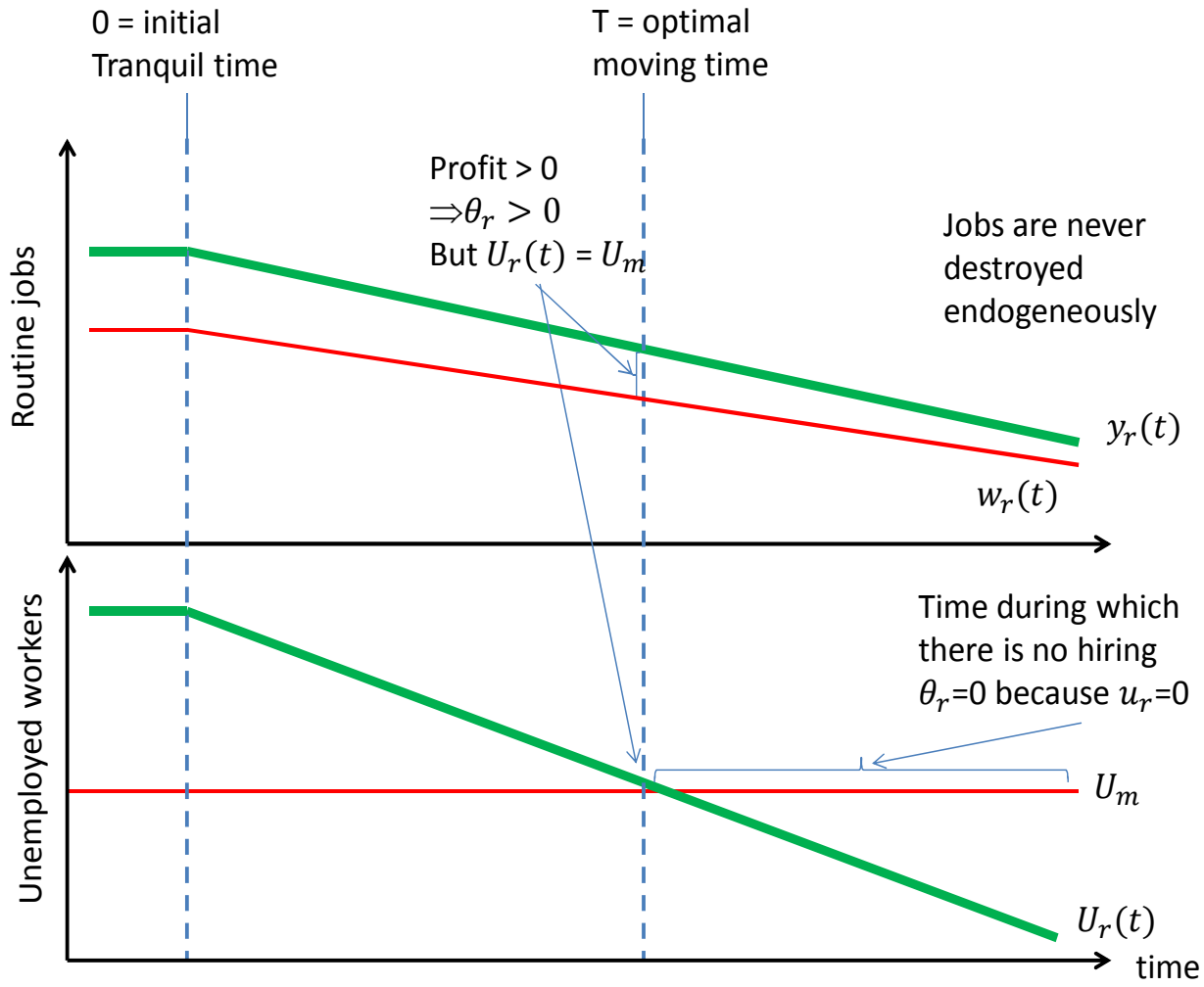
  $\Rightarrow$ The values of the manual jobs dependent from the abstract and routine jobs

  $\Leftrightarrow$ Second general equilibrium effect.
  - There is a combination, specific to each country, of the dynamics of the TBTC and LMI, affecting both the level and the structure of the employment.

  $\Leftrightarrow$ Third general equilibrium effect.

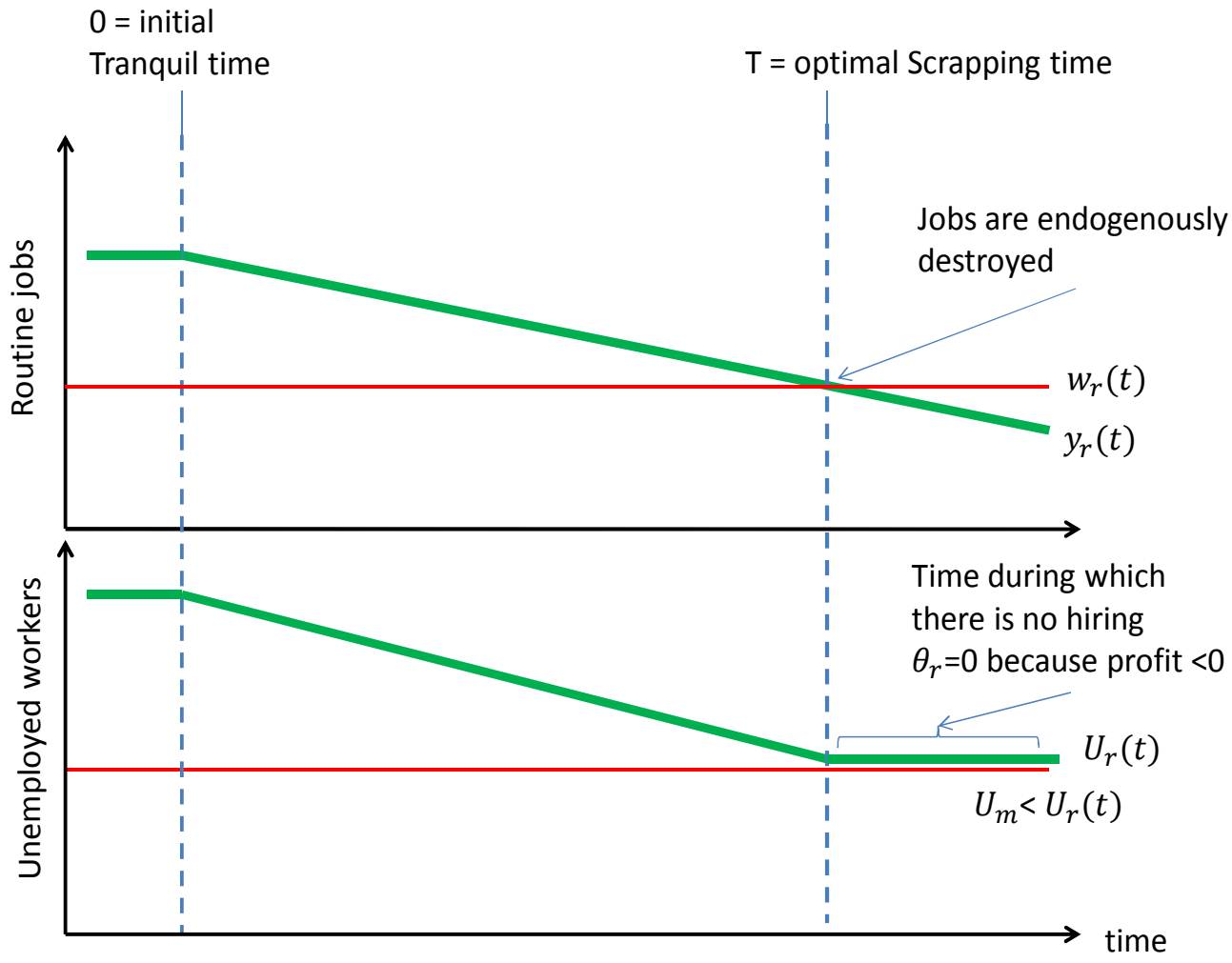
Non-binding scrapping-time with flexible wage

Back



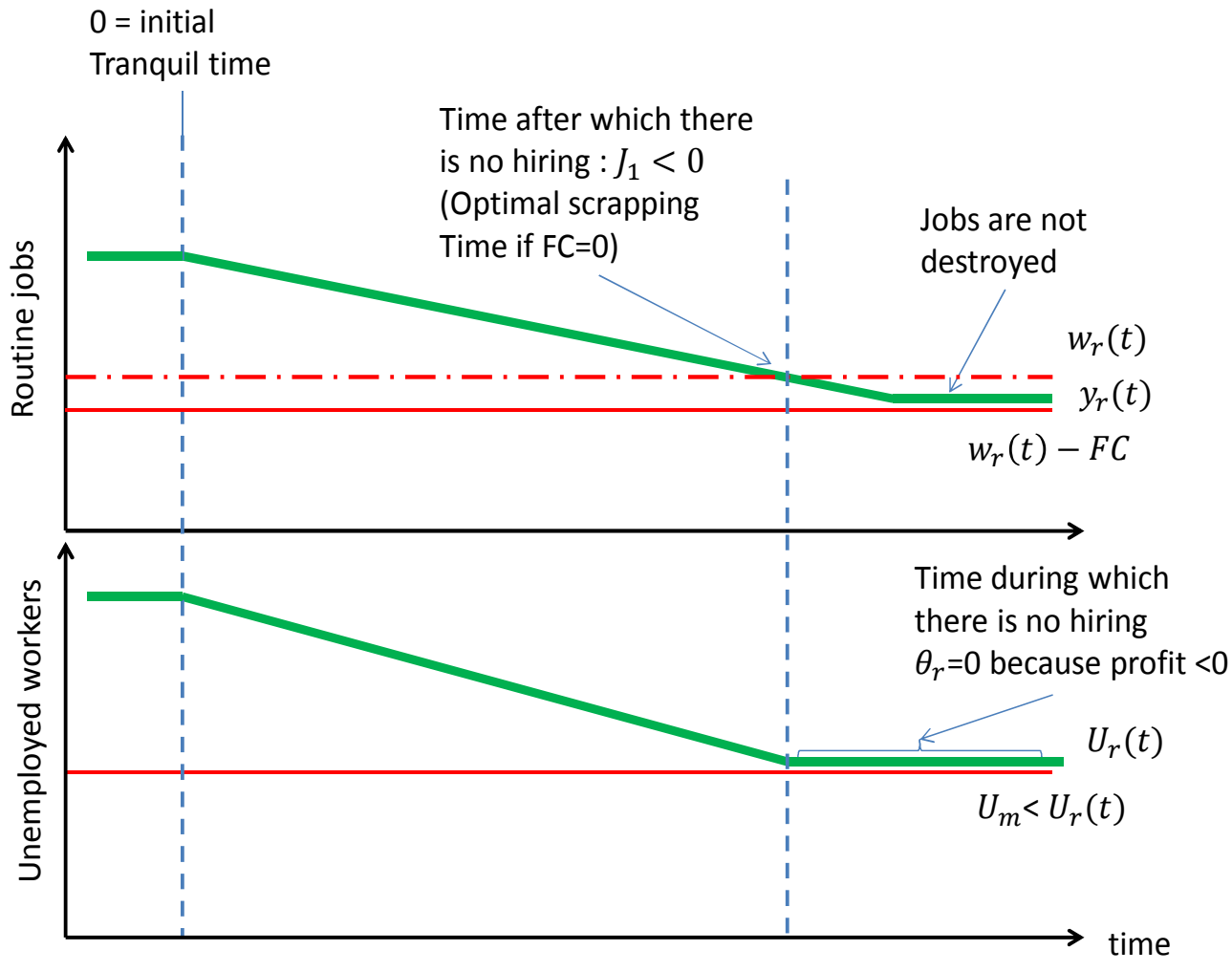
Binding scrapping-time with rigid wage

Back



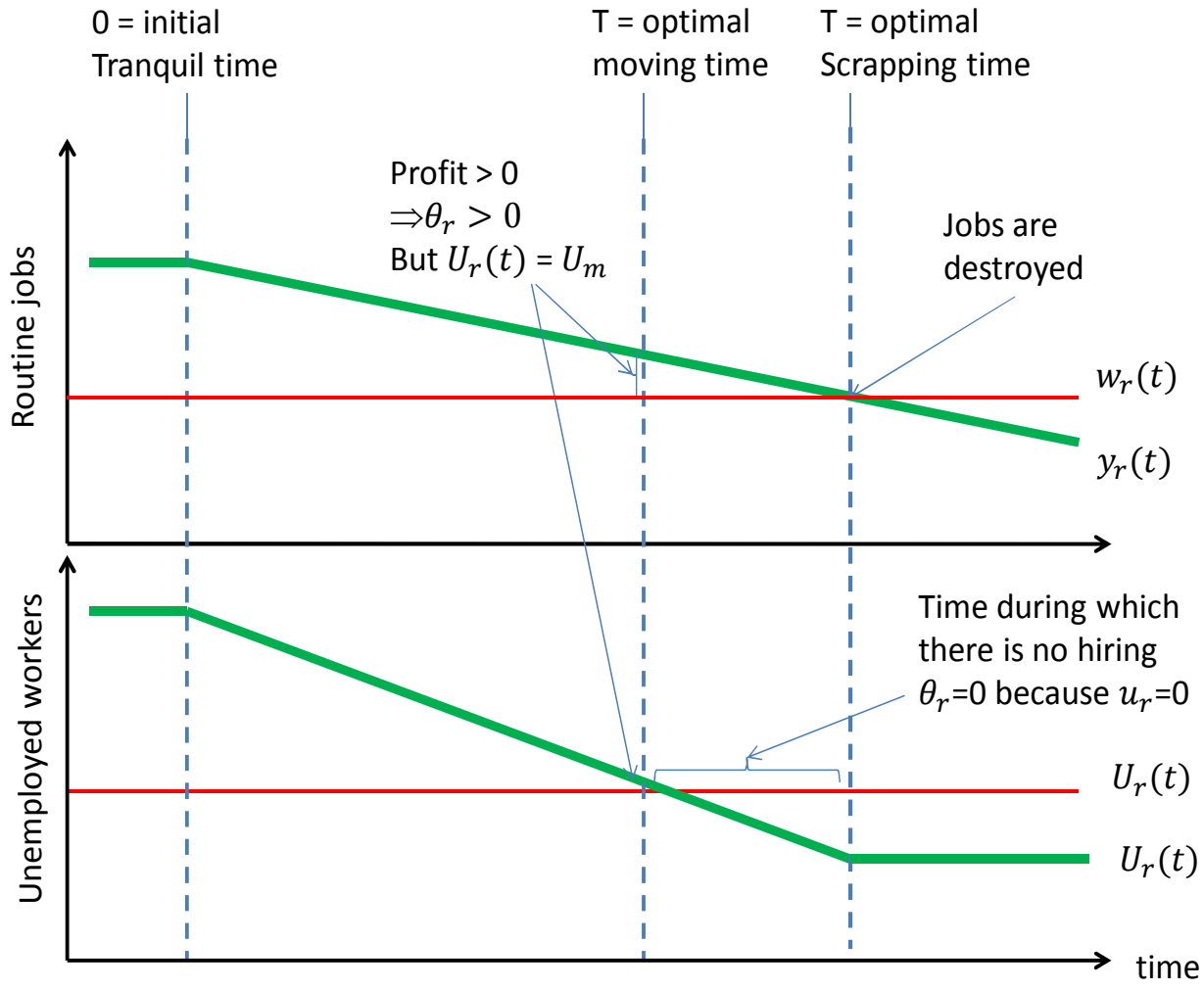
Scrapping-time with rigid wage and firing costs

Back

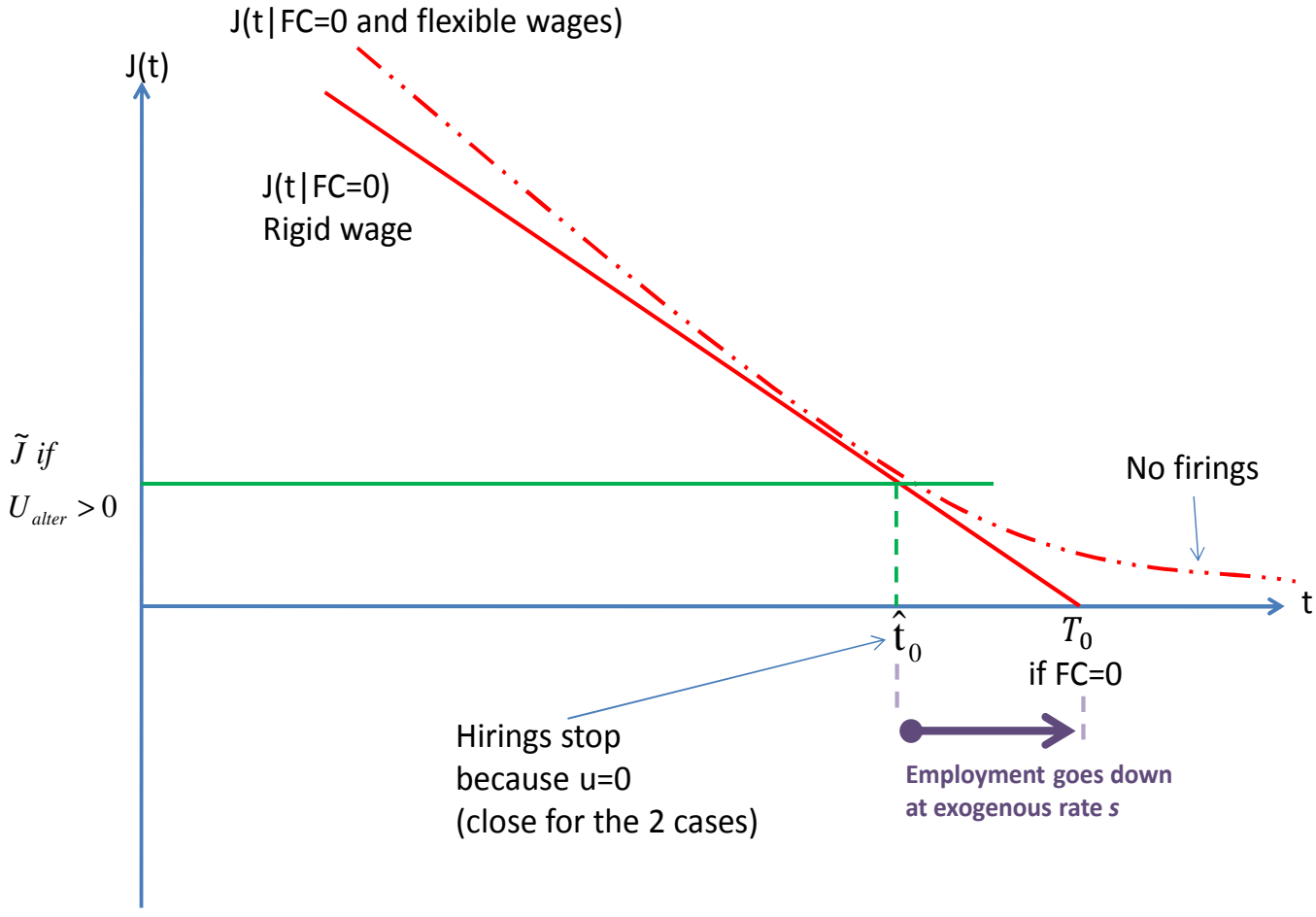


The interaction between moving time and scrapping time

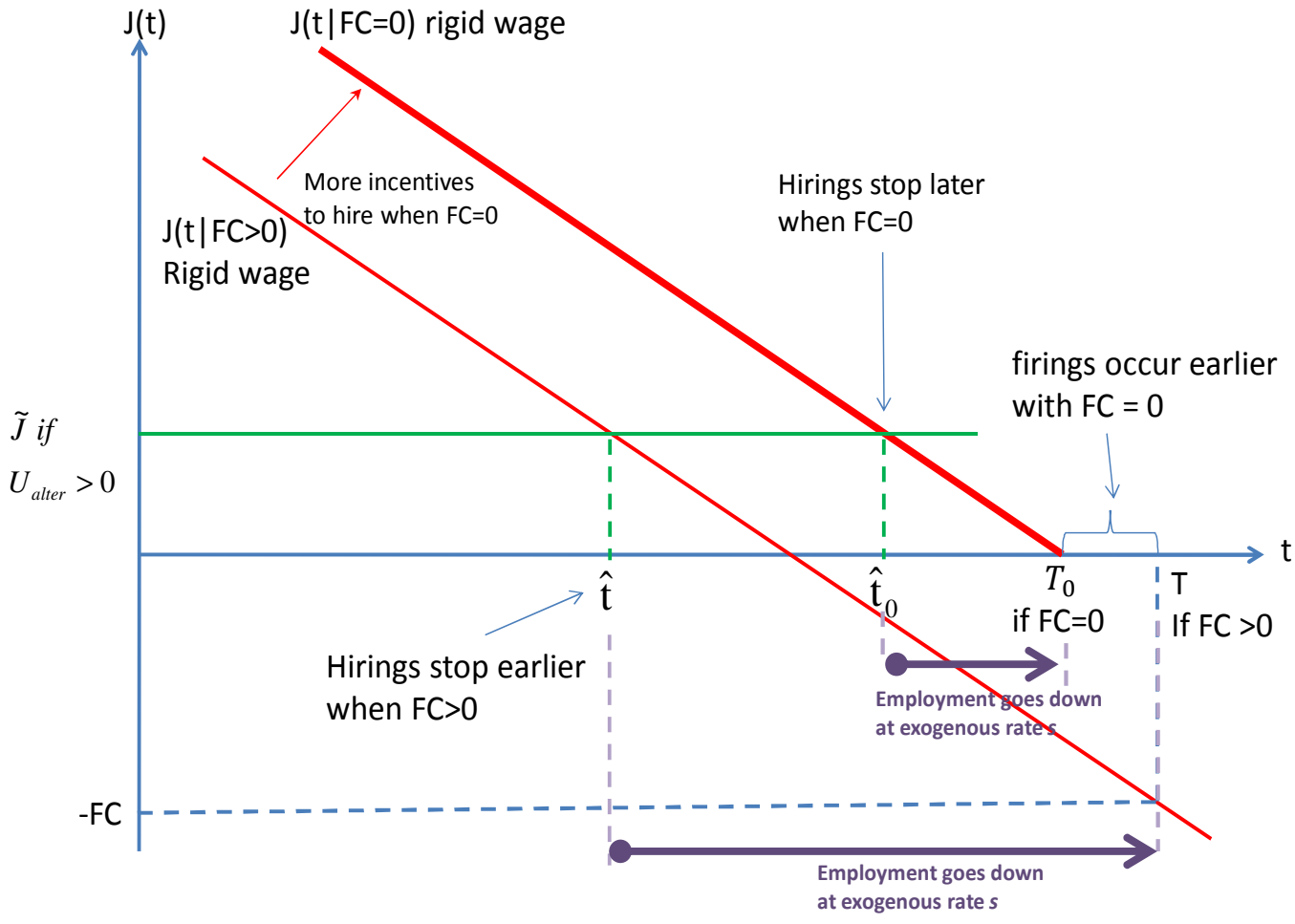
Back



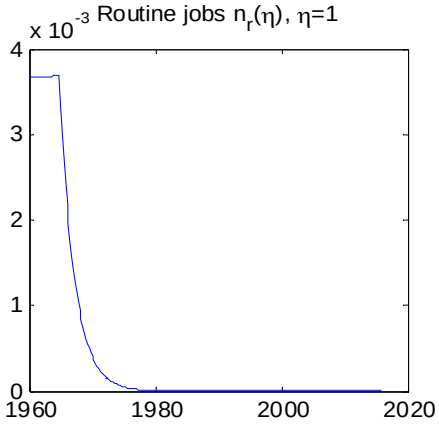
The interaction between moving time and scrapping time

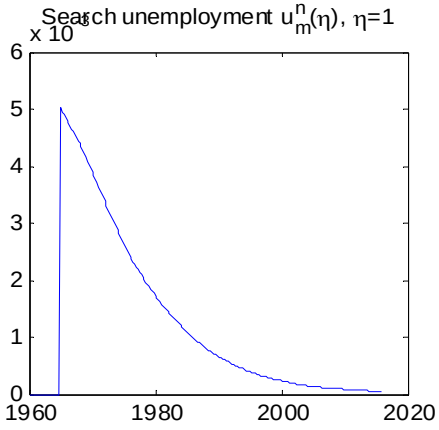


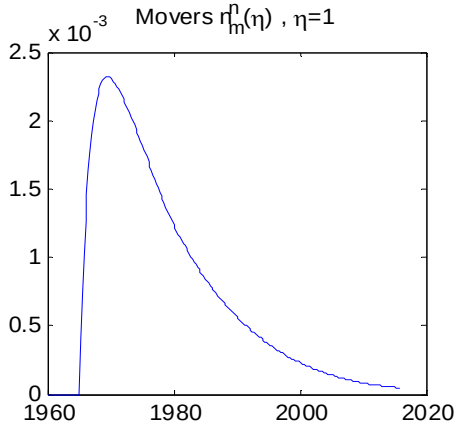
The interaction between moving time and scrapping time, with firing costs



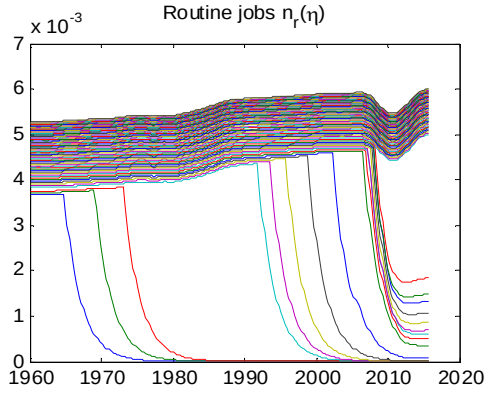
Employment reallocation in the US

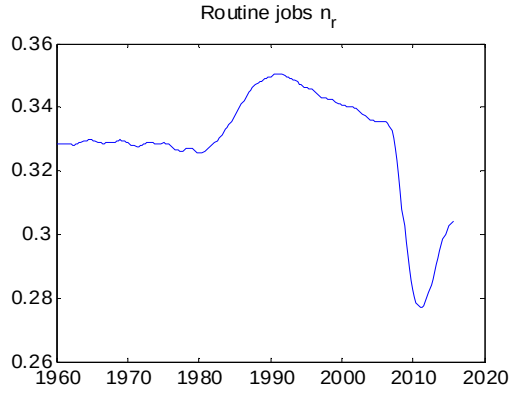


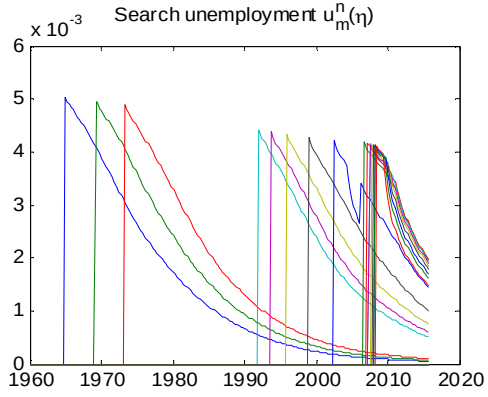


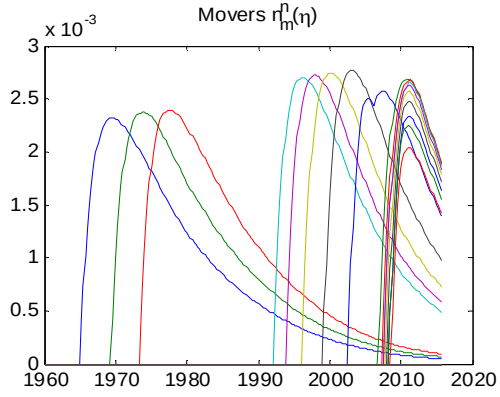


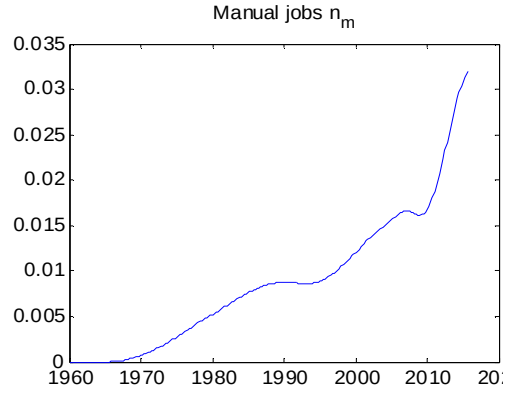
Employment reallocation in the US











In a frictionless labor market

Back to slides

In Autor and Dorn (2013), the impact of the Task-Biaised Technological Change (TBTC) is governed by two equations

$$\text{Worker Mobility} : \tilde{\eta} y_r = A_s p_s \quad \text{Demand} : p_s = MRS(C_g, C_s)$$

where MRS is the marginal rate of substitution between goods, and $F(K, L_a, L_r) = AL_a^{\alpha}[((1-\mu)Lr)^{\sigma} + (\mu K)^{\sigma}]^{\frac{\alpha}{\sigma}}$ the production function of goods, leading to $y_r = F'_{L_r}$. The mobility condition determines the ability threshold $\tilde{\eta}$ below which workers choose manual jobs. Thus, if the elasticities of substitutions of $F(\cdot)$ and the $MRS(\cdot)$ depend on $\{\sigma, \alpha\}$ and ρ respectively, then the impact of the TBTC depends only on these 3 parameters. There is no labor supply elasticity because the supply of skilled labor is fixed in all markets.

In a partial equilibrium (p_s is constant and exogenous), we have in a matching model :

$$\text{Mobility :} \quad U(\theta_r(\tilde{\eta}), LMI) = U(\theta_m, LMI)$$

$$\text{where Hirings :} \quad \begin{cases} \theta_r(\eta) &= \varphi_r(\eta y_r, LMI) \\ \theta_m &= \varphi_m(A_s p_s, LMI) \end{cases}$$

We deduce that the mobility between labor market segments is governed by :

$$\varphi_r(\tilde{\eta} y_r, LMI) = \varphi_m(A_s p_s, LMI)$$

As previously, the impact of the TBTC depends on $\{\sigma, \alpha\}$ (and ρ if p_s is endogenous), but now, combined with $LMI = \{\underbrace{r, h}_{w^r}, \underbrace{\gamma, c}_{w_{Nash}}, \underbrace{MW, \omega, \overline{w}}_{\text{wage rigidity}}\}$ and thus on the labor supply elasticity (extensive margin).

Assume for simplicity that

- the wage is bargained *à la* Hall and Milgrom (2008). In this case, we have $w_r(\eta) = \gamma\eta y_r + (1-\gamma)(h + z_r(\eta))$ and $w_r(\eta) = \gamma p_s A_s + (1-\gamma)(h + z_m)$
- There is no social programs, and the unemployment benefits are proportional to productivity $z_r(\eta) = r\eta y_r$ and $z_m = r p_s A_s$, with r the replacement ratio.

The wage becomes $w_r(\eta) = (\gamma + (1-\gamma)r)\eta y_r$ and $w_m = (\gamma + (1-\gamma)r)p_s A_s$.
Under the assumption that y_r and p_s are constant (equilibrium growth path), mobility across labor market segments is governed by :

$$\eta y_r \left[r + \frac{\beta f_r(\eta)\gamma(1-r)}{1-\beta(1-s-f_r(\eta))} \right] = p_s A_s \left[r + \frac{\beta f_m \gamma(1-r)}{1-\beta(1-s-f_m)} \right]$$

This equation has a trivial solution : $\tilde{\eta} y_r = p A_m$. This comes from the proportionality of all values function to productivity and from the symmetry between routine and manual functional forms ($f_r(\cdot) = f_m(\cdot)$). In this case, the occupational choice is governed by the same equation as in Autor and Dorn (2013).

Thus, assume now that p_s is constant but y_r decreases at the rate g (ie. $y_r(t+1) = (1-g)y_r(t)$). We deduce that the occupational choice is now given by :

$$\eta y_r \left[r + \frac{\beta f_r(\eta)\gamma(1-r)}{1-\beta(1-g)(1-s-f_r(\eta))} \right] = pA_m \left[r + \frac{\beta f_m \gamma(1-r)}{1-\beta(1-s-f_m)} \right]$$

The capitalization effect in the LHS, and absent in the RHS, implies that $\tilde{\eta} y_r = A_m p_s$ is not the equation that determines the ability threshold $\tilde{\eta}$ below which workers allocate to manual jobs.

A simple way to interpret the previous equation is to notice that it defines $\tilde{\eta}$ as follows :

$$\Gamma(\tilde{\eta}, g) = \Upsilon \quad \text{with } \Gamma'_1(\eta, g) > 0 \text{ and } \Gamma'_2(\eta, g) < 0$$

When $g = 0$, the solution is, as previously and as in Autor and Dorn (AD), $\tilde{\eta}_{AD} y_r = p_s A_m$, whereas, when $g > 0$, $\tilde{\eta} < \tilde{\eta}_{AD}$: Search and matching reduces the magnitude of the reallocation process such that less workers reallocate to manual jobs. Due to search and matching, employment is an investment decision : time matters, and thus the capitalization of future profit flows. If profit flows are expected to decline, firms' incentive to open vacancies is reduced. This leads workers to leave earlier the labor market of the routine jobs than in a frictionless market. This results appears even if wage is flexible (Nash bargaining rule) and even if there is no revenues non-indexed on wages, like social program. The gap between $\tilde{\eta}$ and $\tilde{\eta}_{AD}$ depends on the level of LMI, ie. in this example on $\{r, \gamma, c\}$.

- Need accurate data to pin down search costs
- Expected effects ?
- For example, ambiguous effects for predictions on EPL
  - With J2J, lower value of the firm (lower expected duration of the job) then, profit becomes negative sooner, hence larger effect of FC
  - With J2J, more workers leave the firm before profits become negative, hence, there are fewer workers when profit becomes negative, hence smaller effect of FC

Model parameters : values based on external information

Back to main slide

Matching	$c^\star$	$c_a^\star$	$\psi^\star$	$s^\star = s_a^\star$	$\Upsilon^\star$
	0.15	$2c^\star$	0.5	0.0125	0.025
Preferences	$\beta^\star$	$h_s^\star$	ρ	ν	
	4%	0	0.825	0.6	
Technology	A	A_s	σ	α	μ
	4.5	0.95	0.78	0.6	0.5
Learning	$\delta^\star$	$\chi^\star$	$\lambda^\star$		
	0.9	1	0.025		
Wage norms	$\omega_{a,US}$	$\omega_{a,Fr}$	$\omega_{a,Ger} = \omega_{r,Ger}$		
	0.95	0.1	0.55		
Adjustments	g_{p_k}	g_{L_a}	g_{rr}	g_{h_u}	g_{MW}
	0.012	0.005	0.03	0.03	0.02

Blue : "estimated" parameters

Model parameters : calibration $dim(\Phi) = dim(\Psi)$

Back to main slide

The other set of parameters $\Phi = \{\Phi_1, \Phi_{2,US}, \Phi_{2,F}, \Phi_{2,G}, \Phi_3\}$:

$$\begin{aligned}
\Phi_1 &= \left\{ \rho, \nu, A, \sigma, \mu, \alpha, A_s, p_k(0), p_k(T), \overline{\eta}, \underline{\eta}, \sigma_\eta \right\} \\
\Phi_{2,i} &= \left\{ \omega_{a,i}, h_{u,i}(0), h_{u,i}(T) \right\}_{i=US,F} \\
\Phi_{2,G} &= \left\{ \omega_{a,G}, \omega_{r,G}, h_{u,G}(0) = h_{u,G}(T), h_{u,G}(1995) \right\}
\end{aligned}$$

The dynamics of all the exogenous variables are

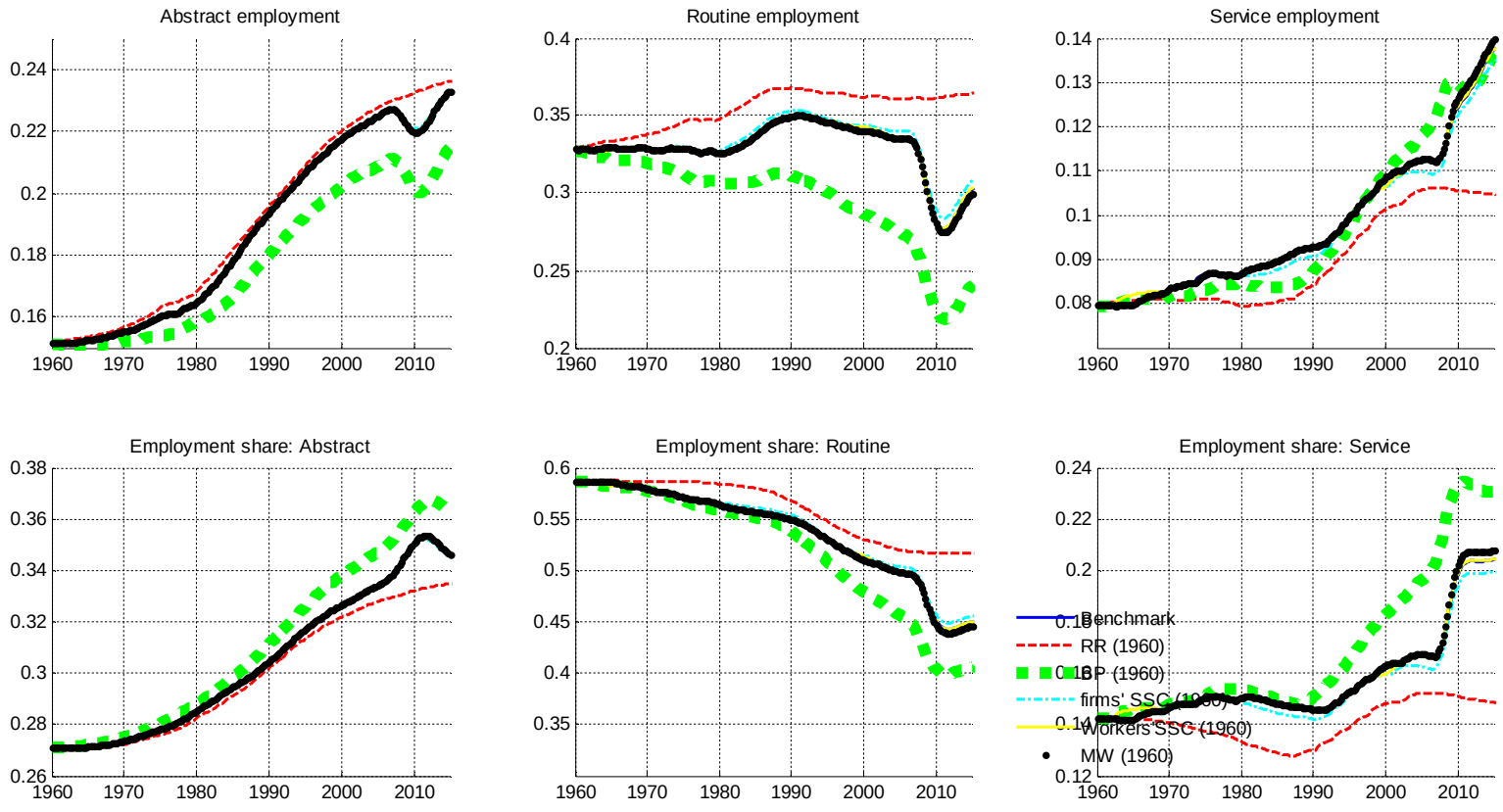
$$x(t) = (x(0) - x(T))e^{-g_x t} + x(T) \quad \text{for } t \in [0, T]$$

This adds $\Phi_3 = \{g_{p_k}, g_{L_a}, g_r, g_{h_u}, g_{MW}\}$ parameters, with $dim(\Phi) = 27$.
The targets of the calibration are :

$$\Psi = \left\{ \begin{array}{l} N_{a,i}(0), N_{r,i}(0), N_{m,i}(0), N_{a,i}(T), N_{r,i}(T), N_{m,i}(T), \\ E_i[N_a], E_i[N_r], E_i[N_m] \end{array} \right\}_{i=US,F,G}$$

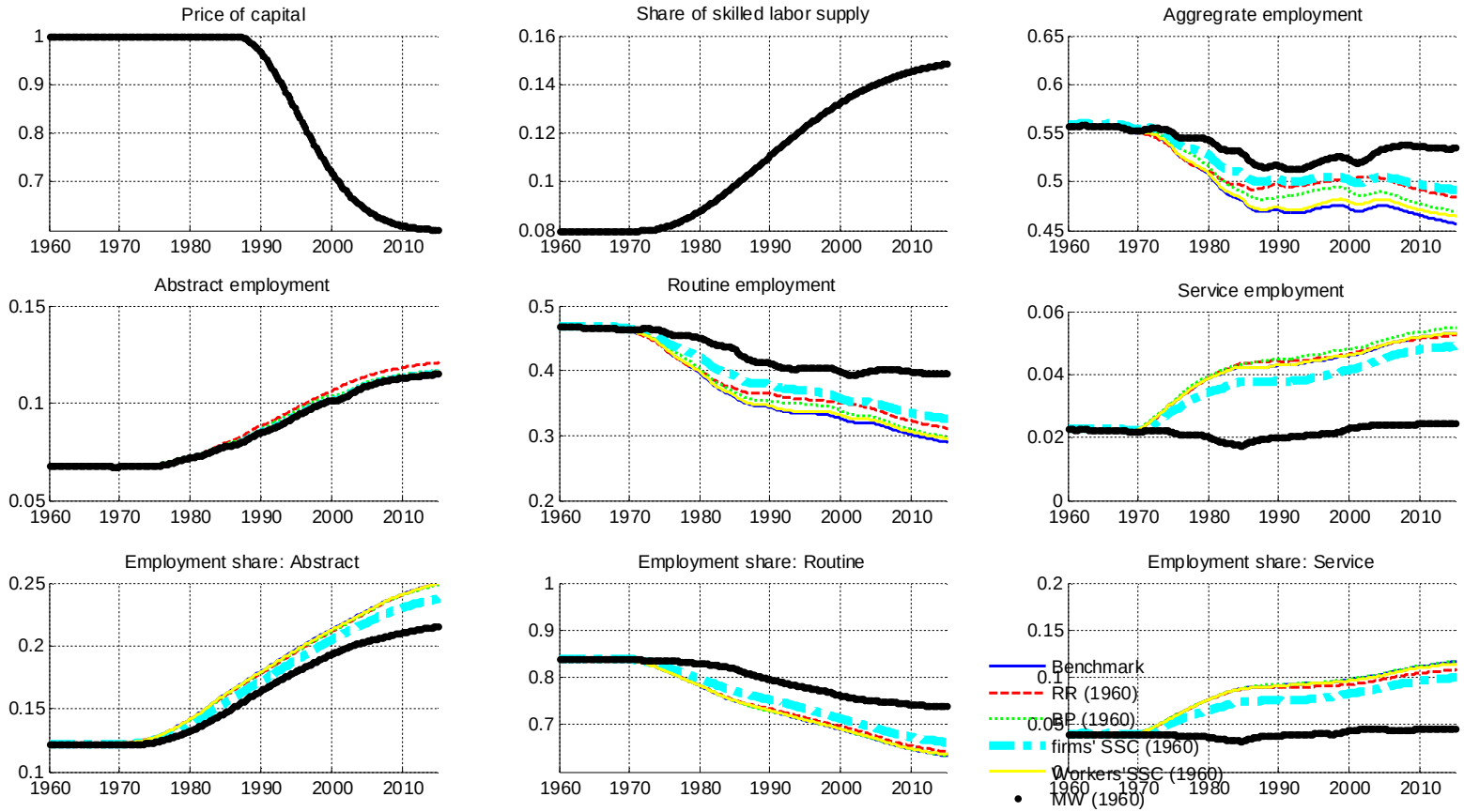
with $dim(\Psi) = 27$.

Counterfactual - TBTC/Labor supply/LMI : US



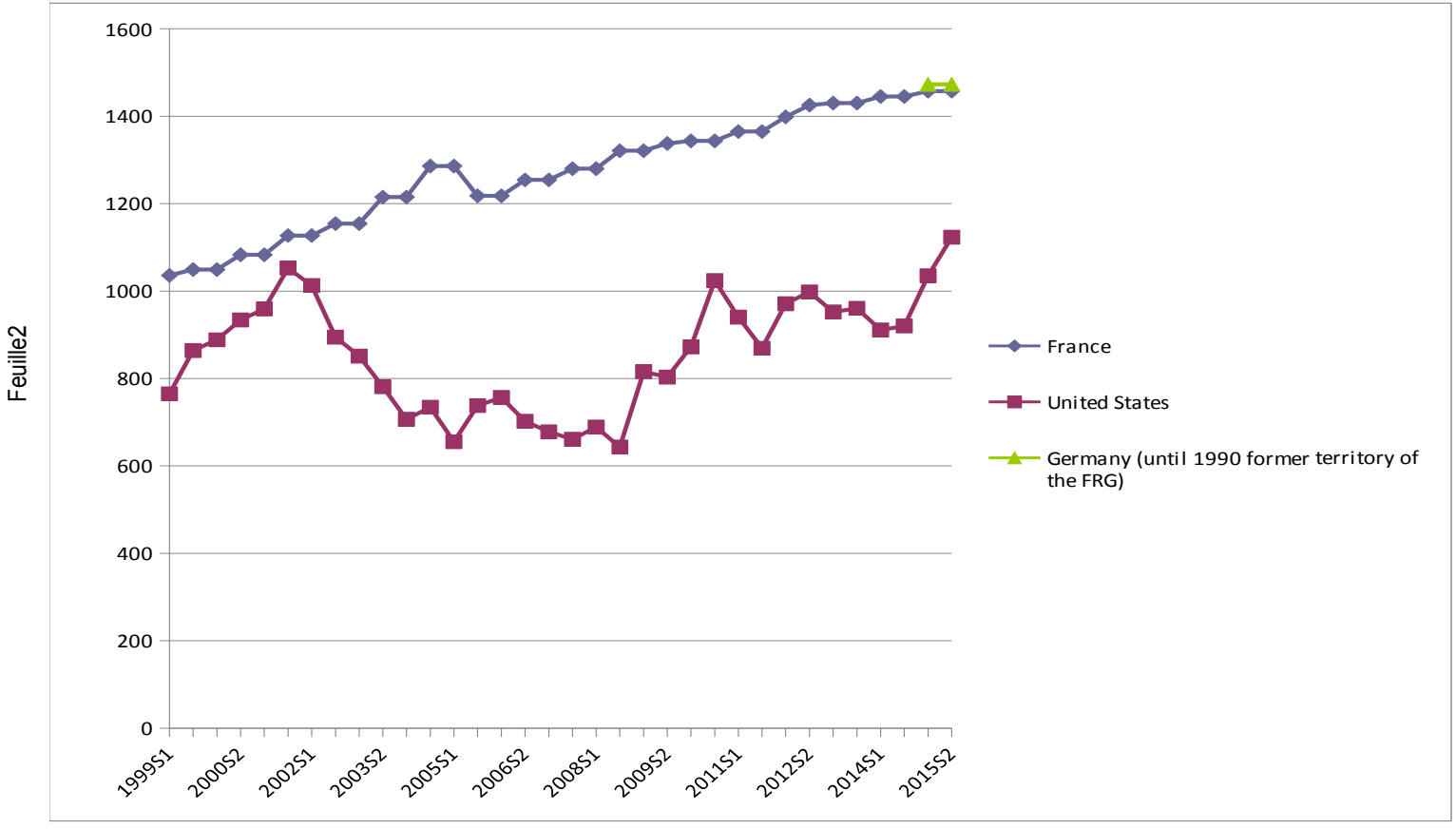
▸ Back to slides

Counterfactual - TBTC/Labor supply/LMI : France



▸ Back to slides

Minimum wage (monthly, in euros)



Eurostat

Declining price of capital

Back to

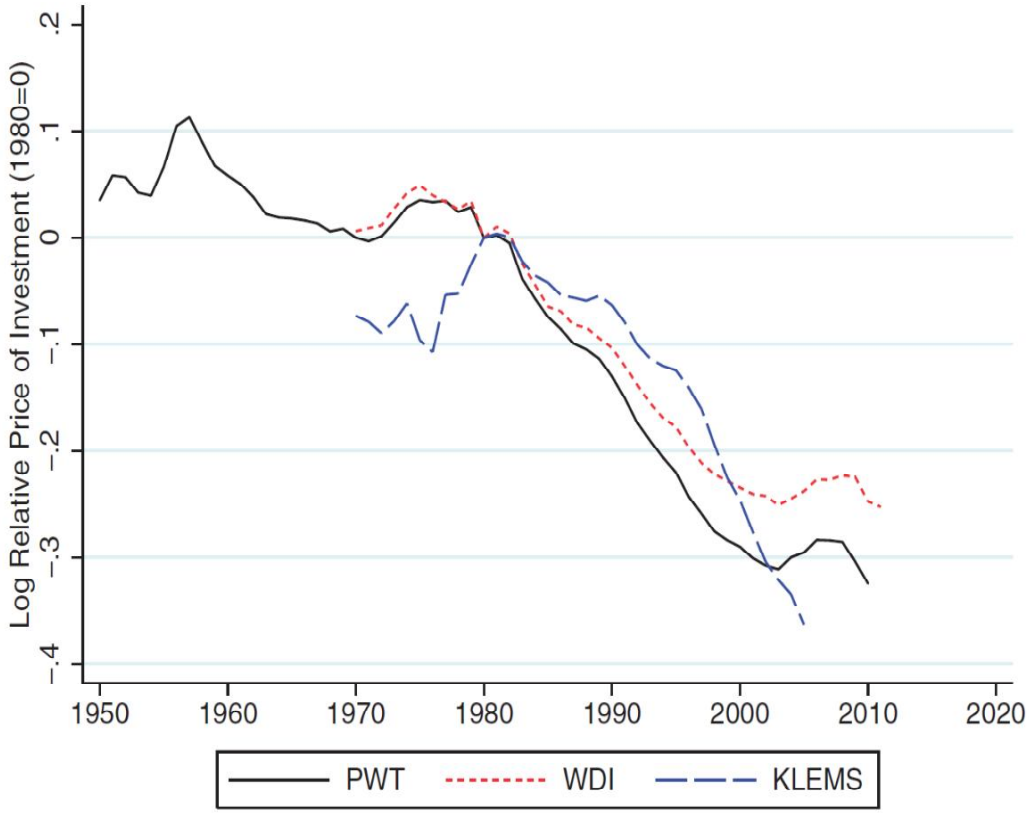


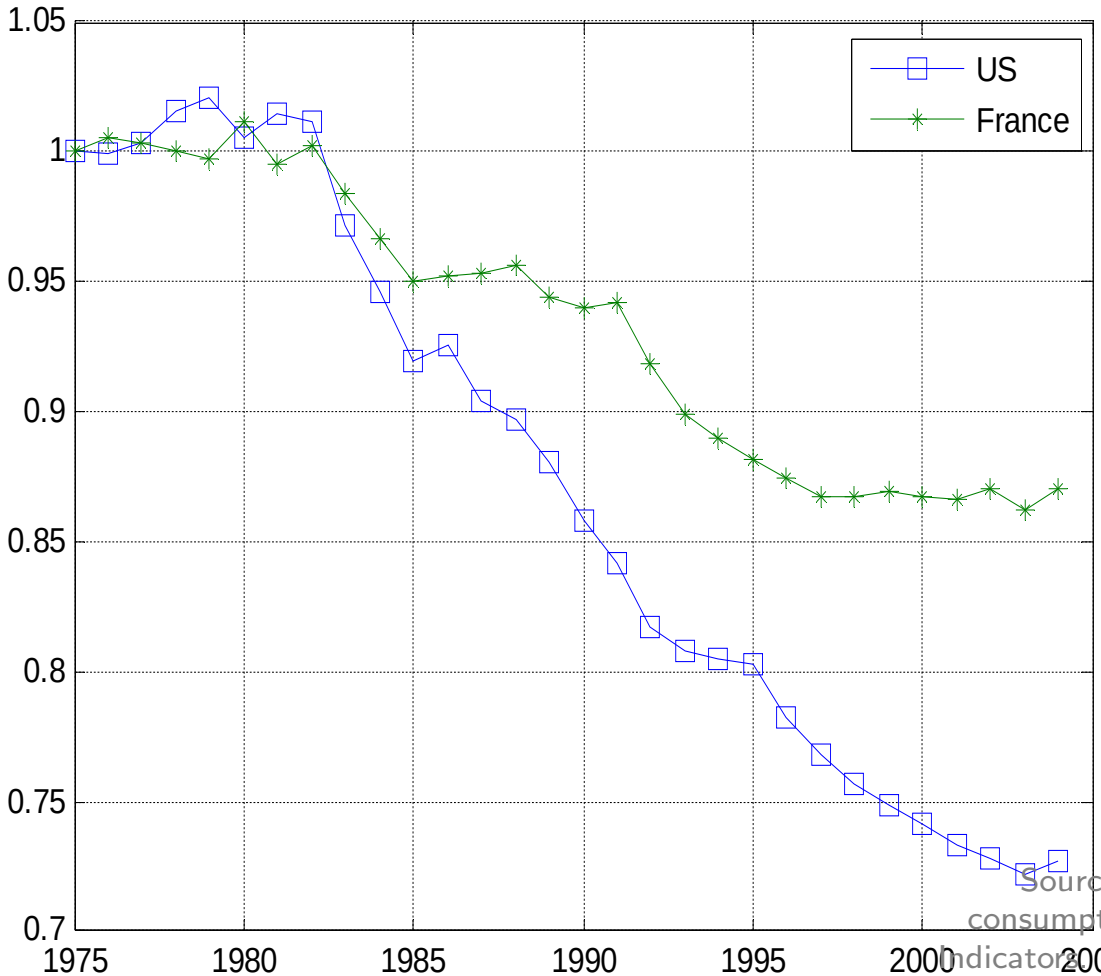
FIGURE VII

Declining Global Price of Investment Goods

Source: Source : Karabarbounis Neiman (QJE 2014).

Declining price of capital

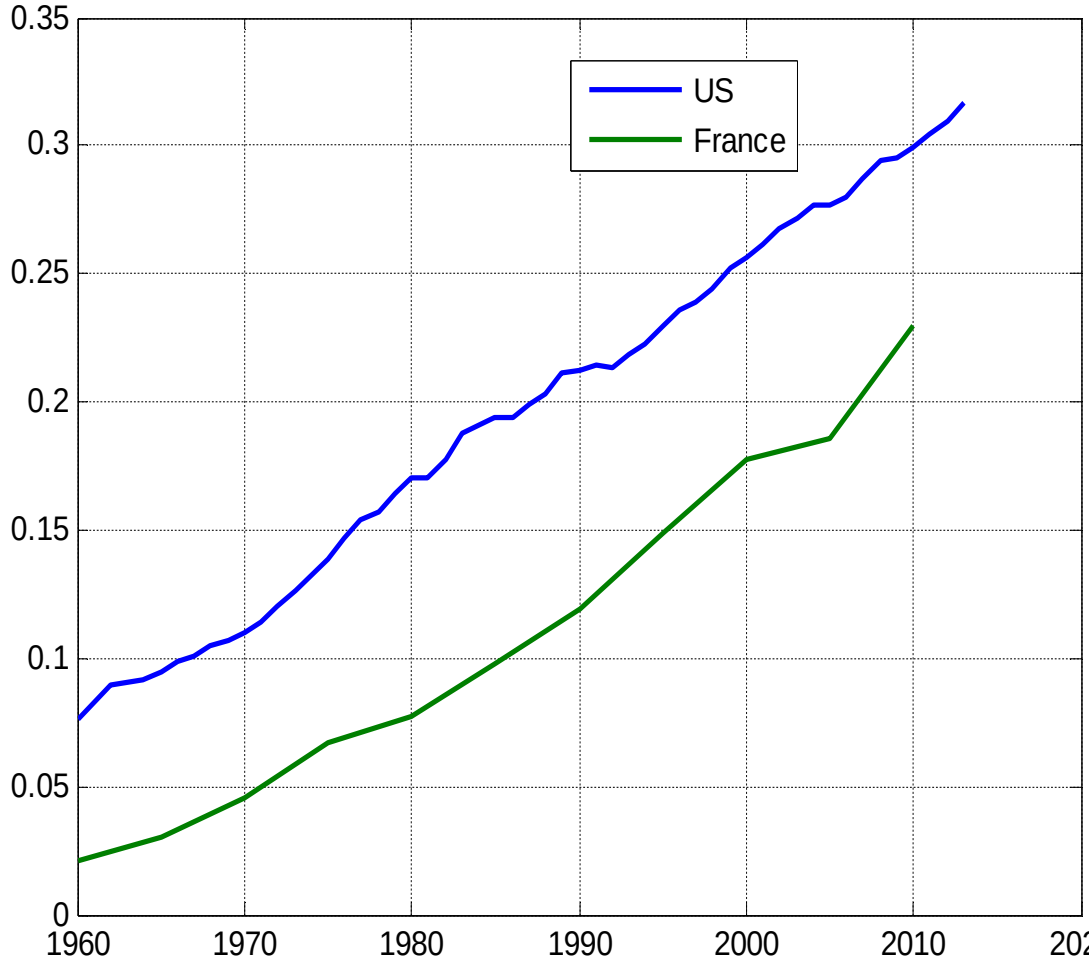
Back to slides



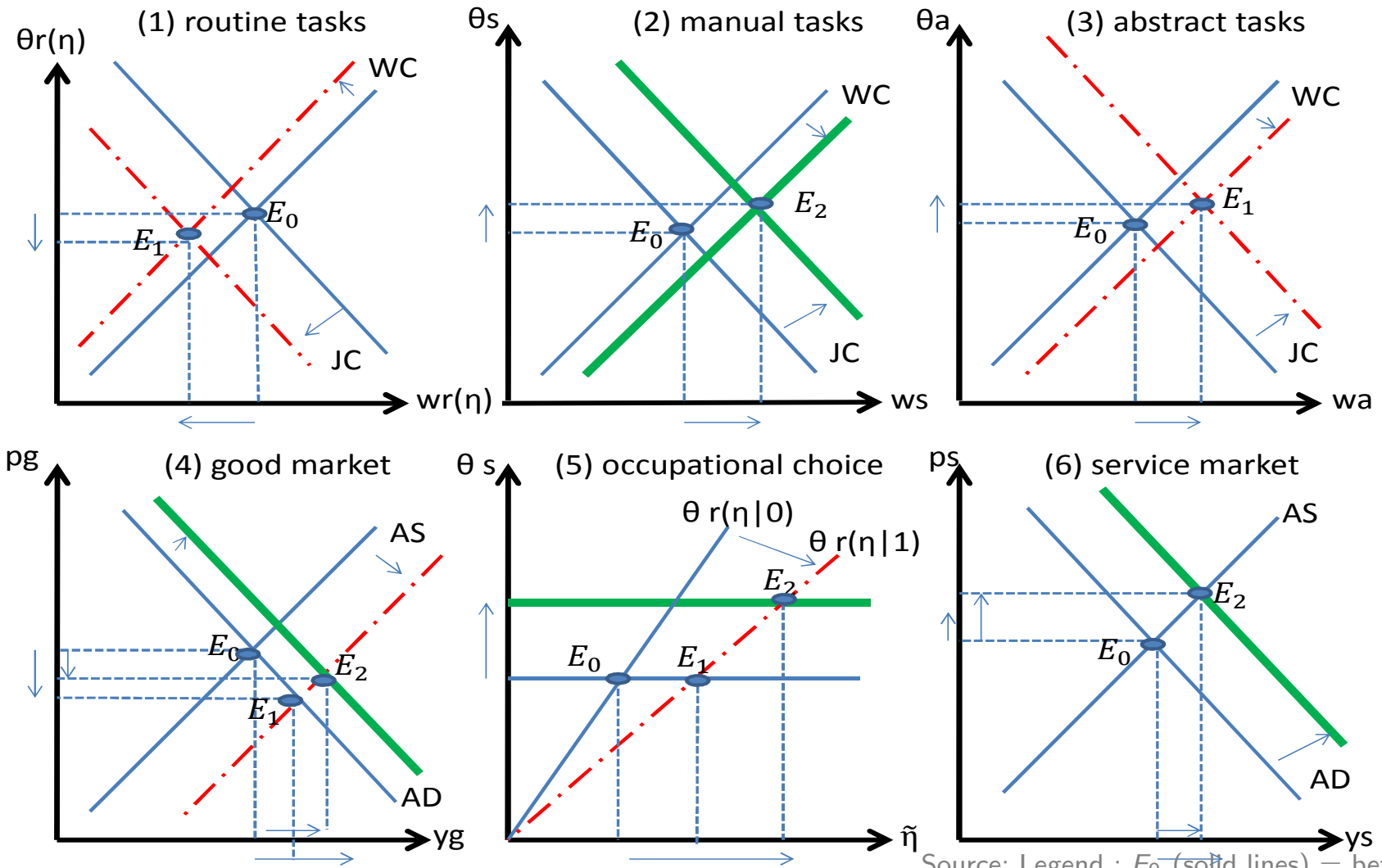
Source: Investment Price (relative to consumption price). World Development Indicators. The relative price is normalized to one in 1980.Source : Data from Karabarbounis Neiman (QJE 2014).

Increase in educational attainment

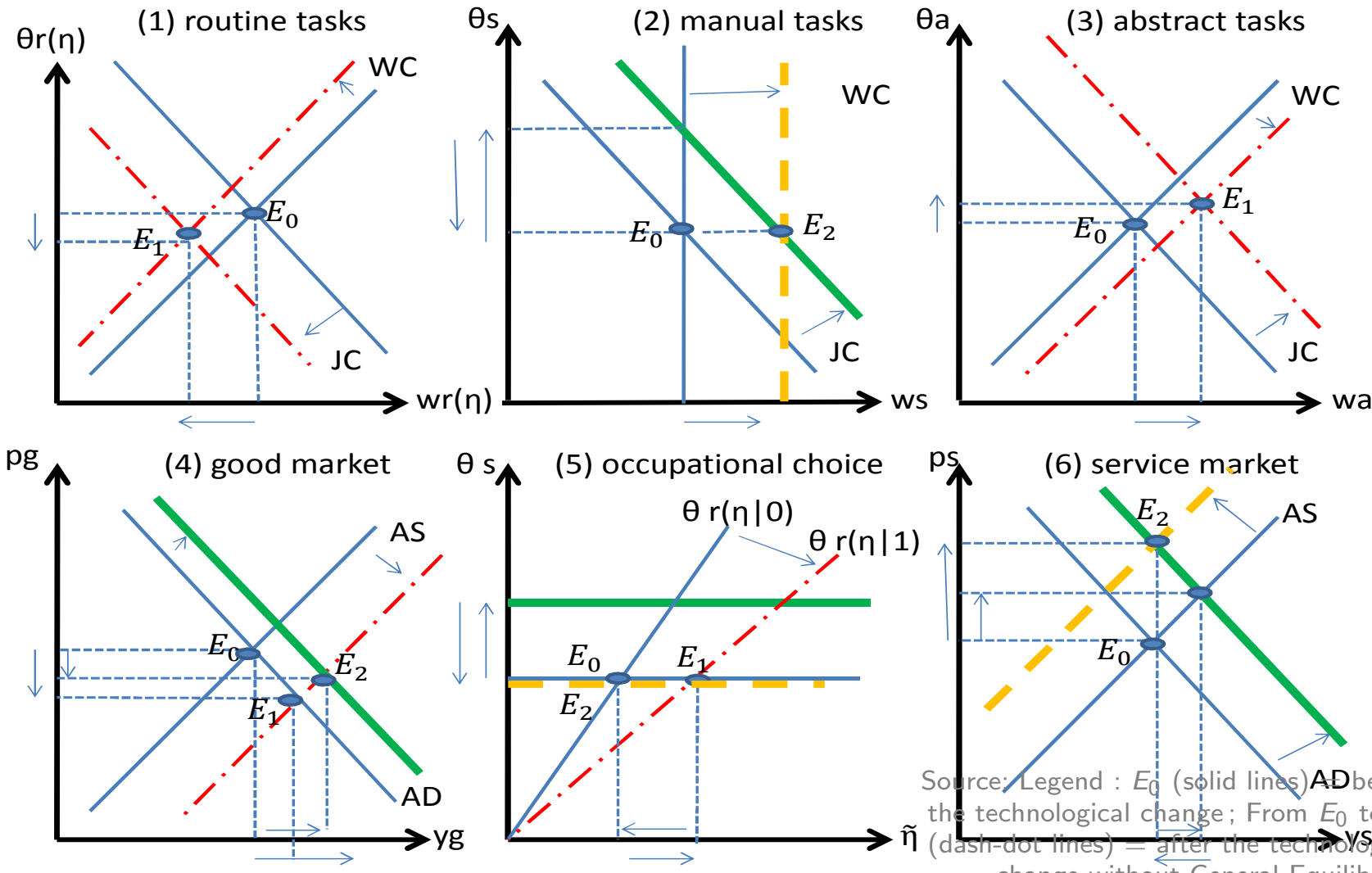
Back to slides



Source: French census. Diplôme universitaire 1er, 2ème ou 3ème cycle, BTS-DUT. US Census (Years of School Completed) College 4 years and more



Source: Legend : E_0 (solid lines) = before the technological change ; From E_0 to E_1 (dash-dot lines) = after the technological change without General Equilibrium feedback (no increase in p_s) ; E_2 (bold lines) = after the technological change with General Equilibrium feedback (after increase in p_s).



Source: Legend : E_0 (solid lines) = before the technological change ; From E_0 to E_1 (dash-dot lines) = after the technological change without General Equilibrium feedback (no increase in p_s) ; E_2 (bold lines) = after the technological change with General Equilibrium feedback (after increase in p_s) ; bold-dashed lines = rise in minimum wage