Macroeconomics A, EI056

Class 12

Labor market and unemployment

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December 11, 2023

What you will get from today class

- Banking **panics**: self-fulfilling crises and policy response.
- Unemployment and **measures** of the state of the labor market.
- Short review of minimum wage and insider-outsider models.
- Models with **asymmetric information** and **costly matching**
  - **Efficiency** wage. Unemployment occurs because the wage is relatively high to induce effort.
  - **Search** and matching. Unemployment occurs because creating job openings is costly (focus on key intuition, technical aspects in extra slides).
- Broader view on interaction between **goods** and **labor** markets, and policy.

BANK PANICS

Vulnerability of financial intermediaries

- Banks have a fundamental vulnerability because of **maturity transformation**: pool short-term deposits to fund long term projects.
- **Tension** between long term commitment to fund profitable projects and liquidity need of some depositors to use their savings in the short run.
- Maturity mismatch can lead to **self-fulfilling** panics.
- Diamond-Dybvig model, with three periods.
  - Period 0: unit mass of agents, each with one unit of endowment (good). Invest in cash or in a long term project.
  - Period 1: a share t of agents want to consume (**liquidity** need). Long term project can be liquidated, with one unit of investment giving one unit back.
  - Period 2: the other $1-t$ agents consume. Long term project gives $R > 1$ units back.

Utility and allocations

- Ex-ante agents do not know whether they will be **impatient** (consume in period 1, probability t) or **patient** (consume in period 2, probability $1-t$).
- Utility of consumption ($s=1$ if impatient, $s=2$ if patient):

$$\frac{1}{1-\sigma}\left(c_s\right)^{1-\sigma}$$

- **Autarky** allocation: $c_1^{\text{autarky}}=1$ if impatient, $c_2^{\text{autarky}}=R$ if patient.
- Liquidity risk is **idiosyncratic** and should be pooled.
- **Insurance** maximizes expected utility, subject to resource constraint.
  - Smooths consumption across states: $1<c_1^*<c_2^*<R$. ▸ Computations
  - No agent wants to claim being patient if they are not (and conversely).

Insurance through bank deposits

- What if the insurance cannot tell who is patient and who isn't?
- Bank **deposits** are the solution.
  - Everyone puts their endowment in the bank at time 0, it invests in the long project.
  - Agents can go to the bank in period 1 and get c_1^*, no questions asked.
  - They can go to the bank in period 2 and get c_2^*.
- This satisfies the resource constraints.
- **No incentive to lie**: patient agent is better of waiting than getting c_1^* in period 1 to keep until period 2.

Panics

- **Safe equilibrium**: impatient agents withdraw c_1^* in period 1 and patient agents withdraw c_2^* in period 2.
- What if some patient agents thinks that $t' > t$ agents will withdraw c_1^* in period 1? Not enough investment left to pay c_2^* to the patient agents.
- Optimal strategy for the patient agent: withdraw in period 1 and secure at least c_1^*.
- **Panic equilibrium**: if enough patient agents withdraw in period 1.
  - More that t agents withdraw c_1^*.
  - The bank pays off c_1^* until it runs out of money (failure).
- Key assumption: **sequential service** constraint, the bank does not observe how many consumers withdraw in the first period before handing out payments in the first period.

Solution: deposit insurance

- Deposit **insurance**: government promises to pay c_2^* in period 2 (maybe using tax revenue).
- No need for patient investors to withdraw at period 1. The government never has to deliver (**off-equilibrium** threat).
  - Creation of central banks in the early 20th century in response to frequent bank panics.
  - Need to monitor the bank so it does not take excessive risk.
- In reality, panics occur in bad times when the investment went wrong. The model can be extended to reflect this.
- Maturity transformation outside depository banks before the financial crisis. No deposit insurance, leading to bank runs in short term lending markets.

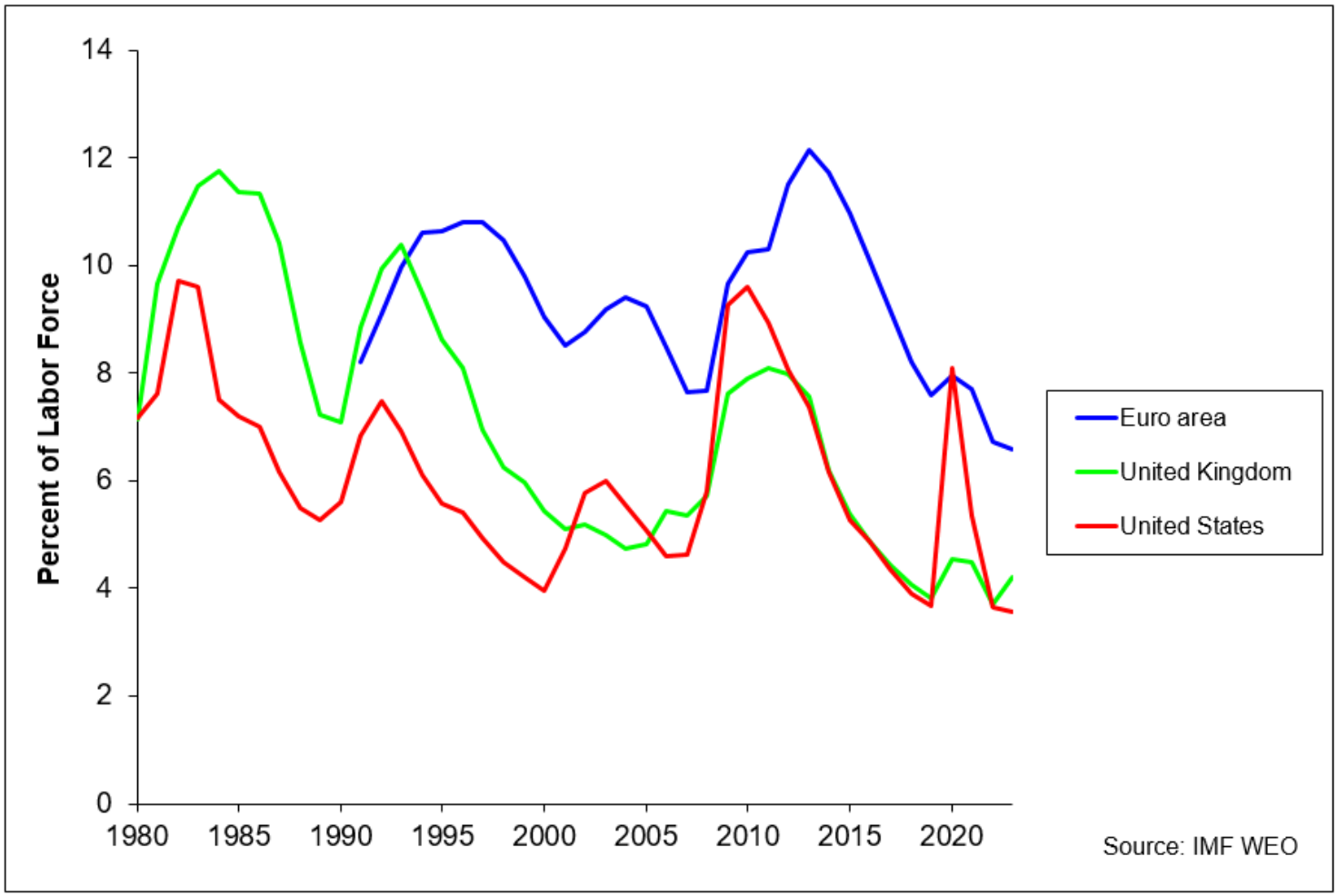
SOME FACTS

Evidence on unemployment

- Definition of unemployment: people are **willing** to work at the prevailing wage (or slightly below) but cannot find a job.
  - Not a situation where people would be willing to work at a higher wage than the prevailing one.
- Individuals can be in **three** groups.
  - Employed, with a job (including self-employment).
  - Unemployed, without a job and looking for one. Labor force = employment + unemployment.
  - Out of the labor force, without a job and not looking.
- Unemployment **rate** is the ratio of unemployment to the labor force.
  - Tends to be lower in the U.S. than in Europe (excepts in crises).
  - Substantial heterogeneity across European countries.

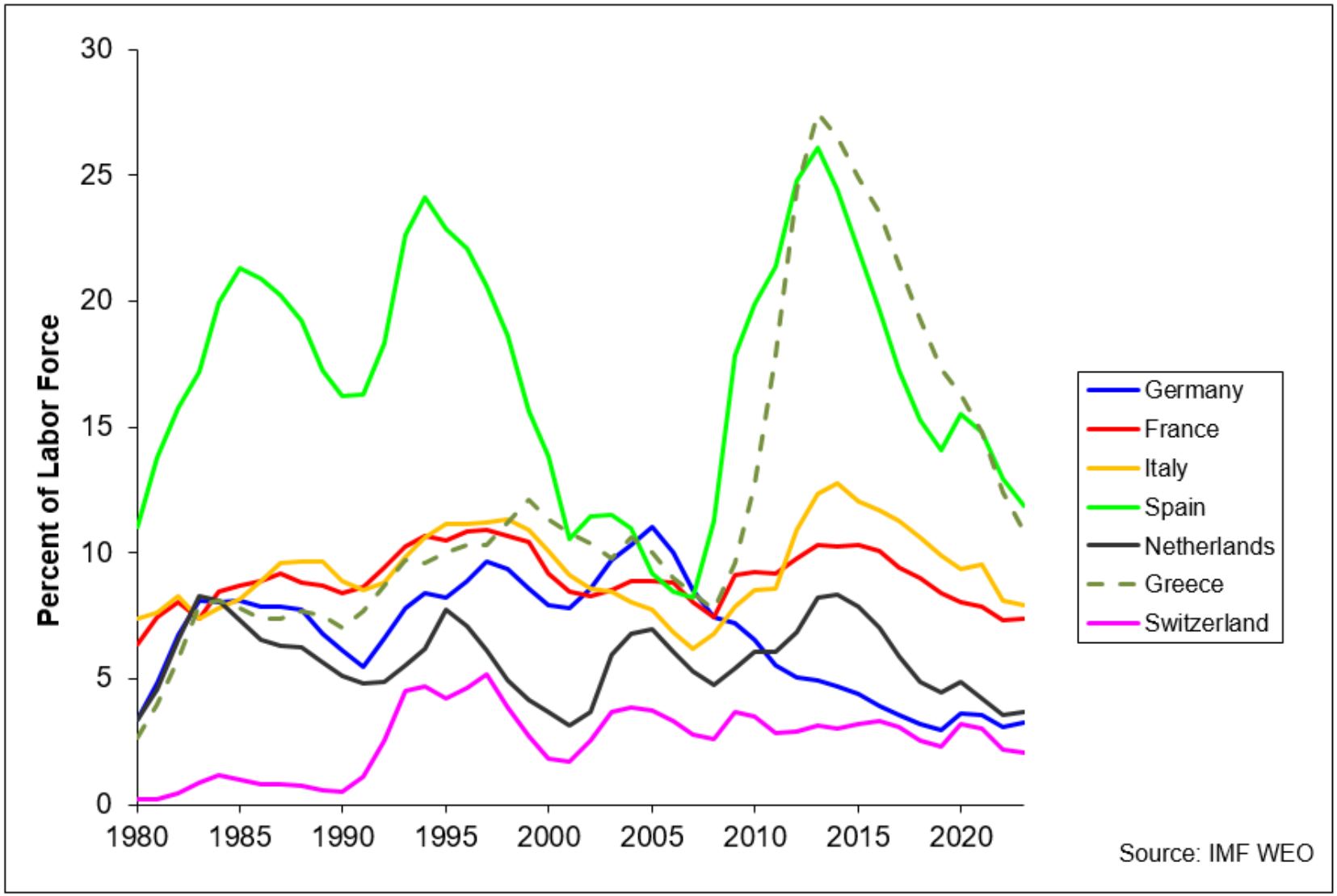
Europe vs. U.S.

- Higher unemployment in Europe on average, large increases during crises (only in U.S. during pandemic).



European heterogeneity

- Some countries had much higher unemployment than others.

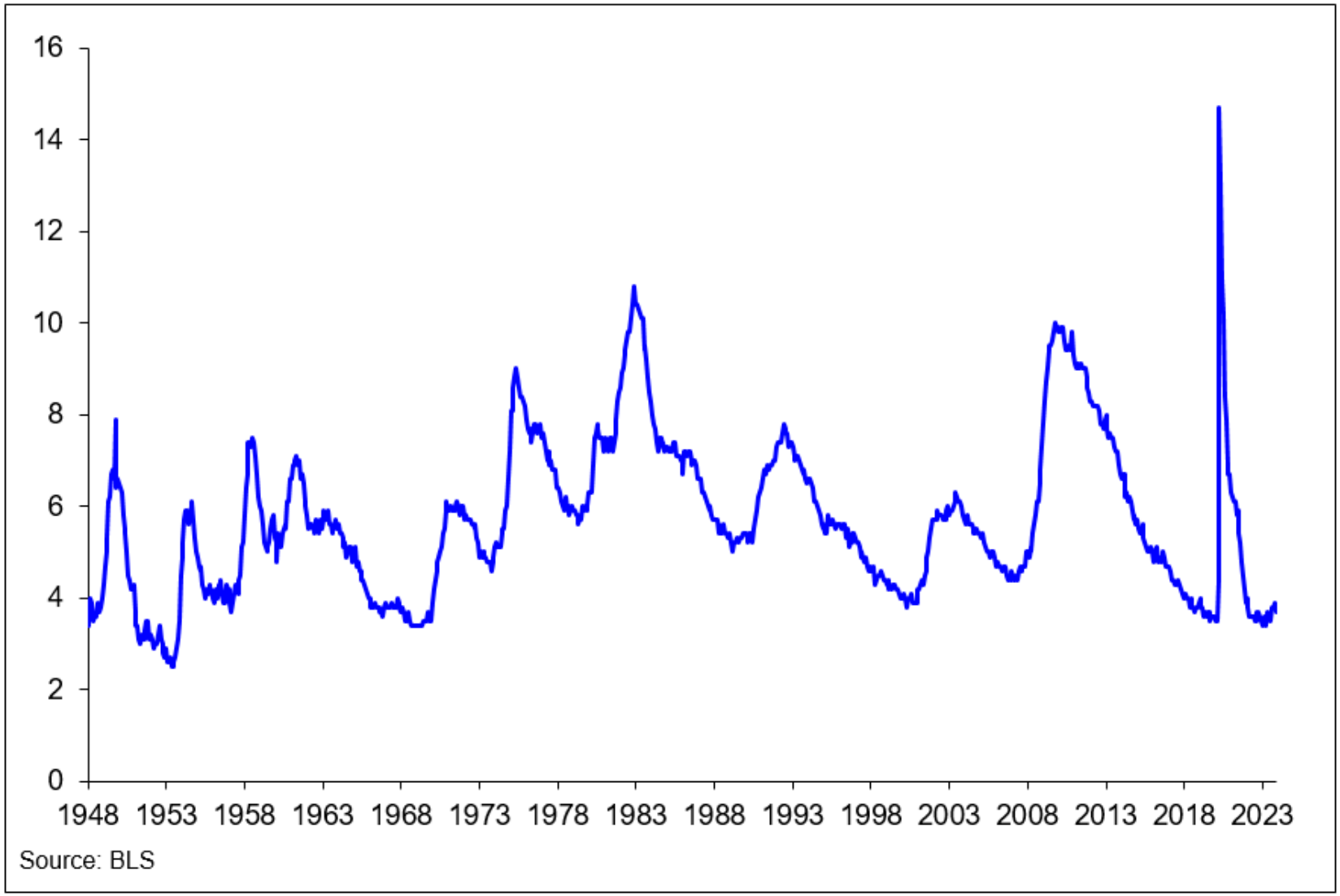


Different measures of the labor market

- **Unemployment** rate, *ur*: share of people willing to work that are not working. It ignores people who gave up looking.
- Labor force **participation** rate, *lfpr*: ratio of labor force to total population (people in and out of the labor force). It measures how many people of working age are either employed or looking.
- **Employment-population** ratio, *epr*: share of working age people that are employed (people in employment as percent of the population).
- The unemployment rate can decrease because people find jobs (higher *epr*) or because they give up (lower *lfpr*): $ur = 1 - (epr/lfpr)$.
- Take a broader view than *ur*.
  - Temporary unemployment measures in Europe (people remained in jobs, paid by the unemployment insurance).
  - *epr* gives a better picture for Europe, especially prime age (25-54).

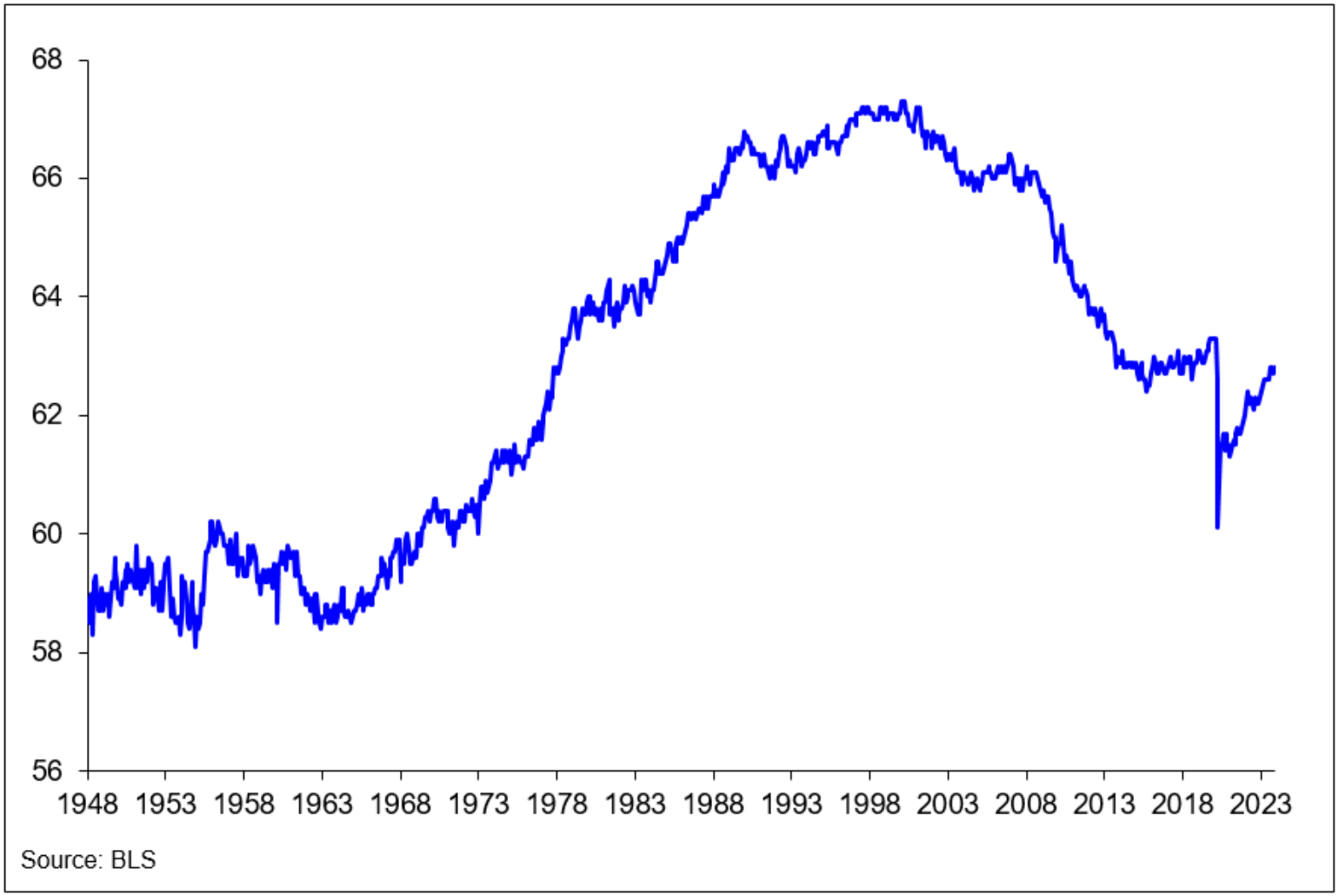
U.S.: unemployment rate

- Cyclical fluctuations with no trend.



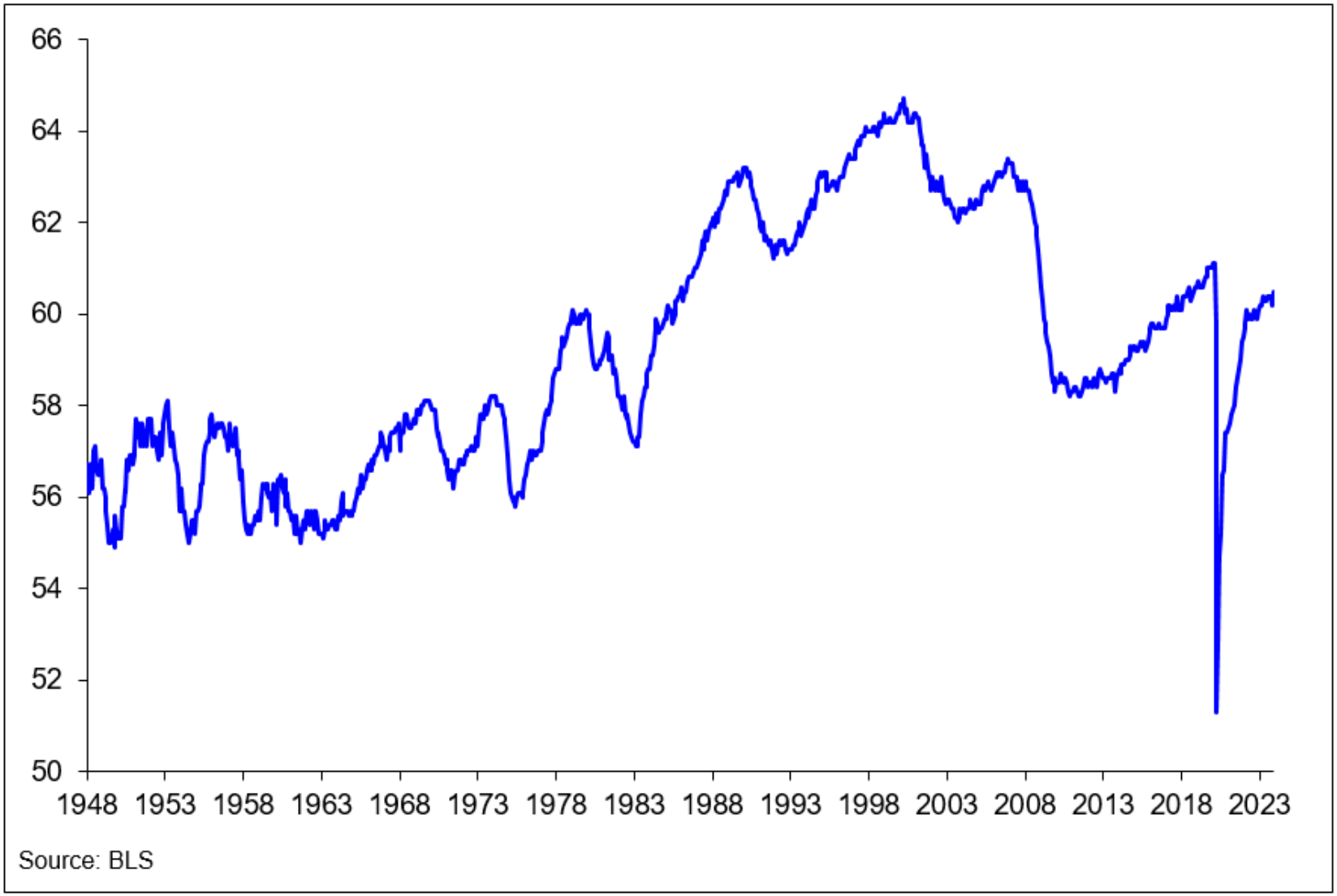
U.S.: participation rate

- Long-lasting waves of labor force as % of working age population. increase from 1960's to 1990's, decrease since 2008 (demographics).

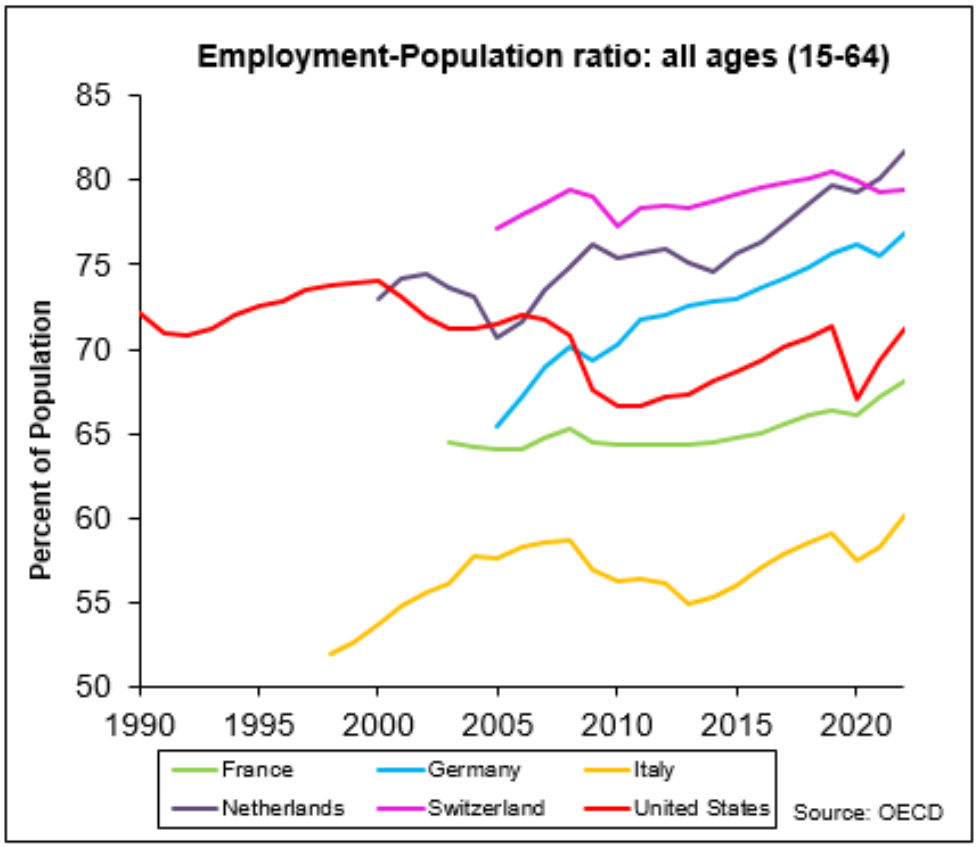


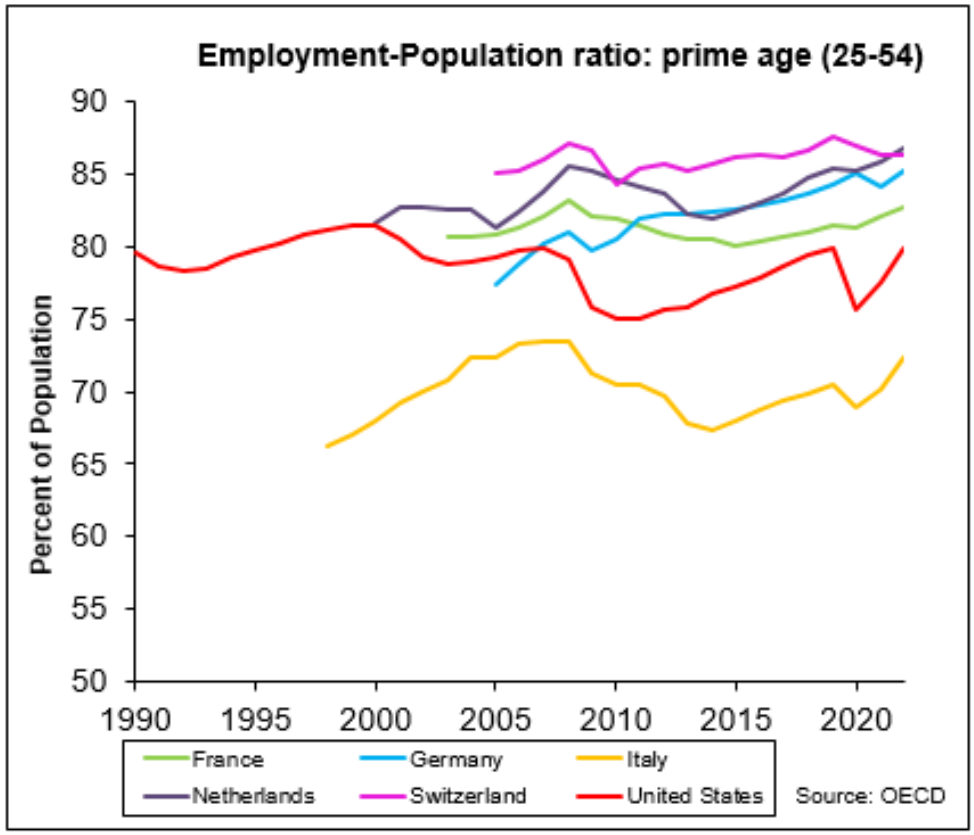
U.S.: population-employment ratio

- Cyclical movements and long-lasting waves.



- European situation not so bad in terms of employment-population ratios.





TWO SIMPLE FRAMEWORKS

Minimum wage

- Standard labor supply: trades off consumption of leisure $1 - L$ and goods C. Given consumption, a high real wage raises labor.
  - Labor demand: marginal product is equal to the real wage. A high wage reduces labor.
  - **Market clearing** at the intersection of labor supply and demand. No workers who would like to work at the prevailing wage, but cannot. If workers work fewer hours it's because they choose so.
- **Minimum wage** can lead to unemployment if set at a level above the market clearing wage.
  - More likely to be binding for young and unskilled workers.
- But: **no evidence of employment impact** of a minimum wage that is not too high (neighboring U.S. states, or Swiss cantons).
- A minimum wage can theoretically increase employment in a labor market where the firm is a monopsony.

Insider-outsiders

- Standard model: the wage as reflecting the interaction between **many** workers and many firms.
- Insider-outsider model: **bargain** between a union and firms. The union sets a wage and lets the firm choose employment (**right to manage**).
- Bargaining by employees (insiders) who care about getting higher wages. Unemployed (outsiders) care about getting a job, but cannot underbid the contracted wage.
- Union sets a wage W_0 at which the firms hires N_0 people. **Adverse shock** (for 1 period) at time 1, so the firm keeps only $N_1 < N_0$ people.
- Union bargains in period 1 for the wage in period 2, W_2. It only cares about the N_1 employees and sets the wage so that $N_2 = N_1$.
- Ratchet effect: recession $\rightarrow$ employment, recovery $\rightarrow$ wages: $W_2 > W_1 = W_0$ and $N_2 = N_1 < N_0$.

EFFICIENCY WAGES

What is the role of wages?

- Standard model: **allocative** wage is the mechanism that equates supply and demand (leads people and firms to use labor more or less).
- Alternative with **imperfect information**. The employer cannot costlessly monitor whether employees work or not.
- Wage is used as an **incentive** device:
  - High wage implies that employees have a lot to lose if they don't work and get caught.
  - High wage motivates workers to invest more effort.
- Wage is **not** allocative, so unemployment can occur.

Shapiro-Stiglitz model

- Workers can **work hard** ($e = \bar{e}$) or **not** (shirk, $e = 0$). Effort is not a continuous function of the wage.
- Workers can be in one of **three** states:
  - Employed and working. **Value** of being in that state is V_E.
  - Employed and but not exerting effort, with value V_S.
  - Unemployed, with "value" V_U (focus on a steady state to compute values).
- Jobs are destroyed at an exogenous rate b, whether the employee works hard or not. Unemployed workers find a job with probability a.
- Firm can observe effort only at a cost, and **randomly monitors** workers. A worker not working is caught with probability q, and then loses the job.

Values of the states

- Value of **employment with effort**: wage w net of effort cost $\bar{e}$, adjusted for the risk of losing the job:

$$\rho V_E = w - \bar{e} + b\,(V_U - V_E)$$

- ρ is the discount rate (i.e. a utility interest rate). ρV_E is the "return" on the asset "being employed": dividend, $w - \bar{e}$, and expected capital loss, $b\,(V_U - V_E)$.
- Value of **employment without effort**: wage, adjusted for the (higher) risk of losing the job:

$$\rho V_S = w + (b + q)\,(V_U - V_S)$$

- Value of **unemployment**: likelihood of finding a job and working (effort is exerted in the new job in equilibrium):

$$\rho V_U = a\,(V_E - V_U)$$

Values and wages

- The various relations give the values as function of wages:

$$
\begin{aligned}
V_E &= \frac{\rho + a}{\rho + a + b} \frac{w - \bar{e}}{\rho} = \frac{w - \bar{e}}{\rho} - \frac{b}{\rho + a + b} \frac{w - \bar{e}}{\rho} \\
V_U &= \frac{a}{\rho + a + b} \frac{w - \bar{e}}{\rho} \\
V_S &= \frac{1}{\rho + b + q} w + \frac{a\,(b + q)}{\rho + a + b} \frac{1}{\rho + b + q} \frac{w - \bar{e}}{\rho}
\end{aligned}
$$

- V_E is the net present value of the wage minus cost, adjusted for the risk of losing the job.
- Firms set the wage to ensure effort: $V_E = V_S$ (or slightly above). The wage is then **above the cost of effort**:

$$
w = \bar{e} + (a + \rho + b) \frac{\bar{e}}{q} > \bar{e}
$$

"No-shirking" condition

- Link the wage to **unemployment**. There are $\bar{L}$ people, employment is $L < \bar{L}$. Unemployment rate is $u = 1 - L/\bar{L}$.
- Flows in and out of employment cancel out in a steady state:

$$bL = a\left(\bar{L} - L\right) \Rightarrow a + b = \frac{b}{u}$$

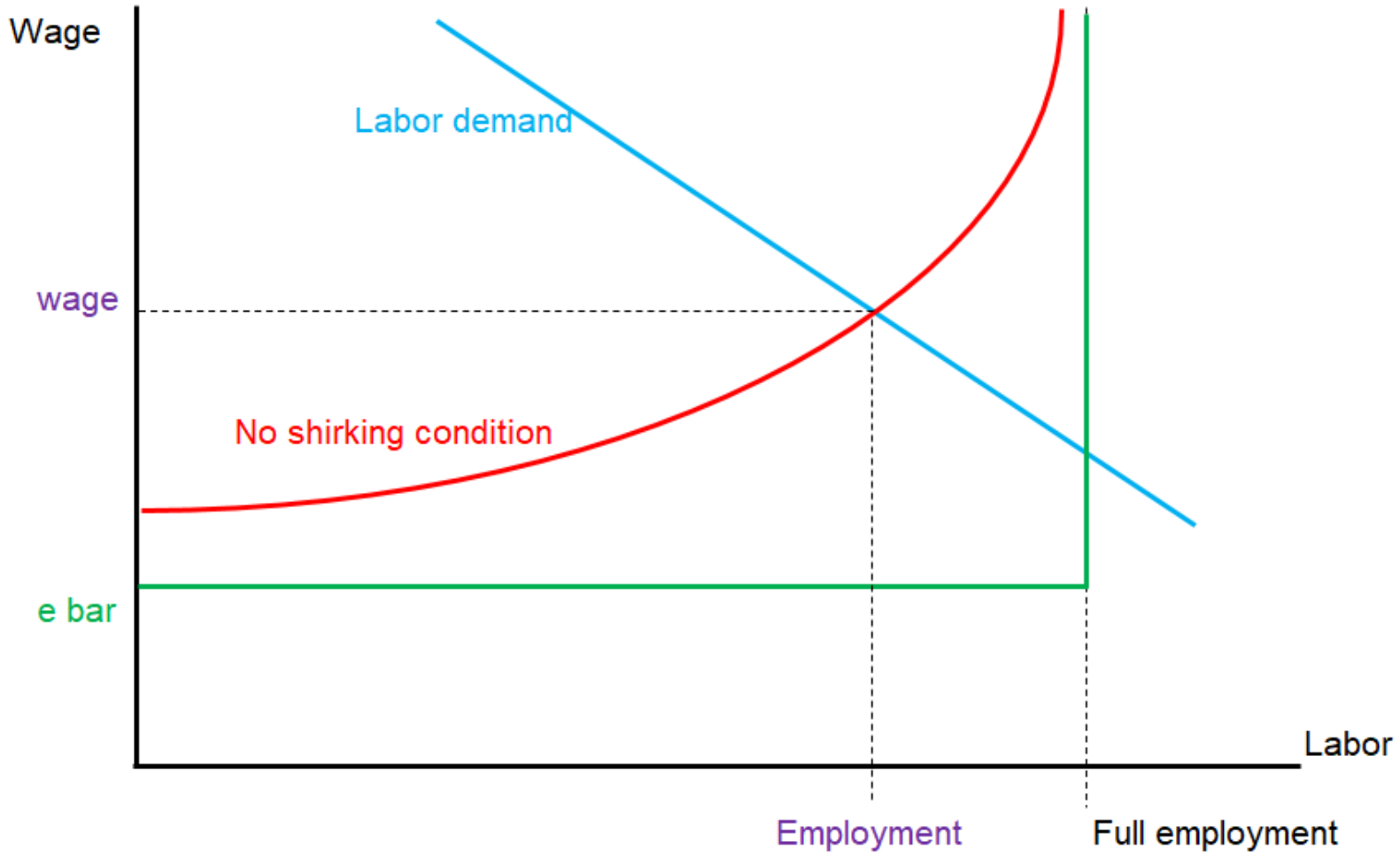
- No-shirking condition: wage is a negative function of unemployment:

$$w = \bar{e} + \left(\rho + \frac{1}{u}b\right)\frac{\bar{e}}{q}$$

- Replaces the **labor supply**. $w > \bar{e}$ even when $u = 1$.
  - Individual labor supply is horizontal at $w = \bar{e}$ as long as there is unemployment, and then vertical.
- Standard labor demand ($w = \bar{e}F'\left(\bar{e}L\right)$). Unemployment in equilibrium. It is reduced with easier monitoring (higher q).

Equilibrium

- Crossing of labor demand and incentive (no shirking) condition occurs below full employment.



SEARCH AND MATCHING

Matching of firms and workers

- Finding a job / filling an empty position **takes time**. Workers look through openings, firms look for suitable candidates.
- Search and matching model consider the process from the point of views of workers and firms.
- A worker can be in one of two states:
  - **Employed** with a wage w. The value of the state is V_E.
  - **Unemployed** with benefits b. The value is V_U.
- An open position can be in one of two states:
  - **Vacant** with cost c (cost of an empty desk). The value is V_V.
  - **Filled** with net earning $y - w - c$ for the firm ($y > b + c$ is output). The value is V_F.

Flows and matching technology

- Flows into unemployment: jobs are destroyed at an exogenous rate λ, total flows λE (E is employment)
- Flows into employment: new jobs are created through **matches** M of unemployed workers $U = 1 - E$ and vacancies V (more of either leads to more matches):

$$M = kU^{1-\gamma}V^{\gamma} = kU(\theta)^{\gamma}$$

- $\theta = V/U$ is the **tightness** of the labor market.
- Probability for a worker to find a position is a, and probability for a vacancy to be filled is α:

$$\begin{aligned} a &= \frac{M}{U} = k(\theta)^{\gamma} \\ \alpha &= \frac{M}{V} = k(\theta)^{\gamma-1} = (k)^{\frac{1}{\gamma}} \left(\frac{1}{a}\right)^{\frac{1-\gamma}{\gamma}} \end{aligned}$$

Wage determination

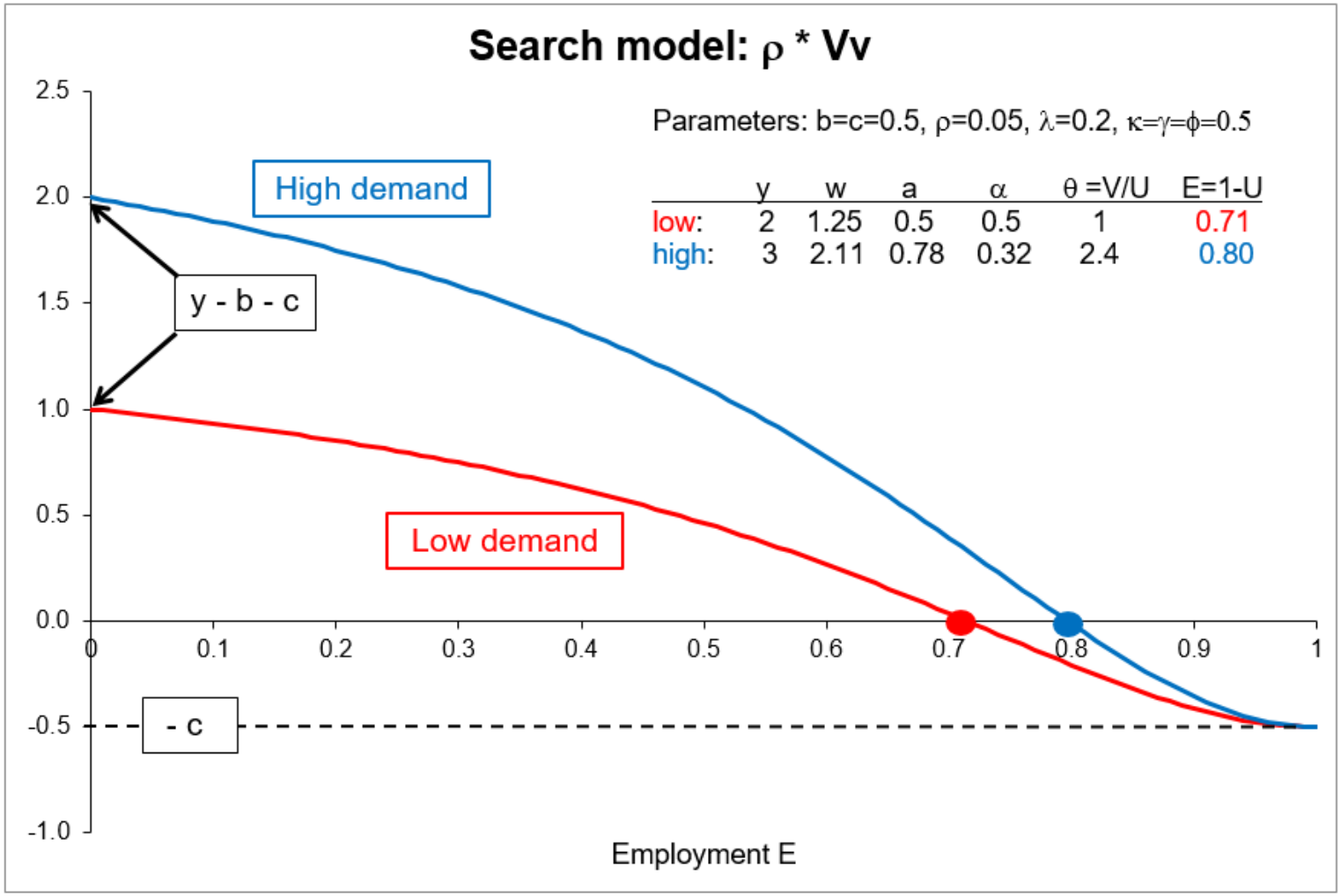
- Focus on a steady state. Compute the **values** of various situations (discount ρ).
  - Employment, V_E, with endogenous wage w.
  - Unemployment, V_U, with benefits b.
  - Vacant position, V_V, with cost c.
  - Filled position, V_F, with net profit $y - w - c$.
- **Surpluses** of a filled position: for the worker $V_E - V_U$, and for the firm $V_F - V_V$.
- Wage set through **bargaining**. Worker gets a share ϕ of the total surplus (reflects her bargaining power). ▸ Computations
  - Wage above b, the more so the higher the bargaining power ϕ and the tighter the labor market ($a > \alpha$, easier for worker to find a job than for firms to find a person).
  - Probabilities of matches, a and α, endogenous.

Employment determination

- **Flows** in and out of employment offset each other: $M = \lambda E$.
  - Probabilities of matches are linked to employment: higher E implies higher a (easy to find a job) and lower α (hard to find a worker).
- The value of a vacant position ρV_V depends on employment: high E makes it harder to find a worker and reduces the value.
  - Zero employment ($E = 0$): finding a worker is very easy ($\alpha \to \infty$) and an open position is valuable ($\rho V_V > 0$).
  - Full employment ($E = 1$): finding a worker is very hard ($\alpha \to 0$) and an open position is not valuable ($\rho V_V < 0$).
- **Creating** an open position entails no cost. The value of a vacant position must be zero in equilibrium: $\rho V_V = 0$.
- This determines employment, which is below full employment. Matching frictions create unemployment. ▸ Computations

Graphical illustration

- Value of open position ρV_V as a function of employment E. Partial employment, lower when output per worker y is lower.



BROADER VIEW AND POLICY

Interactions between goods and labor markets

- **Spillover** of policy in one market to the other.
  - Policy in the goods market $\rightarrow$ creation of firms $\rightarrow$ employment.
  - Policy in the labor market $\rightarrow$ costs for firms $\rightarrow$ goods market.
- Frictions in the good market (**monopolistic competition**, more firms raise competition and lower markups) and the labor market (**search** and wage bargaining).
- Policy impact in the **short run** (set number of firms) and the **long run** (new firms created at a cost).
  - Higher workers' bargaining power: higher wage in the short run, long run unemployment because of lower firm creation.
  - Lower cost of creating firms: no short run effect, higher wages and employment in the long run.

Policies against unemployment

- Beware of unintended consequences. Making it harder to dismiss employees makes firms reticent to hire in the first place.
  - Ambiguous impact of dismissal costs on the **level** of unemployment, but clear on the **incidence** - **duration**: shift towards lower incidence and higher duration.
- Nature of unemployment matters: **long term** unemployed lose skills, hence play a more marginal role in wage formation. Role of "active labor market" policies (training).
- Lessons from success stories (Netherlands and Ireland in the 1980's).
  - Adopt a **broad package**. Wage moderation makes firms more willing to hire. Shifting taxation away from labor makes workers willing to accept wage moderation.
  - Think beyond the labor market: regulation of the product market affects the labor market.

EXTRA SLIDES : BANK PANIC

Utility under autarky

- **Ex-post** utility of consumption under autarky:

$$\frac{1}{1-\sigma}(c_1)^{1-\sigma} \text{if impatient, probability } t$$
$$\frac{1}{1-\sigma}(c_2)^{1-\sigma} \text{if patient, probability } 1-t$$

- **Expected** utility of agent in autarky (consume 1 today if impatient, R tomorrow if patient):

$$U^{\text{autarky}} = t\frac{1}{1-\sigma}(1)^{1-\sigma} + (1-t)\frac{1}{1-\sigma}(R)^{1-\sigma}$$

Optimal insurance

- Insurance sets the consumptions to maximize:

$$U^{\text{insurance}} = t\frac{1}{1-\sigma}\left(c_1^*\right)^{1-\sigma} + (1-t)\frac{1}{1-\sigma}\left(c_2^*\right)^{1-\sigma}$$

- Budget constraints:

$$tc_1^* + s = 1 \qquad ; \qquad sR = (1-t)\,c_2^*$$

- Optimal allocation is (assume $\sigma > 1$):

$$\begin{aligned} c_1^* &= \frac{1}{1-(1-t)\left[1-(R)^{\frac{1-\sigma}{\sigma}}\right]} > 1 \\ c_2^* &= R\frac{1}{1+t\left[(R)^{\frac{\sigma-1}{\sigma}}-1\right]} < R \end{aligned}$$

- Insurance reduces the differential between patient and impatient agents. Patient agents get more: $c_2^* > c_1^*$ (this can be proved).

Return

EXTRA SLIDES : SEARCH MODEL

Values of the states

- Focus on a steady state. Value of employment: wage w adjusted for the risk of losing the job:

$$\rho V_E = w + \lambda (V_U - V_E)$$

- Value of unemployment: benefit adjusted for the chance of finding a job:

$$\rho V_U = b + a (V_E - V_U)$$

- Value of a filled position: profit adjusted for the risk of disappearance:

$$\rho V_F = y - w - c + \lambda (V_V - V_F)$$

- Value of a vacant position: the cost of an open desk adjusted for the chance of finding a worker:

$$\rho V_V = -c + \alpha (V_F - V_V)$$

- Key point: **probabilities** a and α are endogenous.

Surpluses

- Value of employment relative to unemployment:

$$V_E - V_U = \frac{w - b}{\lambda + \rho + a}$$

- Value of a filled position relative to a vacant one:

$$V_F - V_V = \frac{y - w}{\lambda + \rho + \alpha}$$

Wage bargaining

- Matching an unemployed worker and a firm with a vacant position gives a **surplus**: $(V_E - V_U) + (V_F - V_V)$.
- **Bargaining** to share the surplus. Worker gets a share ϕ (reflects her bargaining power).
- Wage exceeds the unemployment benefit, with the extra reflecting a share of the output - benefit surplus:

$$\begin{aligned} w &= b + \Phi\phi(y - b) \\ \Phi &= 1 - \frac{(\alpha - a)(1 - \phi)}{\lambda + \rho + a + (\alpha - a)(1 - \phi)} \end{aligned}$$

- If $\alpha = a$, we have $\Phi = 1$ and the $y - b$ surplus is shared according to the bargaining power ϕ.
- If it is easier for firms to find a worker than for workers to find a job ($\alpha > a$), we have $\Phi < 1$ and the $y - b$ surplus goes more towards firms. Return

Job finding probabilities

- Constant employment in steady state: matches offset the job destruction:

$$M = \lambda E \Rightarrow a = \frac{\lambda E}{1 - E}$$

- **Higher employment** means that **workers have better chances** of finding a job.
- **Firms have lower chances** of filling a position:

$$\alpha = (k)^{\frac{1}{\gamma}} \left(\frac{1 - E}{\lambda E} \right)^{\frac{1-\gamma}{\gamma}}$$

- a and α are thus linked to employment E.

Solving for employment

- Value of a vacant position (after some algebra):

$$\begin{aligned} \rho V_V &= -c + \alpha (V_F - V_V) \\ \rho V_V &= -c + \frac{\alpha (1-\phi)}{\lambda + \rho + \alpha (1-\phi) + a\phi} (y - b) \end{aligned}$$

- ρV_V is a decreasing function of E. Note that for extreme values of E:

E	U	a	α	ρV_V
0	1	0	∞	$y - b - c > 0$
1	0	∞	0	$-c < 0$

- ρV_V is a function with positive value at $E = 0$, then decreasing to negative value when $E = 1$.
- **Vacancies** can be created **without any cost**, so $\rho V_V = 0$. This gives the equilibrium value of $0 < E < 1$.
- Equilibrium unemployment ($E < 1$), wage above unemployment benefits ($w > b$). ◂ Return

EXTRA SLIDES : GOODS AND LABOR MARKETS

Interaction between good and labor markets

- Go beyond the labor market itself, and assess how the structure of the good market (competition) matters. Blanchard *The Economics of Unemployment: Shocks, Institutions, and Interactions*.
- Models wage setting as a bargaining between workers and firms. A match between a firm and a worker generates a surplus. The wage determines how this surplus is split.
- Contrast effects in the short and the long run.

Technology and demand

- There are n firms, with each being the sole producer of a brand (brands are imperfect substitutes). n is set in the short run, but not in the long run. The demand for the output (equal to labor) of firm i is:

$$N_i = Y_i = \frac{Y}{n}\left(\frac{P_i}{P}\right)^{-\sigma}$$

- The elasticity of substitution is increasing in the number of firms:

$$\sigma = \bar{\sigma} g(n) \quad ; \quad g' > 0 \quad ; \quad g(\infty) = \infty$$

- The reservation wage of workers (their outside option) is inversely linked to unemployment. A low unemployment makes workers more picky:

$$\left(\frac{W}{P}\right)_R = bk(u) \quad ; \quad k' < 0$$

Surpluses and price

- Surplus from an agreement between workers and the firms. For workers, it the wage over the reservation wage. For the firms it is profits:

$$N_i \left[\frac{W_i}{P} - bk\left(u\right) \right] \qquad ; \qquad \frac{P_i}{P} Y_i - \frac{W_i}{P} N_i$$

- We first set the firm's price P_i to maximize the sum of surpluses:

$$Y_i \left[\frac{P_i}{P} - bk\left(u\right) \right]$$

- The price is a markup over the reservation wage:

$$\frac{P_i}{P} = \frac{\sigma}{\sigma - 1} bk\left(u\right)$$

Wage determination

- Wages are set through bargaining. The wage maximizes a weighted product of the firm's and workers' surpluses:

$$\left(\frac{P_i}{P}Y_i - \frac{W_i}{P}N_i\right)^{1-\beta}\left(N_i\left[\frac{W_i}{P} - bk\left(u\right)\right]\right)^{\beta}$$

- The weight β is the bargaining power of workers.
- The wage exceeds the reservation wage, especially when β is high (high workers' power) and σ is small (low competition, hence a large surplus):

$$\frac{W_i}{P} = \frac{\sigma - 1 + \beta}{\sigma - 1}bk\left(u\right)$$

General equilibrium: short run

- In equilibrium all firms are identical and $P_i = P$. This gives the unemployment rate (hence employment) as a function of b and σ.
- Unemployment is high if workers are picky (b is high) or there is little competition (σ is small, so the markup is high and output is low):

$$\frac{P_i}{P} = 1 = \frac{\sigma}{\sigma - 1} bk(u) \Rightarrow u = u^{SR}\left(\underset{+}{b}, \underset{-}{\sigma}\right)$$

- The real wage is an increasing function of β (workers' power) and σ (competition):

$$\frac{W_i}{P} = \frac{\sigma - 1 + \beta}{\sigma} = W^{SR}\left(\underset{+}{\beta}, \underset{+}{\sigma}\right)$$

General equilibrium: long run (1)

- In the long run new firms can be created at a real cost cY_i. With free entry profits are zero (we assume $c < 1 - \beta$):

$$0 = \frac{P_i}{P} Y_i - \frac{W_i}{P} N_i - cY_i = \left[\frac{1-\beta}{\sigma} - c \right] Y_i$$

- This gives the long run value of the elasticity of demand.

$$\Rightarrow \sigma = \bar{\sigma} g(n) = \frac{1-\beta}{c}$$

- The zero-profit condition determines the number of firms ($g' > 0$). There are more firms when β is low (workers' power is limited, so profits are high), c is low (entry cost is low) and $\bar{\sigma}$ is low (competition is limited):

$$n = n^{LR}\left(\underset{-}{\beta}, \underset{-}{c}, \underset{-}{\bar{\sigma}}\right)$$

General equilibrium: long run (2)

- In the long run, n determines σ, which determines unemployment through the optimal price.
- Unemployment is high when β is high (workers' extract high wages), b is high (workers are picky) and c is high (business creation is costly):

$$1 = \frac{\sigma}{\sigma - 1} bk(u) \Rightarrow u = u^{LR}\left(\underset{+}{\beta}, \underset{+}{b}, \underset{+}{c}\right)$$

- The real wage is inversely related to the cost of setting up firms:

$$\frac{W_i}{P} = \frac{\sigma - 1 + \beta}{\sigma} = 1 - c$$

Impact of policies

- Product market liberalization: higher $\bar{\sigma}$ or lower c. Labor market liberalization: lower b or β.
- Reforms to the goods market affects the labor market, and conversely. Effects are also different in the short run (with a fixed number of firms) and the long run (when firms can be created).
- The impact on the unemployment rate and the real wage depend on the specific policy and the horizon:

	Short run		Long run	
	u	W_i/P	u	W_i/P
Increase in $\bar{\sigma}$	$-$	$+$		
Decrease in c			$-$	$+$
Decrease in b	$-$		$-$	
Decrease in β		$-$	$-$	