Agency Business Cycles

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Introduction

Agency Business Cycles: Theory of cyclical fluctuations in the labor market where cycles are endogenous and stochastic, feature large fluctuations in unemployment and other labor market variables and feature no correlation between unemployment and labor productivity. The theory implies a new view of what recessions are.

Introduction

Search theoretic model of the labor market in which:

1. matched firms and workers face a moral hazard problem
2. unmatched firms and workers come together through a process with decreasing returns to scale

Introduction

- With incomplete employment contracts, firms fire non-performing workers with some positive probability. Firing is costly ex-post, necessary ex-ante
- To minimize agency cost, firms load the firing probability on states of the world in which the worker's cost of losing his job is highest. Under decreasing returns to matching, these are the states in which unemployment is highest.
- Firms find it optimal to fire non-performing workers in the states of the world in which other firms fire their non-performing workers.

Introduction

We prove existence of an equilibrium in which firms keep non-performing workers for some realizations of a publicly observed sunspot, and they fire them all for other realizations of the sunspot.

Equilibrium features cyclical fluctuations, which we dub "agency business cycles", that are:

- *Endogenous*: Fluctuations are not driven by exogenous shocks to fundamentals, and not driven by exogenous switches in the selection of equilibrium. They are inherent to the equilibrium.

- *Stochastic*: Fluctuations are not caused by deterministic cyclical dynamics. They are caused by aggregate uncertainty inherent to the equilibrium.

Introduction

We calibrate the theory and show that agency business cycles:

1. Account for a large fraction of empirical volatility of unemployment and other labor market variables.
2. Consistent with the empirical pattern of leads and lags between unemployment and other labor market variables.
3. Consistent with the lack of correlation between unemployment and labor productivity.

Introduction

The theory implies a peculiar view of recessions:

- *Real Business Cycle:* a recession is a time when the difference between the value of labor in the market relative to the value of labor at home is *unusually low*. For this reason, employment is low and unemployment is high.
- *Agency Business Cycle*: a recession is a time when the difference between the value of labor in the market relative to the value of labor at home is *unusually high*. This is the time when firms want to fire non-performing workers.

* Use time-series of UE rate, EU rate and wages to compute a measure of the net value of employment. It is *strongly countercyclical*.

Introduction

Business Cycle Theories:

1. **Shocks to fundamentals**: Kydland and Prescott (1982), Mortensen and Pissarides (1994), Beaudry and Portier (2004).

2. **Shocks to selected equilibrium**: Diamond (1982), Heller (1986), Benhabib and Farmer (1994), Christiano and Harris (1999), Kaplan and Menzio (2014).

3. **Deterministic cyclical dynamics**: Diamond and Fudenberg (1989), Mortensen (1999).

Plan

1. A simple two period model
2. General model
3. Calibration and empirical implications

A simple 2 period example

- Worker's effort $e \in \{0, 1\}$
- Output $y_h > y_l$
- High output occurs w.p. $p(e)$, $p(1) > p(0)$
- Firms, workers are risk-neutral

Period 2

- Unemployment rate in begining of pd 2: $\hat{u}$
- Cost of vacancy $\hat{v}$ at cost $k > 0$
- DRTS matching $M(\hat{u}, \hat{v})$
- Probability of unemployed meeting vacancy $\lambda(\hat{u})$
  - $\lambda(\hat{u})$ is decreasing in eqm

Period 2

- In period 2 contract: firm pays wage conditional on output
- Bargaining: worker gets at least $\hat{U} \geq 0$ of output
- Optimal contract

$$\begin{aligned} & \max_{w_H, w_L} \mathbb{E}\left[y - w\right] \\ \text{s.t. } w_H - w_L &\geq \frac{e}{p(1) - p(0)} \\ \mathbb{E}\left[w\right] - e &\geq \hat{U} \\ w_i &\geq 0 \end{aligned}$$

Period 2

- Firm gets a fraction α of surplus:

$$G = \alpha \left\{ \mathbb{E}\left[y \right] - e \right\}$$

- Employed worker gets fraction $1 - \alpha$ of surplus:

$$W = (1 - \alpha) \left\{ \mathbb{E}\left[y \right] - e \right\}$$

- Value of being unemployed in the beginning of pd 2

$$U\left(\hat{u} \right) = \lambda\left(\hat{u} \right) W + \left(1 - \lambda\left(\hat{u} \right) \right) \cdot 0$$

- Key feature: Relative value of having a job for worker is high when $\hat{u}$ is high

$$\frac{W\left(\hat{u} \right) - U\left(\hat{u} \right)}{G\left(\hat{u} \right)} \text{ increases in } \hat{u}$$

Period 1

- In period 1 contract are short-term and **incomplete**: wages paid before output is realized, firms need to fire (s) ex-post to provide incentives
  - can be substantially relaxed
- Firing is conditional on output realization and sunspot z

Period 1

- Optimal contract is

$$\max_{w,\{s_h(z),s_l(z)\}_z} -w + \int \{p(1)\left[y_h + (1-s_h(z))\,G(\hat{u}(z))\right] + (1-p(1))\left[y_l + (1-s_l(z))\,G(\hat{u}(z))\right]\}dz$$

s.t.

$$\int \left[s_l(z) - s_h(z)\right]\left[W(\hat{u}(z)) - U(\hat{u}(z))\right]dz \geq \frac{e}{p(1)-p(0)}$$

$$\begin{aligned} & w + \int \{p(1)\left[s_h(z)\,W(\hat{u}(z)) + (1-s_h(z))\,U(\hat{u}(z))\right] \\ & + (1-p(1))\left[s_l(z)\,W(\hat{u}(z)) + (1-s_l(z))\,U(\hat{u}(z))\right]\}dz \\ \geq\ & \bar{U} \end{aligned}$$

Period 1

- It is immediate that $s_h(z) = 0$ for all z
- Substitute for w

Period 1

- Optimal contract is

$$\max_{s_I(z)} A - B \int s_I(z) \left[G\left(\hat{u}(z)\right) + \left(W\left(\hat{u}(z)\right) - U\left(\hat{u}(z)\right) \right) \right] dz$$

s.t.

$$\int s_I(z) \left[W\left(\hat{u}(z)\right) - U\left(\hat{u}(z)\right) \right] dz \geq \frac{e}{p(1) - p(0)}$$

- Key result: To minimize destruction of surplus, load firing on states z in which

$$\frac{W\left(\hat{u}(z)\right) - U\left(\hat{u}(z)\right)}{G\left(\hat{u}(z)\right)}$$

is highest

Optimal Employment Contract

Intuition for the result:

- Firing is costly because it destroys a valuable relationship. Yet, firing is necessary to give workers an ex-ante incentive to exert effort.

- The value of the destroyed relationship that would have accrued to the worker provides incentives. The value that would have accrued to the firm is *collateral damage*.

- Optimal contract minimizes the collateral damage by concentrating firing in states of the world where the value accruing to the worker is highest relative to the value accruing to the firm.

Period 1

- $\frac{W(\hat{u}(z))-U(\hat{u}(z))}{G(\hat{u}(z))}$ is high when unemployment $\hat{u}(z)$ is high
- Incentives to coordination: fire workers in the states in which other firms also fire

Equilibria

- This game have multiple equilibria that depend with what probability firms coordinate firing
- Perfect coordination equilibrium – all firing done w.p. 1 for same z – is the unique robust equilibrium
- Robustness:
  - perfect coordination is unique outcome of sequential move game
  - the only stable equilibrium with learning (a-la Echenique-Edlin 2004)

Full environment

The model is a version of Mortensen and Pissarides (1994) where matched firms and workers face a moral hazard problem, and unmatched firms and workers come together through a process with decreasing returns to scale.

Environment

Workers

- continuum of homogeneous workers with measure 1;
- preferences: $\sum \beta^t \left[v(i_t) - ce_t \right]$, with $v' > 0$, $v'' \leq 0$, $c > 0$;
- income $i_t \in \{b, w_t\}$, effort $e_t \in \{0, 1\}$.

Environment

Firms

- continuum of homogeneous firms with positive measure;
- preferences: $\sum \beta^t \pi_t$;
- technology:

$$1 \text{ worker } \Longrightarrow y_t = \begin{cases} y_\ell, \text{ w.p. } p_\ell(e_t), \\ y_h, \text{ w.p. } p_h(e_t), \end{cases}$$

where

$$y_\ell \leq y_h, \quad 0 < p_h(0) < p_h(1) < 1.$$

Environment

Agency problem

- production is subject to moral hazard, as the firm cannot directly observe the worker's effort e_t but only the worker's output y_t.

Environment

Each period is divided into five stages

1. *Sunspot:*
2. *Separation:*
3. *Matching:*
4. *Bargaining:*
5. *Production:*

Environment

Each period is divided into five stages

1. *Sunspot:*
   - Publicly observed sunspot z_t is drawn from $U(0,1)$.
2. *Separation:*
3. *Matching:*
4. *Bargaining:*
5. *Production:*

Environment

Each period is divided into five stages

1. *Sunspot:*
2. *Separation:*
   - Employed worker separates for exogenous reasons w.p. $\delta \in [0, 1)$;
   - Employed worker is fired w.p. $s(y_{t-1}, z_t)$, which depends on y_{t-1} and z_t;
3. *Matching:*
4. *Bargaining:*
5. *Production:*

Environment

Each period is divided into five stages

1. *Sunspot:*
2. *Separation:*
3. *Matching:*
   - Firms create vacancies at unit cost $k > 0$;
   - Unemployed and vacancies meet through a DRTS fn $M(u_{t-1}, v_t)$;
   - Unemployed meets vacancy w.p. $\lambda(\theta_t, u_{t-1})$, and vacancy meets unemployed w.p. $\eta(\theta_t, u_{t-1})$, with $\theta_t \equiv v_t / u_{t-1}$.
4. *Bargaining:*
5. *Production:*

Environment

Each period is divided into five stages

1. *Sunspot:*
2. *Separation:*
3. *Matching:*
4. *Bargaining:*
   - Firm and worker bargain over a short-term contract specifying worker's effort e_t, worker's wage w_t, and next period's firing probability $s(y_t, z_{t+1})$.
5. *Production.*

Environment

Each period is divided into five stages

1. *Sunspot:*
2. *Separation:*
3. *Matching:*
4. *Bargaining:*
5. *Production*:

   - Unemployed worker produces and consumes b;
   - Employed worker privately exerts effort e_t, consumes wage w_t.
   - Output y_t is observed after the wage is paid out.

The main result

Theorem

A Perfect Coordination Equilibrium exists, provided c, β are not too high

Sketch of the proof

- Assume that value functions satisfy that $\frac{G(\hat{u})}{W(\hat{u})-U(\hat{u})}$ increases in u and some technical conditions
- Show that Bellman operator preserves this property
- Apply Schauder's fixed point theorem

Agency Business Cycle

In a perfect coordination equilibrium, there is aggregate uncertainty as in some states of the world firms fire their non-performing workers and in others they do not.
Aggregate uncertainty leads to labor market fluctuations that are:

- *Endogenous*, in the sense that they originate as an equilibrium outcome rather than from exogenous shocks to fundamentals or from exogenous shocks in the selection of the equilibrium.
- *Stochastic*, in the sense that they originate from uncertainty rather than from deterministic dynamics.

* *How large and what are the features of agency business cycles?*

Agency Business Cycle

Parameters:

Preferences: $v(w) = \log(w)$, c;

Technology: y_h, y_ℓ, $p_h(1)$, $p_h(0)$, b, δ;

Matching: k, $M(u,v) = e^{-\rho u} \cdot uv \left(u^\sigma + v^\sigma\right)^{-1/\sigma}$.

Targets:

Average of UE and EU rates, std of EU rate;

Home production is 70% of market production;

Sunspot realization is B once every 50 months;

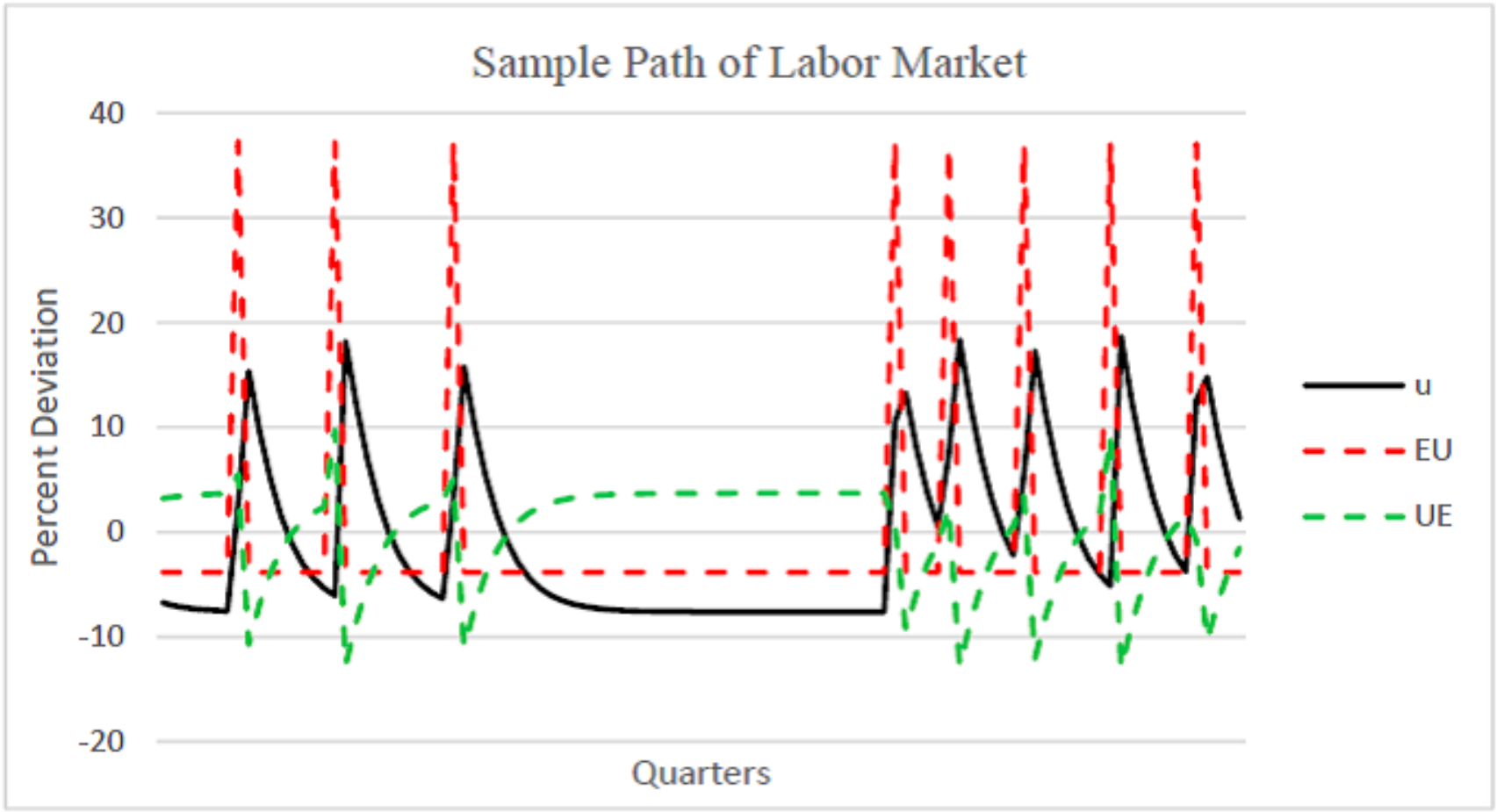
Other parameter values: $E[y|1] = 1$, $\rho = 6$, $\sigma = 1.24$.

Agency Business Cycle

TABLE 2: AGENCY BUSINESS CYCLE

		u rate	UE rate	EU rate	APL
Model	std	9.34	4.09	9.11	0
	cor. wrt u	1	-.98	.32	-
Data: 1951-2014	std	16.9	12.9	9.7	1.98
	cor wrt u	1	-.94	.80	-.37
Data: 1984-2014	std	17.3	13.8	6.91	1.38
	cor wrt u	1	-.96	.70	.09

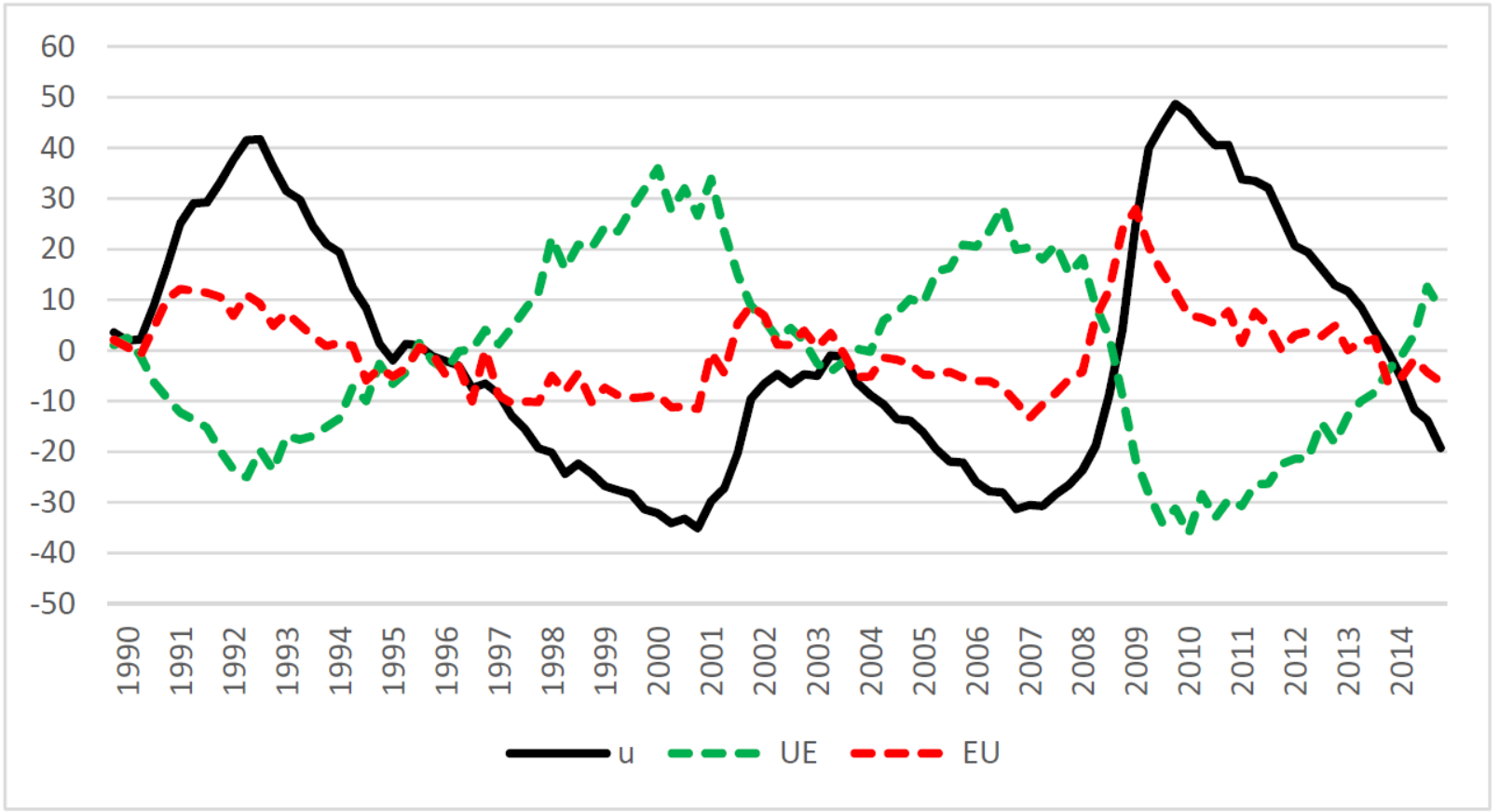
Agency Business Cycle



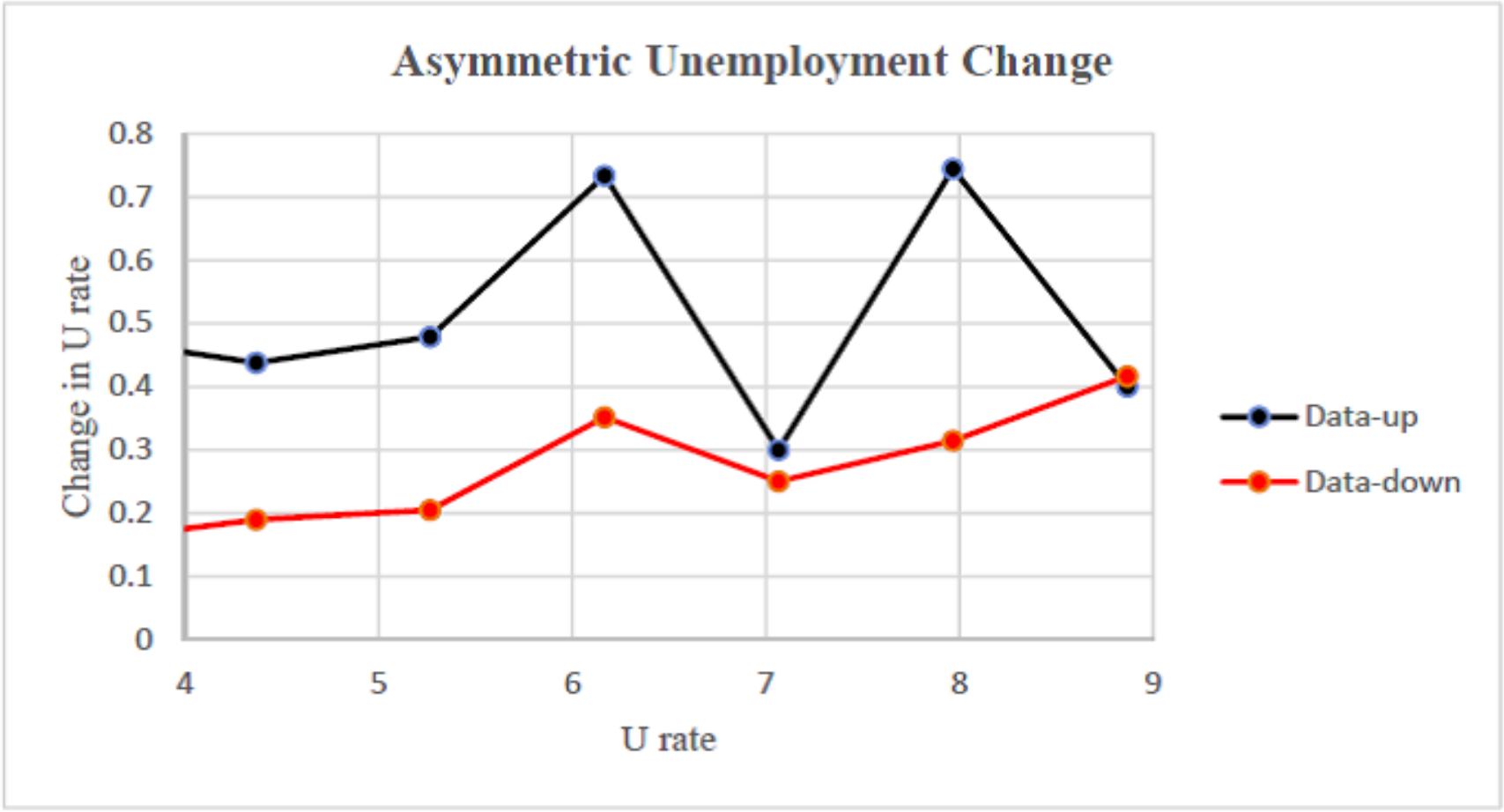
Model predictions

1. Little correlations with primitives: u is uncorrelated with labor productivity
2. Leads and lags: EU leads u, UE is mirror image of u
3. Asymmetries: For given u_t
   - $\Delta u_t, EU_t$ change a lot of $u_{t+1} > u_t$, litte if $u_{t+1} < u_t$
   - UE_t does not depend on u_{t+1}
4. Value of being employed is higher when unemployment is higher

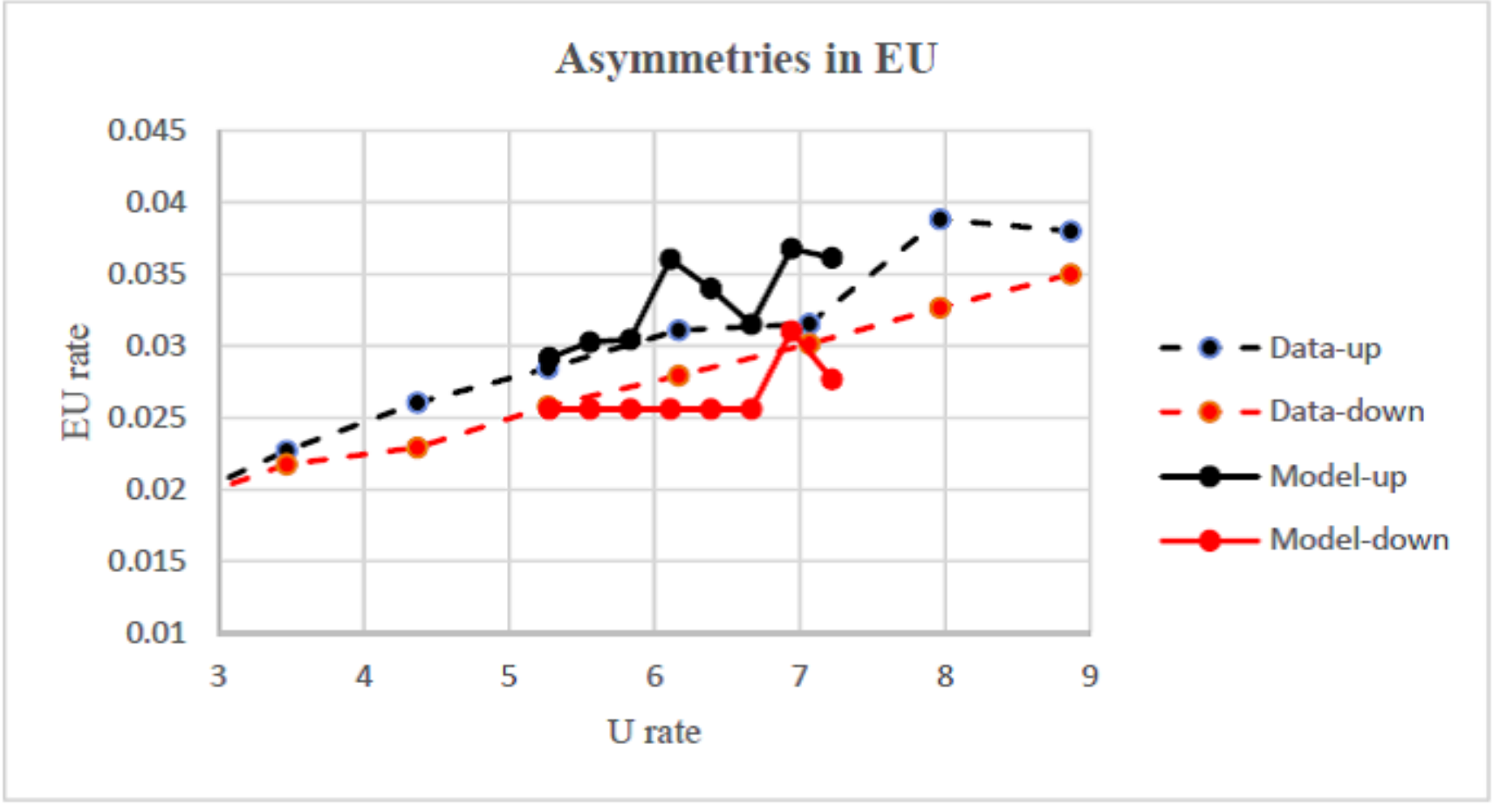
ABC: Prediction 2,3



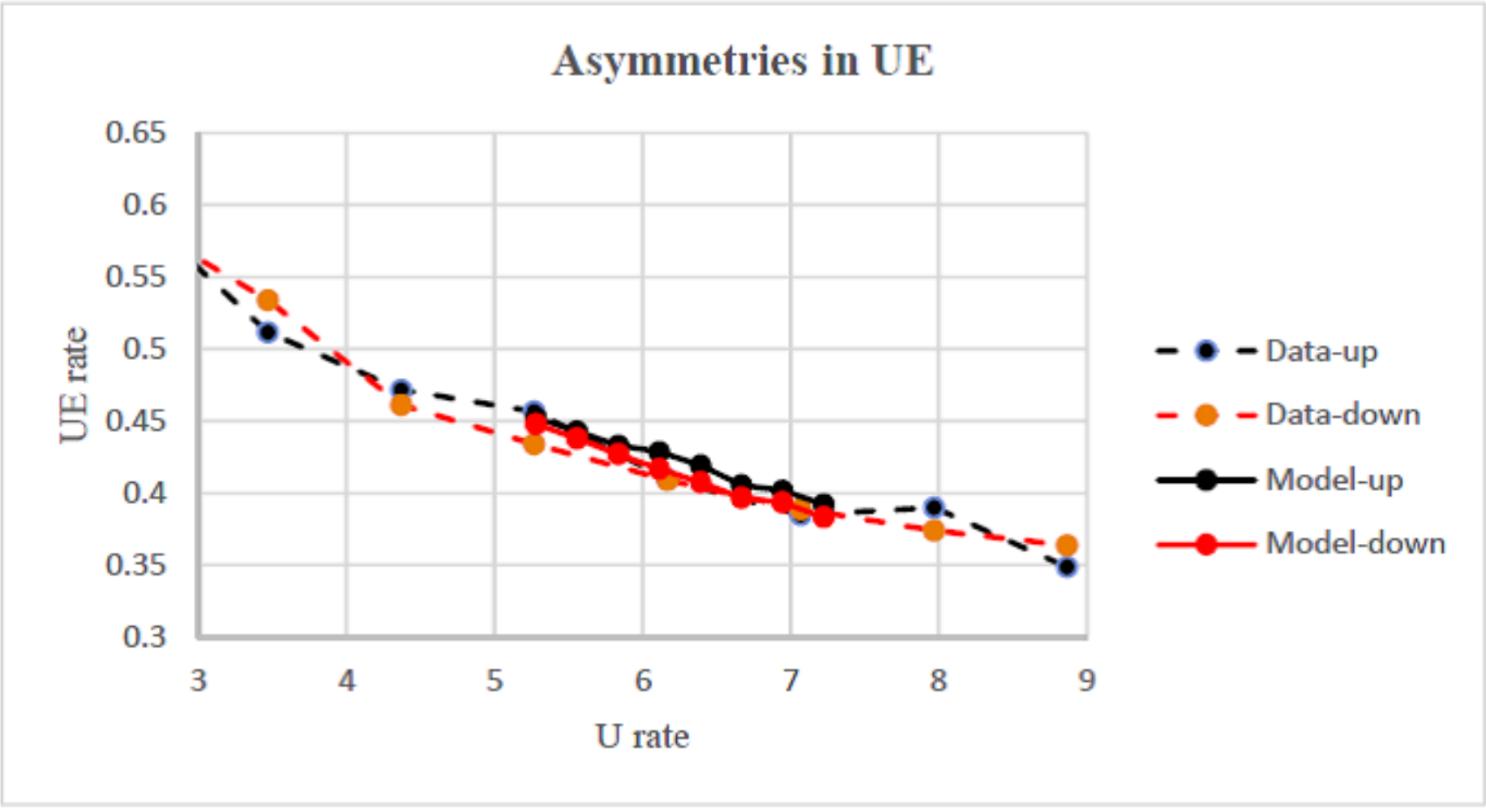
ABC: Prediction 3



ABC: Prediction 3



ABC: Prediction 3



ABC: Prediction 4

The most peculiar feature of our theory is the following:

- *Real Business Cycle:* a recession is a time when the difference between the value of labor in the market relative to the value of labor at home is *unusually low*. For this reason, employment is low and unemployment is high.
- *Agency Business Cycle*: a recession is a time when the difference between the value of labor in the market relative to the value of labor at home is *unusually high*. This is the time when firms want to fire non-performing workers.

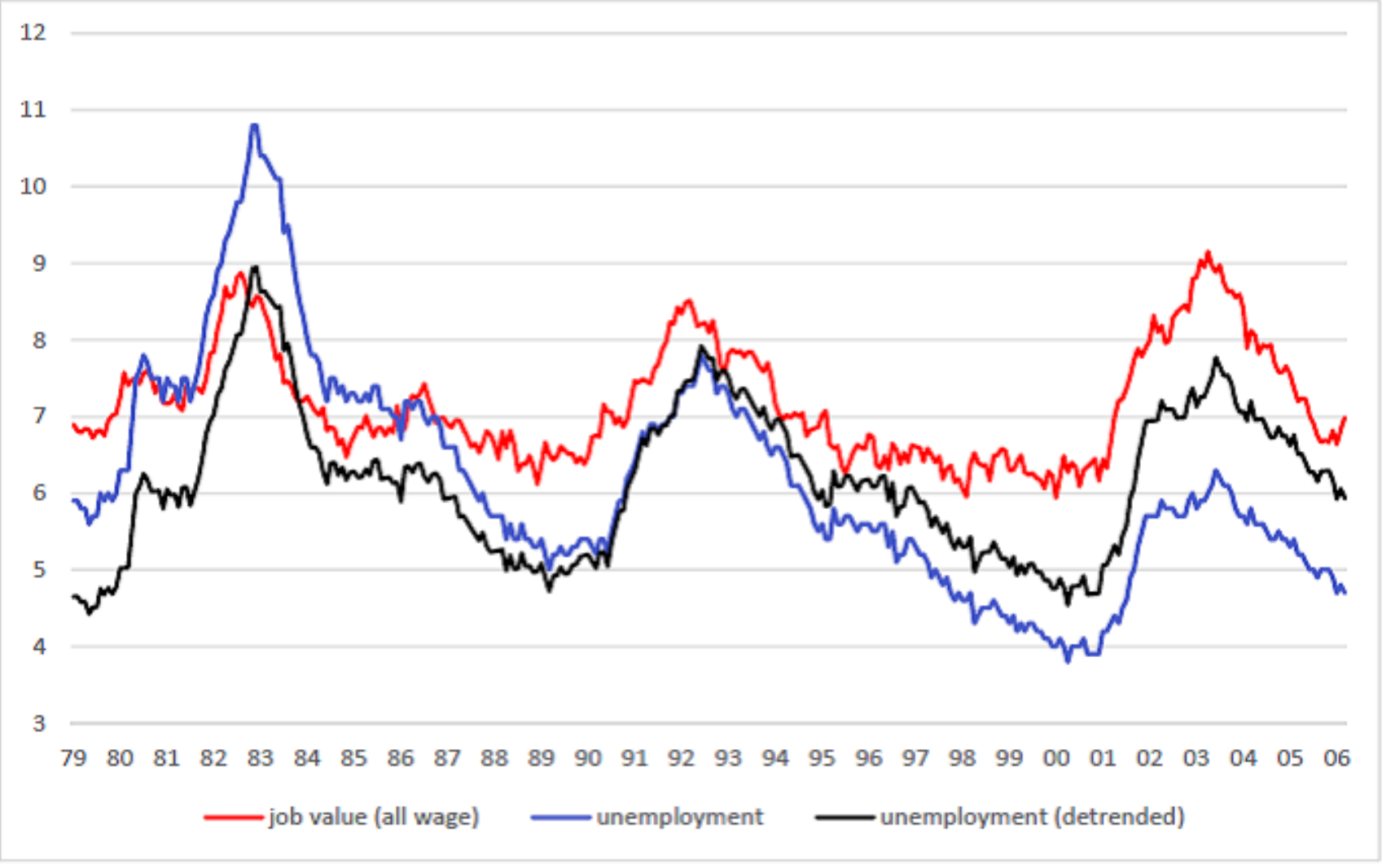
* *Is the net value of employment low or high in recessions?* Use time-series of UE rate, EU rate and wages to compute a measure of the net value of employment.

Value of employment

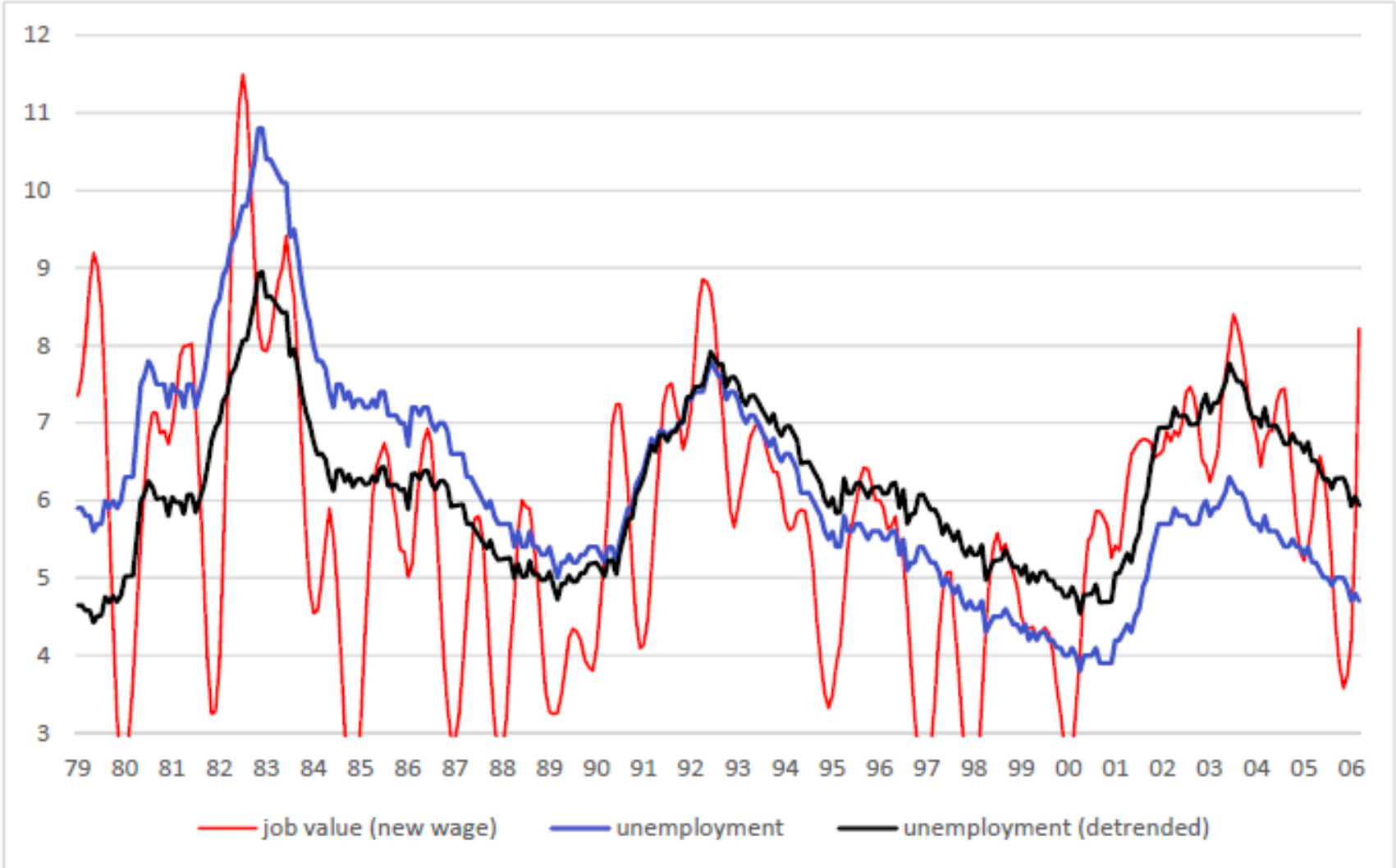
- Data:
  - separation rate s_t
  - job finding rate f_t
  - wages w_t
    - either (a) average wages of all workers
    - or (b) average wages of new hires
- Construct recursively values of employment and unemployment

$$\begin{aligned} W_t &= w_t + \beta \left\{ s_{t+1} U_{t+1} + (1 - s_{t+1}) W_{t+1} \right\} \\ U_t &= \beta \left\{ f_{t+1} W_{t+1} + (1 - f_{t+1}) U_{t+1} \right\} \end{aligned}$$

ABC: Prediction 4



ABC: Prediction 4



Conclusions

1. If ex-post inefficient destruction of principal-agent relationship is needed to provide the agent with ex-ante incentives, it is optimal to allocate the destruction probability on the states of the world where the agent has more to lose relative to the principal.

2. If the agent has more to lose relative to the principal when there are many agents who are unmatched, then there is a strategic complementarity between the optimal resolution of the agency problem of different principals. Principals destroy relationships all at the same time.

3. The strategic complementarity leads to equilibria featuring occasional "purges" of non-performing agents: Agency Business Cycles.