Employment Protection, Temporary and Permanent Employment Share, and Procyclicality of Labor Productivity

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About this paper

- Data: the strictness of employment protection is positively correlated with
  - Procyclicality of average labor productivity (ALP)
  - The share of temporary employment

- Model: the division of permanent and temporary employment
  - Productivity shocks
  - Frictions: Firing costs and training requirement (time-to-build or for labor hoarding)
  - Substitutability between permanent and temporary labor
  - Extensive vs. intensive margins

The main findings

- Firing costs matter and two factors amplify the effect of firing costs:
  - The degree of substitution between the two types of labor
  - Labor hoarding behavior
- Adjustments on the extensive margin perform the dominant role.

The data for OECD countries

- Use annual data for 36 OECD countries during 1970–2016
- Apply hp filter to detrend logged variables
- Compute the correlation coefficient between detrended output and ALP
- Average the indices of employment protection for individual and collective dismissals over the period 1985–2013 in each country

The effect of employment protection

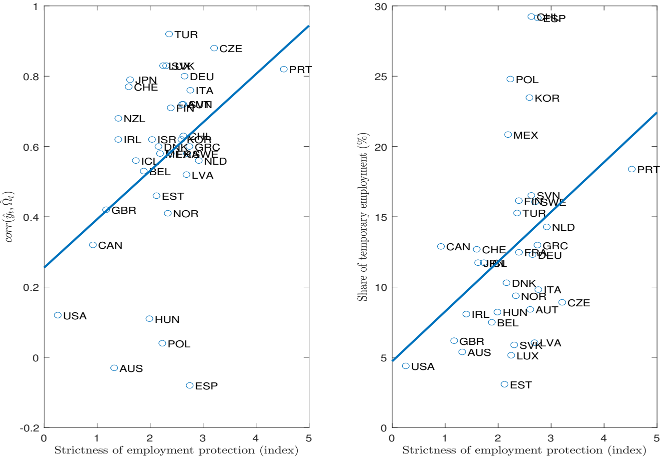

Figure 1: (A) The index of employment protection and procyclicality of ALP; (B) The index of employment protection and the ratio of temporary employment

The literature

- Procyclicality of ALP in the RBC literature
  - Bernanke and Parkinson (1991); Basu and Fernald (2001); Biddle (2014)
- Employment protection and the share of temporary relative to permanent employment
  - Booth et al. (2002); Cahuc and Postel-Vinay (2002); Boeri (2011); Cahuc et al. (2016)
- Labor adjustment costs and procyclicality of ALP
  - Galí and van Rens (2021)
- Employment protection and labor market fluctuations (across-country study)
  - Ohanian and Raffo (2012); Llosa et al. (2015); Dossche et al. (2023)

The Baseline Model

The production function and labor inputs

- The CES production technology:

$$y_t = A_t k_t^{\alpha} \left\{ (e_t x_t)^{\sigma} + [\gamma e_t (h_t + u_t)]^{\sigma} \right\}^{\frac{1-\alpha}{\sigma}}; \ 0 < \gamma < 1, \qquad (1)$$

  - Formal permanent worker x_t
  - Redundant & less-productive permanent worker u_t
  - Temporary worker h_t
  - Hours e_t

- The evolutions of permanent labor:

$$x_{t+1} = (1-\zeta) x_t + l_{1,t}; \ \ 0 < \zeta < 1, \qquad (2a)$$

$$u_{t+1} = u_t + \zeta x_t - s_t, \qquad (2b)$$

  - Dismissed permanent labor: s_t
  - Labor that completes job training in 1 period: $l_{1,t}$

Frictions

- The aggregate of new recruits at time t sums up the labor on training (that entails additional $a \leq b-1$ periods)

$$v_t = \sum_{a=1}^{b} l_{a,t}. \tag{3}$$

- Dismissals of redundancies are subject to firing costs, which is modeled as a quadratic form:

$$\Phi_t = \frac{\phi}{2}\left(\frac{s_t}{x_t + u_t}\right)^2 y_t. \tag{4}$$

The firm problem

- Maximization of the expected sum of discounted future profits:

$$D_t = d_t + E_t \left[\sum_{j=1}^{\infty} \Lambda_{t+j} d_{t+j} \right]. \quad (5)$$

- The period profits:

$$d_t = y_t - w_{n,t} e_t (v_t + x_t + u_t) - w_{h,t} e_t h_t - r_t k_t - \Phi_t y_t. \quad (6)$$

- The total factor productivity (TFP) shock:

$$\log A_t = \rho \log A_{t-1} + \varepsilon_t, \;\; \varepsilon_t \sim N(0, \sigma_\varepsilon). \quad (7)$$

- The FOCS in Appendix

The household problem (I)

- Lifetime utility:

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{\left[c_t - \frac{\psi_1}{1+\chi}(n_t^{1+\chi} + h_t^{1+\chi}) - \frac{\psi_2}{1+\tau}(n_t + h_t)e_t^{1+\tau}\right]^{1-\theta} - 1}{1-\theta},$$

  - $\tau > 0$: the inverse Frisch elasticity of labor supply.

- The household chooses an allocation of
  - Permanent worker supply: n_t
  - Temporary worker supply: h_t
  - Hours: e_t
  - Consumption: c_t
  - Capital and equity: k_{t+1} & z_{t+1}

The household problem (II)

- The flow budget constraint:

$$p_t(z_{t+1} - z_t) = r_t k_t + w_{h,t} h_t e_t + w_{n,t} n_t e_t + d_t z_t - c_t - i_t. \quad (8)$$

- The dynamics of capital:

$$k_{t+1} = (1 - \delta) k_t + i_t. \quad (9)$$

- The FOCS in Appendix

The competitive equilibrium

- Markets clearing conditions are:

$$z_t = 1, \tag{10}$$

$$n_t = v_t + x_t + u_t, \tag{11}$$

and

$$c_t + k_{t+1} - (1-\delta)k_t = \left[1 - \frac{\phi}{2}\left(\frac{s_t}{x_t + u_t}\right)^2\right] y_t. \tag{12}$$

Quantitative Analysis

Measure of procyclicality of ALP

- In the mapping from our model to data, we define ALP as output per hours worked:

$$\Omega_t = \frac{y_t}{N_t} = \frac{y_t}{e_t(n_t + h_t)}$$

- Converting a variable B_t to percentage deviation from its stationary values, i.e., $\hat{B}_t = (B_t - B)/B$ gives

$$corr(\hat{y}_t, \hat{\Omega}_t) = \pm \left\{ 1 + \frac{1 - corr(\hat{y}_t, \hat{N}_t)^2}{\left[\frac{std(\hat{y}_t)}{std(\hat{N}_t)} - corr(\hat{y}_t, \hat{N}_t)\right]^2} \right\}^{-\frac{1}{2}}.$$

- Then, it turns out that

$$corr(\hat{y}_t, \hat{\Omega}_t) > 0 \ \text{ if } \ std(\hat{y}_t)/std(\hat{N}_t) > corr(\hat{y}_t, \hat{N}_t).$$

Variance decomposition

- We can decompose $var(\hat{N}_t) = std(\hat{N}_t)^2$ into variance and covariance terms:

$$var(\hat{N}_t) = var(\hat{e}_t) + \frac{n^2}{L^2} var(\hat{n}_t) + \frac{h^2}{L^2} var(\hat{h}_t) \\ + 2cov(\hat{e}_t, \hat{L}_t) + 2\frac{nh}{L^2} cov(\hat{h}_t, \hat{n}_t).$$

  - The mean shares of temporary and permanent employment: h/L and n/L

- A dampened employment volatility (due to labor market frictions) is likely to raise the procyclicality of ALP.

Baseline model calibration

Category	Parameter	value
Preference	Intertemporal elasticity of substitution in consumption $(1/\theta)$	1
	Subjective discount factor (β)	0.99
	Disutility of labor supply (ψ_1)	varied
	Disutility of labor supply (ψ_2)	varied
	Degree of immobility of temporary and permanent employment labor supply (χ)	1
	Intensive margin Frisch labor supply elasticity $(1/\tau)$	0.9
Technology	Periods required for a new recruit to become a permanent worker (b)	4
	Share of physical capital (α)	0.36
	Substitution elasticity between temporary and permanent labor $(1/(1-\sigma))$	100
	Capital depreciation rate (δ)	0.025
	Transition probability from x_t to u_t (ζ)	0.068
	Intensity of firing costs (ϕ)	varied
	Productivity of temporary relative to permanent workers (γ)	0.35

Notes: The calibration targets to fit their steady-state values are (ii) hours per worker $e = 0.33$; (ii) employment rate $L = 0.65$; (iii) the data for the share of temporary employment h/L for each country.

The parameter estimation

- We apply the SMM to estimate the rest of parameters for country o, collected by the vector $\Theta^o = \{\rho^o, \sigma^o_\varepsilon\}$

- The estimates are the solution to the optimization problem:

$$\tilde{\Theta}^o = \arg\min J(\Theta^o) = [m^s(\Theta^o) - \bar{m}^o] (W^o)^{-1} [m^s(\Theta^o) - \bar{m}^o]',$$

  - The simulated moments contained in $m^s(\Theta^o)$ are the standard deviations of output $std(\hat{y}^o_t)$, consumption $std(\hat{c}^o_t)$, investment $std(\hat{i}^o_t)$, and total hours $std(\hat{N}^o_t)$.

The moment-matching result

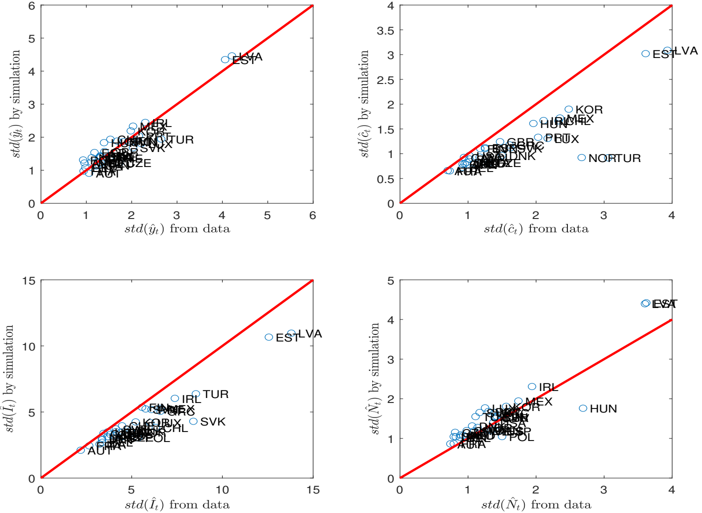

Figure 2: Data moments vs. theoretical moments

The effects of firing costs

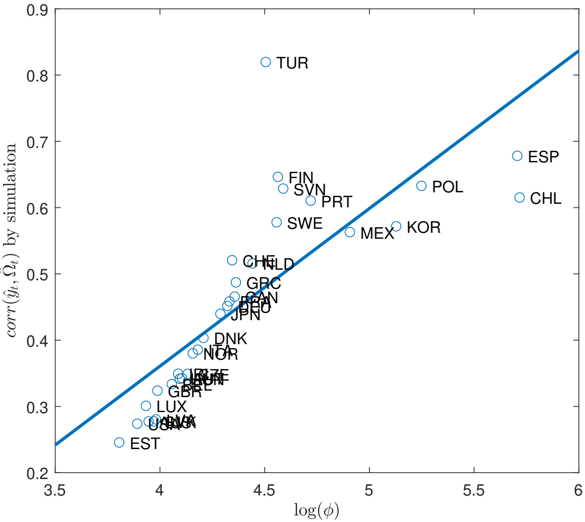

Figure 3: The effect of ϕ on the procyclicality of ALP

The effects of a rise in firing costs: IRFs

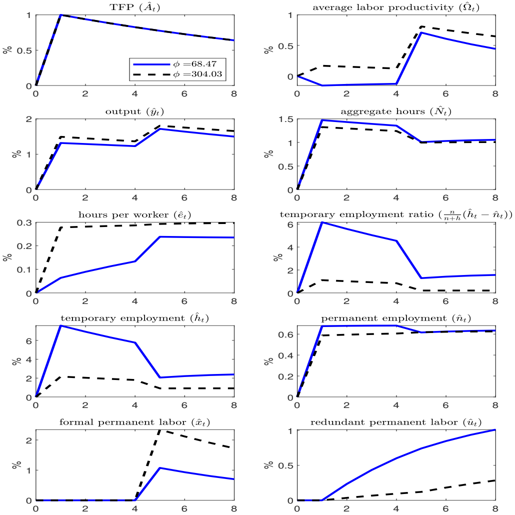

Figure 4: The IRFs of main variables to a 1% positive TFP

The effects of a rise in firing costs: intuitions

- When a positive TFP shock hits, firms tend to hire more temporary workers as substitutes for permanent ones if labor firing costs are higher:
  - A higher share of temporary employment in the steady state (the 1st moment)
  - Firms will not maintain so many redundant permanent workers since massively firing them in the future is more costly.
  - Instead, firms will hire more temporary workers.
  - A less volatile permanent employment raises the volatility of output relative to aggregate employment (the 2nd moment)

How variations in hours and employment matter

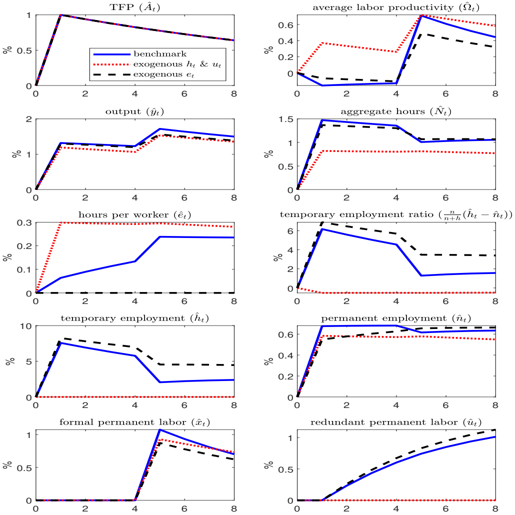

Figure 5: The IRFs of main variables to a 1% positive TFP shock: the benchmark and counterfactual cases

Summary of counterfactual cases

Table 1: A summary of moments with different model assumptions

models	$std(\hat{y}_t)$	$std(\hat{N}_t)$	$std(\hat{e}_t)$	$std(\hat{h}_t)$	$std(\hat{n}_t)$	$corr(\hat{h}_t, \hat{n}_t)$	$corr(\hat{y}_t, \hat{\Omega}_t)$
benchmark	0.015	1.42	0.19	7.22	0.69	0.84	0.39
fixed e_t	0.015	1.36	0.00	7.92	0.64	0.86	0.35
fixed h_t & u_t	0.014	0.86	0.31	0.00	0.61	0.04	0.93

The role of the extensive vs. intensive margins

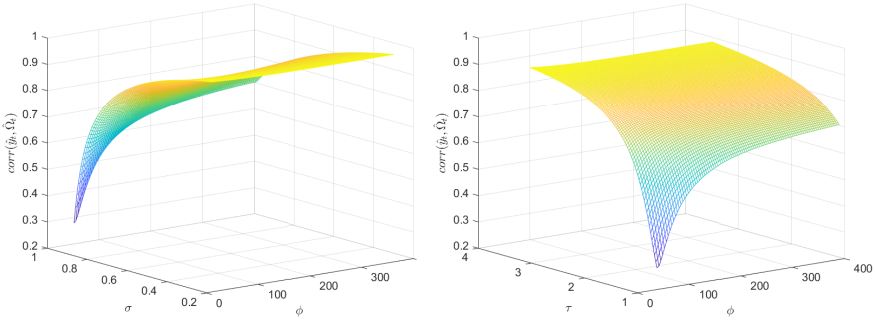

Figure 6: Sensitivity analysis: joint variations in σ and τ with ϕ

Summary of parameter sensitivity

Table 2: A summary of moments for different model parameters

models			moments				
ϕ	σ	τ	$std(\hat{y}_t)$	$std(\hat{N}_t)$	$corr(\hat{y}_t, \hat{N}_t)$	$corr(\hat{y}_t, \hat{\Omega}_t)$	n/L
68.47	0.99	1.11	1.54	1.42	0.90	0.39	0.894
304.03	0.99	1.11	1.67	1.28	0.92	0.69	0.708
68.47	0.30	1.11	1.55	1.12	0.99	0.96	0.673
68.47	0.99	3.33	1.40	0.93	0.96	0.89	0.713

Another key mechanism

- The training requirement for permanent labor matters
    - During the periods of training, firms hire temporary workers as short-term substitutes even though they are less productive
    - A factor that raises the temporary employment shares makes this channel weaker and ALP more procyclical (e.g., higher firing costs and a lower degree of substitutability between two types of labor)

Extension exercise: Model with Labor Search-and-matching Frictions

Model features

- Model: with the same household preference and production function as the baseline model
- Search framework: Merz (1995) and Andolfatto (1996)
- Extra assumptions: (i) Only hiring permanent workers is subject to labor search frictions (ii) training takes one period.

The matching technology

- The matching function of a CRTS form:

$$l_{1,t} = m v_t^{\varphi} (1 - x_t - u_t)^{1-\varphi},$$

  - $1 - x_t - u_t$: workers looking for permanent jobs at the beginning of t
  - v_t: vacancy
  - φ: the elasticity of $l_{1,t}$ with respect to v_t
  - m: matching efficiency
  - $q_t = l_{1,t}/v_t$: the vacancy-filling rate
  - $f_t = l_{1,t}/(1 - x_t - u_t)$: the job-finding rate

The timeline

The firm problem

- The value of a firm with state $\Omega_t^F = \{x_t, u_t\}$:

$$V(\Omega_t^F) = \max_{s_t, v_t, h_t, k_t} d_t + E_t \Lambda_{t+1} V(\Omega_{t+1}^F),$$

where the firm profits:

$$d_t = (1 - \Phi_t) y_t - w_{x,t} e_t (x_t + l_{1,t} + u_t) + w_{h,t} e_t h_t - r_t k_t - \kappa v_t,$$

and the dynamics of states:

$$x_{t+1} = (1 - \zeta) x_t + q_t v_t,$$

$$u_{t+1} = u_t + \zeta x_t - s_t,$$

  - κ: the mean cost of creating a vacancy

The household problem

- The value of a "large" household satisfies the Bellman equation with state $\Omega_t^H = \{k_t, z_t, x_t, u_t\}$:

$$W(\Omega_t^H) = \max_{c_t, h_t, e_t, i_t, z_{t+1}, l_{1,t}} U_t + \beta E_t W(\Omega_{t+1}^H),$$

subject to

$$p_t(z_{t+1} - z_t) = r_t k_t + e_t(w_{x,t} n_t + w_{h,t} h_t) + d_t z_t - c_t - i_t,$$

$$x_{t+1} = (1 - \zeta) x_t + (1 - x_t - u_t) f_t,$$

$$u_{t+1} = u_t + \zeta x_t - s_t.$$

  - $n_t = x_t + l_{1,t} + u_t$: total permanent employment

Wage bargaining

- The determination of $w_{x,t}$ satisfies the split of surplus:

$$W_x(\Omega_t^H) = \left(\frac{1-\xi}{\xi}\right) V_x(\Omega_t^F)\lambda_t,$$

so that the hourly wage rate of permanent workers:

$$(1-f_t)e_t w_{x,t} = \xi \left[(1-f_t)\left(\frac{\psi_2}{1+\tau}e_t^{1+\tau}\right) - \zeta\beta\frac{1}{\lambda_t}E_t W_u(\Omega_{t+1}^H)\right] + (1-\xi)\left[(1-\Phi)MPX_t + \kappa\vartheta_t - \phi\left(\frac{\zeta s_t}{x_t+u_t} - \frac{s_t^2}{(x_t+u_t)^2}\right)\left(\frac{y_t}{x_t+u_t}\right)\right],$$

- Takeaway: The role of firing costs vs. the search-and-matching frictions on the extensive margin

The parameter sensitivity

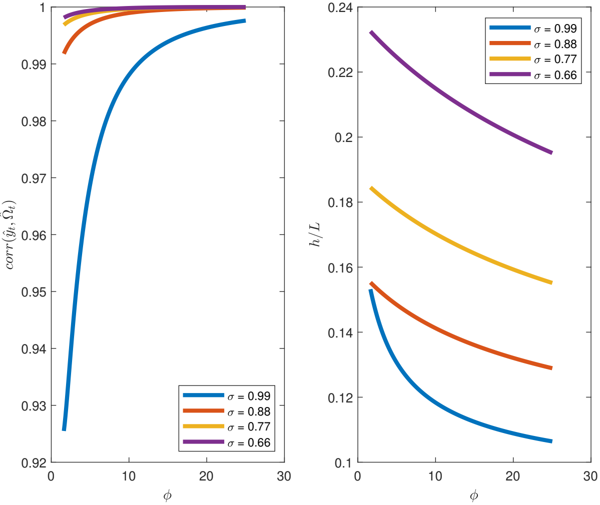

Figure 7: Sensitivity analysis: variations in ϕ

Conclusion and future work

- Extensions of the quantitative analysis show that firing costs play an important role in accounting for the varying procyclicality of ALP.

- The rise in the procyclicality of ALP is much more significant in the case where adjustment on the extensive margin, in particular, via hiring different types of workers is no longer available.

The End & Thank You!

Appendix: The FOCS of the firm problem (I)

$$k_t : r_t = \alpha(1-\Phi_t)\frac{y_t}{k_t},$$

$$h_t : w_{h,t} = (1-\alpha)\,(1-\Phi_t)\,\frac{[\gamma(h_t+u_t)]^\sigma}{x_t^\sigma + [\gamma(h_t+u_t)]^\sigma}\,\frac{y_t}{e_t(h_t+u_t)},$$

$$l_{b,t} : E_t\left[\sum_{a=1}^{b}\beta^{a-1}\frac{\lambda_{t+a-1}}{\lambda_t}w_{n,t+a-1}e_{t+a-1}\right] = E_t\left[\beta^{b-1}\frac{\lambda_{t+b-1}}{\lambda_t}\eta_{t+b-1}\right],$$

Appendix: The FOCS of the firm problem (II))

$$x_{t+1} : E_t\left(\eta_{t+b-1}\right) = E_t\left\{\beta\frac{\lambda_{t+b}}{\lambda_{t+b-1}}\left[\left(1-\Phi_{t+b}\right)\frac{(1-\alpha)x_{t+b}^{\sigma}}{x_{t+b}^{\sigma}+[\gamma(h_{t+b}+u_{t+b})]^{\sigma}}\frac{y_{t+b}}{x_{t+b}}\right.\right.$$

$$\left.\left.-w_{n,t+b}e_{t+b}+(1-\zeta)\eta_{t+b}+\phi\left(\frac{s_{t+b}^2}{(x_{t+b}+u_{t+b})^2}-\frac{\zeta s_{t+b}}{x_{t+b}+u_{t+b}}\right)\frac{y_{t+b}}{x_{t+b}+u_{t+b}}\right]\right\},$$

$$u_{t+1} : \phi\left(\frac{s_t}{x_t+u_t}\right)\frac{y_t}{x_t+u_t}+E_t\left\{\beta\frac{\lambda_{t+1}}{\lambda_t}\left[\phi\left(\frac{s_{t+1}^2}{(x_{t+1}+u_{t+1})^2}-\frac{s_{t+1}}{x_{t+1}+u_{t+1}}\right)\frac{y_{t+1}}{x_{t+1}+u_{t+1}}\right.\right.$$

$$= E_t\left[\beta\frac{\lambda_{t+1}}{\lambda_t}(w_{n,t+1}-w_{h,t+1})e_{t+1}\right].$$

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Appendix: The FOCs of the household problem

$$c_t : \lambda_t = \left[c_t - \frac{\psi_1}{1+\chi}(n_t^{1+\chi} + h_t^{1+\chi}) - \frac{\psi_2}{1+\tau}(n_t + h_t)e_t^{1+\tau} \right]^{-\theta},$$

$$h_t : \psi_1 h_t^{\chi} + \frac{\psi_2}{1+\tau} e_t^{1+\tau} = w_{h,t} e_t,$$

$$n_t : \psi_1 n_t^{\chi} + \frac{\psi_2}{1+\tau} e_t^{1+\tau} = w_{n,t} e_t,$$

$$e_t : \psi_2 e_t^{\tau} = \frac{n_t}{n_t + h_t} w_{n,t} + \frac{h_t}{n_t + h_t} w_{h,t},$$

$$k_{t+1} : 1 = E_t \left[\beta \frac{\lambda_{t+1}}{\lambda_t} (r_{t+1} + 1 - \delta) \right],$$

$$z_{t+1} : \ p_t = E_t \left[\beta \frac{\lambda_{t+1}}{\lambda_t} (p_{t+1} + d_{t+1}) \right].$$

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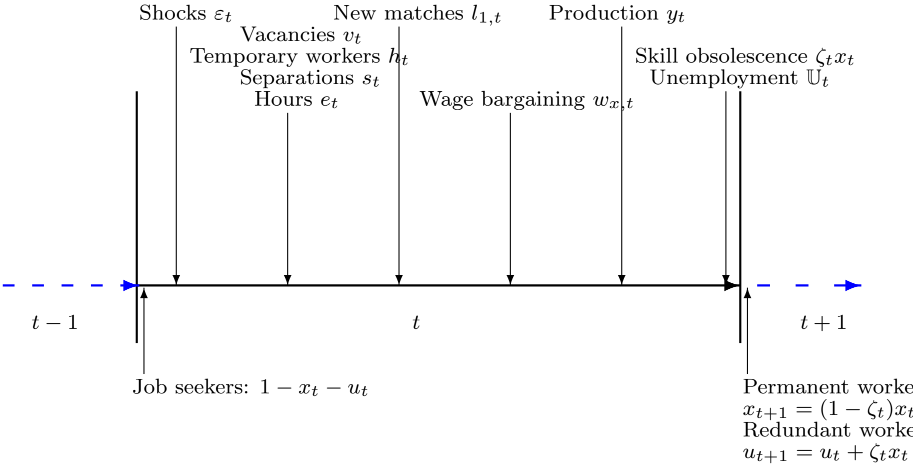
Appendix: The timeline of the firm's decisions



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