# Countercyclical Job Values

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# MOTIVATION AND KEY IDEAS

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- Important for our understanding of business cycles and employment dynamics
- I look at the optimal recruiting equation of the firm
- I estimate alternative specifications and examine implications
- A surprising result: firms hire at a faster rate in recessions as the job value is counter-cyclical

# PLAN OF TALK

- Preview of the Results

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- The Model

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- The Emerging Picture

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- Note that this value is a forward-looking expected present value of future labor profitability.
- Correspondingly, hiring rates from non-employment (unemployment + out of the labor force) are counter-cyclical.
- It is the dynamic behavior of the labor share that engenders the counter-cyclicality of the forward-looking job values.

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- Part of the explanation has to do with job values and another part with the interaction with investment (in capital) behavior.
- Changes in job values are also helpful in explaining the reduction in labor market fluidity in the U.S.

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- Relates the marginal costs of vacancies or of hiring which the firm faces with the marginal benefit, which is the expected present value of what the firm will get from the employment relationship.
- $$MC_t(\cdot) = E_t PV_t(\cdot)$$

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- There are different specifications for the economic mechanisms underlying these components, for the functional form of costs, and for the relevant arguments to be used in the functions.
- The two sides of this equation express the value of the job

# THE MODEL

*Set-Up.* There are identical workers and identical firms, who live forever and have rational expectations. All variables are expressed in terms of output.

*Worker Flows.*

$$\frac{h}{n} = \left(\frac{h^1}{n}\right) + \left(\frac{h^2}{n}\right)$$

$$\frac{h^1}{n} = \frac{OE+UE}{E};\ \frac{h^2}{n} = \frac{EE}{E}$$

$$\psi = \psi^1 + \psi^2$$

$$\psi^1 = \frac{EO+EU}{E};\ \psi^2 = \frac{EE}{E} = \frac{h^2}{n}$$

Employment dynamics are thus given by:

$$
\begin{aligned}
n_{t+1} &= (1-\psi_t^1-\psi_t^2)n_t + h_t^1 + h_t^2 \\
&= (1-\psi_t)n_t + h_t, \quad 0 \le \psi_t \le 1 \\
h_t^2 &= \psi_t^2 n_t
\end{aligned}
$$

*Matching and Separations.*

- Firms hire from non-employment ($h_t^1$) and from other firms ($h_t^2$).
- Each period, the worker's effective units of labor (normally 1 per person) depreciate to 0, in the current firm, with some exogenous probability $\psi_t$.
- Thus, the match suffers an irreversible idiosyncratic shock that makes it no longer viable.
- The worker may be reallocated to a new firm where his/her productivity is (temporarily) restored to 1.
- This happens with a probability of $\psi_t^2$.
- Those who are not reallocated join unemployment, with probability $\psi_t^1 = \psi_t - \psi_t^2$.
- So the fraction $\psi_t^2$ that enters job to job flows depends on the endogenous hiring flow $h_t^2$.
- The firm decides how many vacancies $v_t$ to open and, given job filling rates $(q_t^1, q_t^2)$, will get to hire from the pre-existing non-employed and from the pool of matches just gone sour.

The matching rates satisfy:

$$q_t^1 = \frac{h_t^1}{v_t}$$
$$q_t^2 = \frac{h_t^2}{v_t}$$
$$q_t = q_t^1 + q_t^2$$

*Firms Optimization.*

$$y_t = f(z_t, n_t, k_t),$$

$$k_{t+1} = (1-\delta_t)k_t + i_t, \quad 0 \leq \delta_t \leq 1.$$

$$n_{t+1} = (1-\psi_t)n_t + q_t v_t, \quad 0 \leq \psi_t \leq 1$$

- The representative firm chooses sequences of $i_t$ and $v_t$ in order to maximize its profits as follows:

$$\max_{\{i_{t+j}, v_{t+j}\}} E_t \sum_{j=0}^{\infty} \left( \prod_{i=0}^{j} \rho_{t+i} \right) (1-\tau_{t+j}) \left( \begin{array}{c} f(z_{t+j}, n_{t+j}, k_{t+j}) \\ -g\left(i_{t+j}, k_{t+j}, v_{t+j}, h_{t+j}, n_{t+j}\right) \\ -w_{t+j} n_{t+j} \\ -\left(1-\chi_{t+j} - \tau_{t+j} D_{t+j}\right) \widetilde{p}^{I}_{t+j}\, i_{t+j} \end{array} \right)$$

**FOC**

$$Q_t^K = (1-\tau_t)\left(g_{i_t} + p_t^I\right) = E_t\left[\rho_{t,t+1}(1-\tau_{t+1})\left[\begin{array}{c} f_{k_{t+1}} - g_{k_{t+1}} \\ +(1-\delta_{t+1})(g_{i_{t+1}} \\ +p_{t+1}^I) \end{array}\right]\right]$$

$$Q_t^N = (1-\tau_t)\frac{g_{v_t}}{q_t} = E_t\left[\rho_{t,t+1}(1-\tau_{t+1})\left[\begin{array}{c} f_{n_{t+1}} - g_{n_{t+1}} - w_{t+1} \\ +(1-\psi_{t+1})\frac{g_{v_{t+1}}}{q_{t+1}} \end{array}\right]\right]$$

$$f(z_t,n_t,k_t) = e^{z_t} {n_t}^{\alpha} k_t^{1-\alpha},\ 0 < \alpha < 1.$$

$$g(\cdot) = \left[ \begin{array}{c} \frac{e_1}{\eta_1} \left( \frac{i_t}{k_t} \right)^{\eta_1} \\ + \frac{e_2}{\eta_2} \left[ \frac{(1-\lambda_1-\lambda_2)\mathbf{v}_t + \lambda_1 \mathbf{q}_t^1 \mathbf{v}_t + \lambda_2 \mathbf{q}_t^2 \mathbf{v}_t}{n_t} \right]^{\eta_2} \\ + \frac{e_{31}}{\eta_{31}} \left( \frac{i_t}{k_t} \frac{q_t^1 v_t}{n_t} \right)^{\eta_{31}} + \frac{e_{32}}{\eta_{32}} \left( \frac{i_t}{k_t} \frac{q_t^2 v_t}{n_t} \right)^{\eta_{32}} \end{array} \right] f(z_t,n_t,k_t).$$

# Alternative Specifications I

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- $$(1-\tau_t)\frac{e_2}{q_t}\frac{f_t}{n_t} = E_t\left[\rho_{t+1}(1-\tau_{t+1})\left[\begin{array}{c} f_{n_{t+1}} - w_{t+1} \\ +(1-\psi_{t+1})\frac{e_2}{q_{t+1}}\frac{f_{t+1}}{n_{t+1}} \end{array}\right]\right]$$

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- $e_1 = e_{31} = e_{32} = 0, \lambda_1 = 1; \lambda_2 = 0$ and $\eta_2 = 2$.
- $$(1-\tau_t)\, g_{h_t} = E_t\left[\rho_{t,t+1}\,(1-\tau_{t+1})\left[\begin{array}{c} f_{n_{t+1}} - g_{n_{t+1}} - w_{t+1} \\ +(1-\psi_{t+1})g_{h_{t+1}} \end{array}\right]\right].$$

- GMM estimation of the parameters $\alpha; e_1, e_2, e_{31}, e_{32}; \eta_1, \eta_2, \eta_{31}, \eta_{32}, \lambda_1, \lambda_2$, or a sub-set of these parameters.

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- Post estimation I compute an approximated present value on which a variance decomposition is computed.

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- Post estimation I compute an approximated present value on which a variance decomposition is computed.
- $$\frac{Q^N_{t,T}}{\frac{f_t}{n_t}} = PV_{t,T} = \sum_{j=1}^{T} \left[ \begin{array}{c} \left( \prod_{l=1}^{j} \rho_{t+l-1,t+l} \frac{\frac{f_{t+l}}{n_{t+l}}}{\frac{f_{t+l-1}}{n_{t+l-1}}} \right) \\ \left( \prod_{l=2}^{j} (1-\psi_{t+l-1}) \right) (1-\tau_{t+j}) \\ \left[ \alpha - \frac{g_{n_{t+j}}}{\frac{f_{t+j}}{n_{t+j}}} - \frac{w_{t+j}}{\frac{f_{t+j}}{n_{t+j}}} \right] \end{array} \right]$$

- Following Cochrane (1992), I use the following first-order Taylor expansion to get

$$PV_{t,T} \cong \left[ \sum_{j=1}^{T} \exp \left[ \sum_{l=1}^{j} g^{r}_{t+l} \right] \exp \left[ \sum_{l=1}^{j} g^{f}_{t+l} \right] \exp \left[ \sum_{m=l}^{j} g^{s}_{t+m-1} \right] MP_{t+j} \right]$$

where

$$MP_{t+j} \equiv (1 - \tau_{t+j}) \left( \alpha - \frac{g_{n_{t+j}}}{\frac{f_{t+j}}{n_{t+j}}} - \frac{w_{t+j}}{\frac{f_{t+j}}{n_{t+j}}}) \right)$$

$$g^{f}_{t} = \ln \left( \frac{\frac{f_{t+1}}{n_{t+1}}}{\frac{f_t}{n_t}} \right)$$

$$g^{s}_{t} \equiv \ln(1 - \psi_t)$$

$$g^{r}_{t} \equiv \ln \rho_{t,t+1} \equiv \ln \left( \frac{1}{1 + r_t} \right)$$

This yields the variance decomposition:

$$
\begin{aligned}
var(PV_{t,T}) \quad \cong \quad & \frac{\Omega^r \Omega^f E(MP)}{1-\Omega} \sum_{j=1}^{T} (\Omega)^{j-1} cov(P_t, g^r_{t+j}) + \\
& \frac{\Omega^r \Omega^f E(MP)}{1-\Omega} \sum_{j=1}^{T} (\Omega)^{j-1} cov(P_t, g^f_{t+j}) + \\
& \frac{\Omega^r \Omega^f E(MP)}{1-\Omega} \sum_{j=2}^{T} (\Omega)^{j-1} cov(P_t, g^s_{t+j}) + \\
& \Omega^r \Omega^f \sum_{j=1}^{T} (\Omega)^{j-1} cov(P_t, MP_{t+j})
\end{aligned}
$$

Future discount rates ($g^r_{t+j}$), productivity growth ($g^f_{t+j}$), separation rates ($g^s_{t+j}$ ) and marginal profits ($MP_{t+j}$).

# Results

- **GMM Estimates**

# RESULTS

- **GMM Estimates**

| specification | $e_1$ | $e_2$ | $e_{31}$ | $e_{32}$ | $\alpha$ | J-Stat |
|---|---|---|---|---|---|---|
| benchmark | 77.3 | 9.1 | $-2.8$ | $-19.6$ | 0.66 | 51.6 |
| | (6.29) | (0.98) | (1.2) | (0.9) | (0.003) | (0.74) |
| Tobin's q | 0 | 30.8 | 0 | 0 | 0.70 | 61.9 |
| | – | (0.9) | – | – | (0.003) | (0.48) |
| Matching | 0 | 9.3 | 0 | 0 | 0.77 | 62.5 |
| | – | (0.1) | – | – | (0.002) | (0.46) |

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| | benchmark | Tobin's Q | Std. matching |
|---|---|---|---|
| mean | 0.12 | 0.90 | 0.97 |
| (in wages) | 0.2 | 1. 5 | 1.6 |
| (in weeks of wages) | 0.9 | 6. 4 | 6. 8 |
| | | | |
| median | 0.12 | 0.89 | 1.00 |

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| | benchmark | Tobin's Q | Std. matching |
|---|---|---|---|
| std. | 0.03 | 0.03 | 0.13 |
| auto-correlation | 0.91 | 0.55 | 0.92 |

- **Variance Decomposition ($T = 30$)**

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-

| | benchmark | Tobin's Q | Std. matching |
|---|---|---|---|
| $var(PV_{t,T})$ | 0.01 | 0.008 | 0.01 |
| | | | |
| $\frac{\frac{\Omega^r \Omega^f E(MP)}{1-\Omega} \sum_{j=1}^{T} (\Omega)^{j-1} cov(P_t, g^r_{t+j})}{var(PV_{t,T})}$ | 0.04 | 0.09 | 0.07 |
| $\frac{\frac{\Omega^r \Omega^f E(MP)}{1-\Omega} \sum_{j=1}^{T} (\Omega)^{j-1} cov(P_t, g^f_{t+j})}{var(PV_{t,T})}$ | $-0.02$ | 0.04 | 0.03 |
| $\frac{\frac{\Omega^r \Omega^f E(MP)}{1-\Omega} \sum_{j=2}^{T} (\Omega)^{j-1} cov(P_t, g^s_{t+j})}{var(PV_{t,T})}$ | $-0.007$ | 0.06 | 0.06 |
| $\frac{\Omega^r \Omega^f \sum_{j=1}^{T} (\Omega)^{j-1} cov(P_t, MP_{t+j})}{var(PV_{t,T})}$ | 0.74 | 0.78 | 0.62 |
| residual/error | 0.24 | 0.02 | 0.21 |

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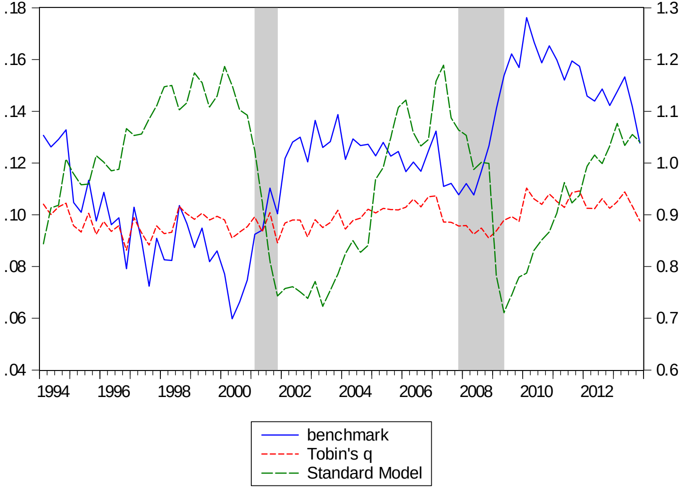



**Cyclicality of Job Values (logged, HP filtered)**

## Job Value Cyclicality

$$\rho\left(\frac{Q_t^N}{\frac{f_t}{n_t}}, y_{t+i}\right)$$

*HP filtered* ($\lambda = 1600$)

Benchmark model

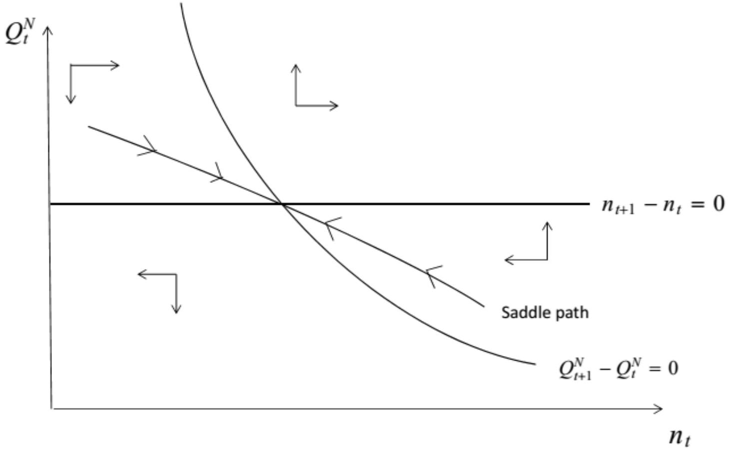
| $i$ | $-8$ | $-4$ | $-1$ | $0$ | $1$ | $4$ | $8$ |
|---|---|---|---|---|---|---|---|
| $y$ | $-0.04$ | $-0.46$ | $-0.67$ | $-0.63$ | $-0.49$ | $0.04$ | $0.33$ |

Tobin's q

| $i$ | $-8$ | $-4$ | $-1$ | $0$ | $1$ | $4$ | $8$ |
|---|---|---|---|---|---|---|---|
| $y$ | $-0.28$ | $-0.24$ | $0.03$ | $0.13$ | $0.27$ | $0.41$ | $0.19$ |

Standard model

| $i$ | $-8$ | $-4$ | $-1$ | $0$ | $1$ | $4$ | $8$ |
|---|---|---|---|---|---|---|---|
| $y$ | $-0.26$ | $0.38$ | $0.85$ | $0.90$ | $0.79$ | $0.39$ | $-0.18$ |




**Saddle Path Dynamics**

- **The Labor Share and GDP**

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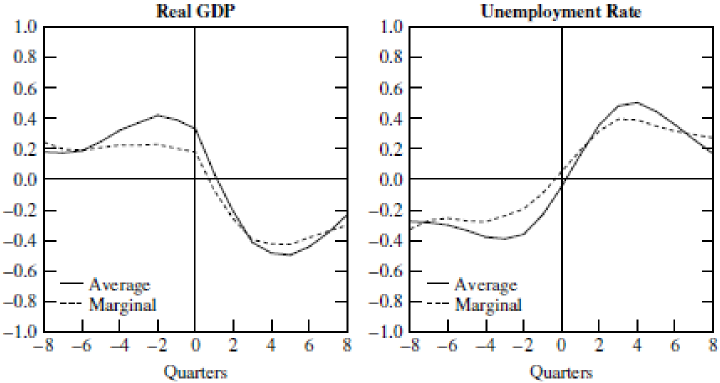
| $i$ | $-8$ | $-4$ | $-1$ | $0$ | $1$ | $4$ | $8$ |
|---|---|---|---|---|---|---|---|
| | $-0.36$ | $-0.38$ | $-0.29$ | $-0.23$ | $-0.02$ | **0.53** | **0.46** |

# From Ramey and Nekarda (2013)

**Figure 2. Cross-Correlations of Markup with Real GDP and Unemployment Rate**




Source: Authors' calculations using quarterly BEA and BLS data.

Notes: Markup is inverse labor share for private business (BLS) over 1948:1–2012:4. Correlation of cyclical components of $\mu_{t+j}$ with $y_t$ and $u_t$; detrended using HP filter ($\lambda = 1,600$).

## Consistency I

$$\underbrace{MC_t\left(\frac{h_t^1}{n_t}, \frac{h_t^2}{n_t}, \frac{v_t}{n_t}\right)}_{\text{counter-cyclical}} = \underbrace{E_t PV_t(\cdot)}_{\text{counter-cyclical}}$$

$\rho(\frac{h_t^1}{n_t}, y_t) = -0.30$
$\rho(\frac{h_t^2}{n_t}, y_t) = 0.68$
$\rho(\frac{v_t}{n_t}, y_t) = 0.89$

**Consistency II**

$\rho(Q_t^N, y_t) = -0.63$

$\rho(\frac{h_t^1}{n_t}, y_t) = -0.30$

$$\underbrace{\overbrace{\frac{h^1}{n}}^{counter}}_{\text{hiring rate}} = \underbrace{\frac{\overbrace{h^1}^{pro}}{u+o}}_{\text{job finding}} \times \underbrace{\frac{\overbrace{u+o}^{counter}}{pop}}_{\text{non-emp}} \times \underbrace{\frac{\overbrace{pop}^{counter}}{n}}_{\text{inv emp ratio}}$$

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- with each factor being a function of the job filling rates and model parameters. These factors are functions of market conditions.
- b. Much of the variance comes from the term which depends on the investment rate, hence the interaction of hiring costs and investment costs is key.

- **Behavior of Recruiting Rates (volatility and cyclicality)**
- The key series pertaining to recruiting display differential behavior.
- For both the vacancy rate $\frac{v_t}{n_t}$ and the total hiring rate $\frac{h_t}{n_t}$ the following is found:
- a. There are two determinants: the job value $\frac{Q_t^N}{(1-\tau_t)\frac{f_t}{n_t}}$ multiplied by a factor and the investment rate $\frac{i_t}{k_t}$ multiplied by a different factor,
- with each factor being a function of the job filling rates and model parameters. These factors are functions of market conditions.
- b. Much of the variance comes from the term which depends on the investment rate, hence the interaction of hiring costs and investment costs is key.
- Both are pro-cyclical due to the fact that the high pro-cyclicality of the investment rate term dominates the counter-cyclicality of the job value term.

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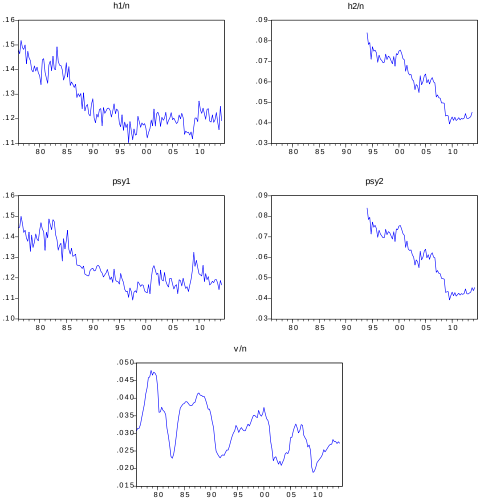
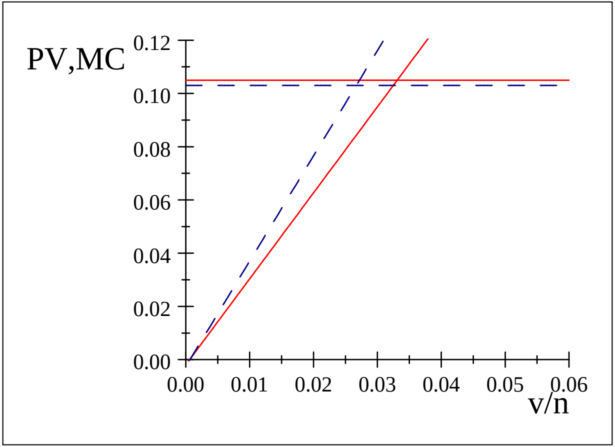



## Decline in Worker Flows and Vacancy Rates

$$\frac{Q_t^N}{\frac{f_t}{n_t}} = (1-\tau_t)\frac{g_{v_t}}{q_t\frac{f_t}{n_t}}$$
$$= \frac{(1-\tau_t)}{q_t}\left(e_2\left(1-\lambda_1+\lambda_1 q_t\right)^2\frac{v_t}{n_t}+e_3 q_t^1\frac{i_t}{k_t}\right)$$

| | |
|---|---|
| $e_2$ | 1.6 |
| $e_3$ | $-0.15$ |
| $\lambda_1$ | 0.9 |

| | **1976:1-1995:4** | **1996:1-2013:4** |
|---|---|---|
| $\frac{Q_t^N}{\frac{f_t}{n_t}}$ | 0.105 | 0.103 |
| $\frac{v_t}{n_t}$ | 0.035 | 0.028 |
| $\tau_t$ | 0.41 | 0.34 |
| $q_t$ | 4.0 | 4.4 |
| $\frac{i_t}{k_t}$ | 0.022 | 0.026 |




**Job Values and Marginal Costs Across Sub-Periods**

red – 1976-1995
blue – 1996-2013

# CONCLUSIONS

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- These patterns are consistent with phase dynamics of a Q model.