The Beveridge Curve: A Survey

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Roadmap

Some familiar material

1. Empirical Beveridge curves.
2. Canonical search model as a benchmark.

Directions for future research

3. Conceptual and measurement issues.
4. Wage setting.
5. Costly entry [incl. recruitment intensity].
6. Participation margin.
8. Heterogeneity [incl. mismatch and duration dependence].
I. EMPIRICAL BEVERIDGE CURVES
The Beveridge Curve in the United States

Vacancy rate (V/L, Composite HWI, CPS)

1960 to 1970
1975 to 1986
1990 to 2000
2001 to 2013

Source: Barnichon (2010) HWI/JOLTS composite
The Beveridge Curve in the United States

Unemployment rate (U/L, CPS)
Vacancy rate (V/L, Composite HWI, CPS)

1960 to 1970
1975 to 1986
1990 to 2000
2001 to 2013

1. Inverse cyclical co-movement.
2. Periodic lateral shifts.

Source: Barnichon (2010) HWI/JOLTS composite
The Beveridge Curve in selected OECD countries

France

Netherlands

Sweden

United Kingdom

Source: OECD Registered Vacancies database
Conceptual issues

• Of the two axes, $u$ is better understood.
  – ILO definition (or similar) commonly used.
  – Participation margin beginning to be understood.

• Much less understood about vacancies, $v$.
  – $u$: idle resource = worker; $v$: less conspicuous.
  – Mapping from unused capacity to unfilled jobs?
  – Production not undertaken due to unfilled job?
  – Pre-emptive $vs$; need not $\Rightarrow$ unmet labor demand.
Vacancy data

• 12/2000+: JOLTS advanced measurement of \( \nu \).
  – Product of decades of BLS research since 1950s.
  – “Position exists; work could start within 30 days; actively recruiting from outside establishment.”
  – Firms appear to interpret \( \nu \) in line w/ this def.

• Pre-JOLTS: Help-Wanted Index proxy.
  – Counts of ads in newspapers in 51 large U.S. cities.
  – Used for want of a better alternative!
Measurement issues

- **Help-Wanted Index** [Abraham 1987].
  - One ad = many vs? Not all vs covered by ads. Idiosyncratic trends: ↑ in 1960s; ↓ since 1990s.

- **JOLTS** [Davis, Faberman and Haltiwanger].
  - 40% hires w/ no v; ⅓ time agg.; remaining ⅓?
  - Miss young, fast-growing firms: 8.5% of vs!

- **Beyond United States.**
  - Coverage and consistency of registered vacancies.
Stylized facts of Beveridge dynamics

• Inverse cyclical co-movement.
  – Data consistent over high frequencies.

• Periodic lateral shifts.
  – 1980s Europe: shifts too large to be just error.

• Canonical account: standard search model...
II. CANONICAL EXPLANATIONS
A descriptive model

\[
\frac{dU}{dt} = \lambda(L - U) - m(U, V)
\]

\[
\frac{dV}{dt} = \gamma(...) - m(U, V)
\]

Unemployment inflow rate

Flow of new vacancies
A descriptive model

\[
\frac{dU}{dt} = \lambda(L - U) - m(U, V)
\]

\[
\frac{dV}{dt} = \gamma(...) - m(U, V)
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A descriptive model

Pervasive interpretation of Beveridge curve:

\[ \frac{dU}{dt} = 0: \lambda(L - U) = m(U, V) \]
A descriptive model

Pervasive interpretation of Beveridge curve:

\[
\frac{dU}{dt} = 0: \lambda(L - U) = m(U, V)
\]

- Beveridge curve is close cousin of matching function.
- Inverse relation between \( u \) and \( v \), mirroring data.
- Changes in \( \lambda \) induce shifts in \( u, v \) locus.
- Could these explain empirical shifts?

Constant returns
[Petrongolo/Pissarides 2001]
A descriptive model

Pervasive interpretation of Beveridge curve:

\[
\frac{dU}{dt} = 0: \lambda(1 - u) = m(u, v)
\]
A descriptive model

Pervasive interpretation of Beveridge curve:

\[
\frac{dU}{dt} = 0: \lambda = m \left( \frac{u}{1-u}, \frac{v}{1-u} \right)
\]

• For a given \( \lambda \):
  – Beveridge curve is close cousin of matching fn.
  – Inverse relation b/w \( u \) and \( v \), mirroring data.

• Changes in \( \lambda \) induce shifts in \((u, v)\) locus.
  – Could these explain empirical shifts?...
Unemployment inflow rate ($\lambda$) in the United States

Unemployment inflow rate ($\lambda$) in the United States


Trend rise in $\lambda$ in 70s-80s; trend decline since [Baby boom, Shimer 2001].
A counterfactual exercise

Implied vertical shift induced by changes in $\lambda$:

\[
\left. \frac{d \ln v}{d \ln \lambda} \right|_{u, \dot{u} = 0} = \frac{1}{1 - \alpha}
\]

where $\alpha = \partial \ln m / \partial \ln u = \text{matching elasticity}$. 
A counterfactual exercise

Implied vertical shift induced by changes in $\lambda$:

$$\left. \frac{d \ln v}{d \ln \lambda} \right|_{u, \dot{u}=0} = \frac{1}{1 - \alpha} \approx 2$$

where $\alpha \approx 0.5$ [Petrongolo and Pissarides 2001].

• Infer $\lambda$-constant locus by subtracting above shifts from path of $v$.

• Not necessarily counterfactual eqm. path!
Actual and counterfactual Beveridge curves

A. Actual Beveridge curve

B. Constant inflow rate counterfactual

1. 1970s/80s: Elevated \( \lambda \) accounts for all of BC shift [cf. Abraham].

2. 2008+: Trend decline in \( \lambda \) masked even larger outward shift!
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What about vacancy creation?

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\frac{dU}{dt} = \lambda (L - U) - m(U, V)
\]

\[
\frac{dV}{dt} = \gamma (...) - m(U, V)
\]
What about vacancy creation?

Unemployment inflow rate

\[
\frac{dU}{dt} = \lambda (L - U) - m(U, V)
\]

Flow of new vacancies

\[
\frac{dV}{dt} = \gamma (...) - m(U, V)
\]

Canonical search model is a model of \(\gamma\). Two pillars:

1. Nash wage setting; 2. Free entry.
Beveridge dynamics in the canonical search model

A. $\lambda \uparrow$ or match efficiency $\downarrow$

- Free entry $\Rightarrow$ flow of new vacancies $\gamma$ jumps to maintain $(v/u)^*$. 
- $\lambda \uparrow$ or match efficiency $\downarrow$ typically $\Rightarrow$ positive co-movement.
- Productivity $\downarrow$ $\Rightarrow$ negative co-movement.
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• $\lambda \uparrow$ or match efficiency $\downarrow$ typically $\Rightarrow$ positive co-movement.
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B. Productivity $\downarrow$
Beveridge dynamics in the canonical search model

A. \( \lambda \uparrow \) or match efficiency \( \downarrow \)

- Free entry \( \Rightarrow \) flow of new vacancies \( \gamma \) jumps to maintain \( (v/u)^* \).

- \( \lambda \uparrow \) or match efficiency \( \downarrow \) typically \( \Rightarrow \) positive co-movement.

B. Productivity \( \downarrow \)

- Productivity \( \downarrow \) \( \Rightarrow \) negative co-movement.

Periodic lateral shifts
Quantitative limitations of the canonical model

A. Amplitude and co-movement

- Feed observed paths of \( \{ p, \lambda \} \) through conventional calibration.
- Amplitude and co-movement only when surplus is small [Shimer].
- Jump vacancy dynamics miss empirical persistence.

B. Propagation

- Log deviation relative to pre-recession

\[
\begin{align*}
\text{Unemployment rate (U/L)} & \quad \text{Vacancy rate (V/L)} \\
0 & \quad 0.12 \\
0.02 & \quad 0.1 \\
0.04 & \quad 0.08 \\
0.06 & \quad 0.06 \\
0.08 & \quad 0.04 \\
0.1 & \quad 0.02 \\
0.12 & \quad 0 \\
\end{align*}
\]

\[
\begin{align*}
\text{Quarters since start of recessionary rise in unemployment} & \quad \text{Log deviation relative to pre-recession} \\
0 & \quad 0.5 \\
2 & \quad 0.4 \\
4 & \quad 0.3 \\
6 & \quad 0.2 \\
8 & \quad 0.1 \\
10 & \quad 0 \\
12 & \quad 0.1 \\
\end{align*}
\]
III. WAGE SETTING
Extending the standard model

\[
\frac{dU}{dt} = \lambda (L - U) - m(U, V)
\]

\[
\frac{dV}{dt} = \gamma (... - m(U, V)
\]

Canonical search model is a model of \( \gamma \). Two pillars:

1. Nash wage setting;
2. Free entry.
Wage setting and amplification

Nash ∈ {continuum of privately efficient wages}.

\[
\frac{d \ln(v/u)}{d \ln p} = \frac{1}{\alpha} \frac{1 - \varepsilon_w(w/p)}{1 - (w/p)}
\]

where \( \varepsilon_w = \frac{d \ln w}{d \ln p} \). (Note: total derivative!)

Key issues:
1. Sources of wage rigidity (\( \varepsilon_w \) low).
2. Magnitude of rents (\( w/p \) high).
3. Appropriate measure of wages \( w \).
Sources of wage rigidity ($\varepsilon_w$ low).

- *Ex post* rents $\Rightarrow$ wages need not change [Hall 2005].
- Staggered wage setting [Gertler/Trigari 2009].
- Delay as a threat point [Hall/Milgrom 2008].
- Private information over productivity [Kennan 2010].
- Commit not to replace workers [Menzio/Moen 2010].
- Equal treatment by tenure [Bewley 99; Snell/Thomas 10].
- Downward nominal wage rigidity [Bewley 1999].
Magnitude of rents \( (w/p \text{ high}) \).

- Tension: Low surplus amplifies job creation BUT also raises job destruction.

- Diminishing returns \( \Rightarrow \) low marginal surplus and large infra-marginal surplus [Elsby and Michaels 2013].

Appropriate measure of wages \( w \).

- Vacancy creation a marginal decision: flexibility of entry wages crucial. [Bewley 1999; Shimer 2004].

- Early evidence suggests entry wages are flexible [Martins et al. 2012; Carneiro et al. 2012; Stüber 2013].
IV. COSTLY ENTRY
Extending the standard model

\[ \frac{dU}{dt} = \lambda (L - U) - m(U, V) \]

\[ \frac{dV}{dt} = \gamma (...) - m(U, V) \]

Canonical search model is a model of \( \gamma \). Two pillars:

1. Nash wage setting;
2. Free entry.
Costly entry [Coles and Moghaddasi Kelishomi 2011]

\[
\frac{dV}{dt} = \gamma(V) - m(U,V)
\]

Key: \( \varepsilon_{VV} < \infty \). [Free entry \( \Rightarrow \varepsilon_{VV} \to \infty \).]

- Slope of \( \dot{V} = 0 \) reflects delicate counterbalance.
- \( \uparrow U \Rightarrow \uparrow \) hires \( m \) and \( \uparrow \) flow of new vacancies \( \gamma \).
- But \( \gamma \) responds only partially under costly entry.
- Vacancy stock gets depleted; vacancies “dry up.”
Beveridge dynamics under costly entry

A. Rise in job destruction $\lambda \uparrow$

- Costly entry: $\dot{v} = 0$ can slope downward w/ $v$ persistent.
- Rise in job destruction $\lambda$ can induce negative co-movement.
- Can generate amplitude and propagation from just $\lambda$ shocks!

B. Response to job destruction shocks

![Graph showing Beveridge dynamics]

- Log deviation relative to pre-recession
- Quarters since start of recessionary rise in unemployment
- $u$ (model) vs. $u$ (data)
- $v$ (model) vs. $v$ (data)
Costly entry and recruitment intensity

\[ m = m(u, av) \]

Recruiting effort \( a \) chosen s.t. convex cost \( c(a) \).

Under **free entry** [Pissarides 2000]

- All adjustment at *extensive* margin (\( v \) creation).
- \( a \) set to minimize avg. cost \( c(a)/a \Rightarrow \text{invariant} \).
- \( a \) has *no effect* on Beveridge dynamics.
Costly entry and recruitment intensity

\[ m = m(u, av) \]

Recruiting effort \( a \) chosen s.t. convex cost \( c(a) \).

Under **costly** entry: \( a \) rises with \( p \) and falls with \( \lambda \).

• Reductions in \( p \) now shift out Beveridge curve!
• Rises in \( \lambda \) induce greater shift of Beveridge curve.
• \( \gamma \) responds *even more sluggishly*: extra margin.
Costly entry and recruitment intensity

Recession ($p \uparrow$, $\lambda \downarrow$)

- Amplifies shifts in $u = 0$ locus as $a \downarrow$ in recession.
- Renders $v = 0$ even more negatively sloped.
- All the effects of costly entry amplified: significant promise for future research.
Costly entry and recruitment intensity

Recession $(p \uparrow, \lambda \downarrow)$

- Amplifies shifts in $u = 0$ locus as $a$ falls in recession.
- Renders $v = 0$ even more negatively sloped.
- All the effects of costly entry amplified: significant promise for future research.

Recruitment intensity...

- Amplifies shifts in $\dot{u} = 0$ locus as $a$ ↓ in recession.
Costly entry and recruitment intensity

Recession \((p \uparrow, \lambda \downarrow)\)

Recruitment intensity...

- Amplifies shifts in \(\dot{u} = 0\) locus as \(a\) \(\downarrow\) in recession.
- Renders \(\dot{v} = 0\) even more negatively sloped.
- All the effects of costly entry amplified: significant promise for future research.

1. Recruitment intensity fell a lot in Great Recession [Davis et al.].

2. Potential account for significant rise in $u$ (though not BC shift).
V. THE PARTICIPATION MARGIN
The participation margin

\[ u^* = \frac{\pi_{EU} + \epsilon}{\pi_{EU} + \epsilon + m(1, v/u)} + \xi \]

where:

\[ \epsilon \equiv \pi_{EN} \frac{\pi_{NU}}{\pi_{NU} + \pi_{NE}} \]

\[ \xi \equiv \pi_{UN} \frac{\pi_{NE}}{\pi_{NU} + \pi_{NE}} \]
The participation margin and the Beveridge curve

A. Flows via nonparticipation

1. Participation flows contribute to unemployment in recession.

2. Account for some of the BC shift during Great Recession.
Understanding the participation margin

- $\pi_{UN}$ falls and $\pi_{NU}$ rises in recession [Elsby/Hobijn/Şahin 13].

- *Opposite* of discouraged worker effect and predictions of many models.  
  [Garibaldi/Wasmer 05; Haefke/Reiter 11; Tripier 04; Veracierto 08; Ebell 08; Shimer 12]

- Cyclical shifts in labor force attachment among pools of $U$ and $N$ [Elsby/Hobijn/Şahin 13; Barnichon/Figura 13].

- Krusell/Mukoyama/Rogerson/Şahin 2012 only model able to capture this, but $\pi_{UE}$ and $\pi_{EU}$ are exogenous in that model—work to be done!
VI. JOB-TO-JOB TRANSITIONS
Job-to-job transitions

\[ m = m(u + s_e, v) \]

Share of searchers who are unemployed, \( \sigma = \frac{u}{u + s_e} \).

- Job-finding rate, \( f(\sigma(v/u)) \downarrow \): congestion.
- Job-filling rate, \( q(\sigma(v/u)) \uparrow \): larger search pool.
- Free entry \( \rightarrow \text{augmented tightness}, \sigma(v/u) \).
- Cyclical implications depend on cyclicality of \( s_e \)...
Job-to-job transitions and Beveridge dynamics

A. Recession w/ OTJ search

B. Job-to-job transition rate

- Conventional models: Sub. effect $\Rightarrow S_e$ procyclical [Pissarides 2000].
- BC shifts less in recessions; $\nu$ more procyclical [Fujita/Ramey 2012].
- $\pi_{EE'}$ is procyclical but this does not imply $S_e$ is procyclical...
One view of the effect of job-to-job transitions

\[ \pi_{UE} = f(\sigma \theta), \text{ and } \pi_{EE'} = \frac{s_{e} f(\sigma \theta)}{1 - u} \]
One view of the effect of job-to-job transitions

\[ \pi_{UE} = f(\sigma\theta), \text{ and } \pi_{EE'} = \frac{s_e f(\sigma\theta)}{1 - u} \Rightarrow s_e = (1 - u) \frac{\pi_{EE'}}{\pi_{UE}} \]
One view of the effect of job-to-job transitions

A. Implied $s_e$

\[
\pi_{UE} = f(\sigma\theta), \text{ and } \pi_{EE'} = \frac{s_e f(\sigma\theta)}{1 - u} \Rightarrow s_e = (1 - u) \frac{\pi_{EE'}}{\pi_{UE}}
\]
One view of the effect of job-to-job transitions

A. Implied $s_e$

$$\pi_{UE} = f(\sigma \theta), \text{ and } \pi_{EE'} = \frac{s_e f(\sigma \theta)}{1 - u} \Rightarrow s_e = (1 - u) \frac{\pi_{EE'}}{\pi_{UE}}$$

B. Counterfactual Beveridge curve

Implied $s_e$ countercyclical!

Accounts for $\frac{1}{4}$ of shift???
Heterogeneity

\[ \frac{du}{dt} = \lambda (1 - u) - \Omega fu \]

- \( \Omega = \sum_j \omega_j \left( \frac{f_j}{f} \right) \) captures decline in aggregate job-finding rate associated with composition.
- Note: isomorphic to a decline in match efficiency.
- We examine two sources of heterogeneity:
  1. “Mismatch”;
  2. Duration dependence
Heterogeneity

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  1. “Mismatch”; 2. Duration dependence
Mismatch [Jackman/Roper 1987; Şahin, Song, Topa, and Violante 2013]

– Consider planner w/ total unemployed \( u \) and total vacancies \( v \) to allocate over \( j \) markets.

– If markets are symmetric, w/ matching functions \( m_j = m(u_j, v_j) \), efficient to set:

\[
\frac{v_j}{u_j} = \frac{v}{u} \Rightarrow f_j = f \equiv m\left(1, \frac{v}{u}\right) \quad \forall j
\]

– Can be extended to asymmetries in matching, productivity, endog. vacancy creation [Şahin et al. 2013].
Mismatch and the Beveridge curve

A. Match efficiency due to mismatch

- Mismatch across 17 industries almost irrelevant for BC.
- Also extends to more nuanced measures [Şahin et al. 2013].
Cautionary notes on mismatch

– Latter approach: Mismatch transparent and measurable; but requires strong assumptions.

– Not clear how to model or measure allocation of searchers to markets, $m_j(u_j, v_j, \{u_k, v_k\}_{j \neq k})$.

– Assumes heterogeneity at market $j$ level; misses two-sided worker-firm heterogeneity.

  [Lise and Robin 2013]

– Conjecture: Even smaller mismatch effects (envelope theorem).
Heterogeneity

\[
\frac{du}{dt} = \lambda (1 - u) - \Omega fu
\]

- \( \Omega = \sum_j \omega_j \left( \frac{f_j}{f} \right) \) captures decline in aggregate job-finding rate associated with composition.
- Note: isomorphic to a decline in match efficiency.
- We examine two sources of heterogeneity:
  1. “Mismatch”;  
  2. Duration dependence
Duration dependence [Barnichon/Figura 13; Kroft et al. 13]

Negative duration dependence, U.S.

- Unemployment exit rates decline w/ duration in U.S.
- *If duration dependence is causal*, Δ duration structure can shift Beveridge curve.
- Some evidence to suggest duration dependence is (in part) causal [Kroft et al. 2012].
Duration dependence and the Beveridge curve

A. LTU and implied match efficiency

- ↑↑ LTU × duration dependence ⇒ ↓↓ in match efficiency.
- Potentially explains all of shift in Beveridge curve!
Cautionary notes on duration dependence

– Duration dependence need not be causal; could arise from dynamic selection [Kaitz 1970].

– Interpretation not clear in this case...

– Outward shift in Beveridge curve
  ≡ exit rate from $u$ “too low” (given $v$)
  ≡ some individuals face v. low exit rates

– Potential *tautology*: those w/ low exit rates will also experience LTU.
Summary and directions for future work

Most crucial / promising avenues:

– Measurement of vacancies.
– Measures of wage flexibility (plus ça change...)
– Understanding of flow of new vacancies.
– Joint determination of participation & search.
– Cyclicality of search effort on-the-job.
– Nuanced understanding of mismatch.
– Understanding determinants of LTU.