Top Ten Questions for Understanding Firm Dynamics and Productivity Growth

By

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(My) Top Ten Questions for Understanding Firm Dynamics and Productivity

- Wide ranging, covering lots of ground (but promise less than 193 slides!)
- Not in ascending or descending order of importance…but some threads
- Some basic that we have made lots of progress on…some much more speculative for which we have made much less progress

1. Why is there so much dispersion in productivity across businesses in narrowly defined sectors?

- Background facts:
  - Dispersion in U.S. in revenue productivity within 4-digit SIC:
    - Interquartile range of log of revenue TFP is 0.29
    - Interquartile range of log of revenue Labor Productivity is 0.65
      - Source: Syverson (2004)
  - Dispersion in TFPQ, TFPR, and output price within narrow product classes (7-digit) in U.S.:
    - Std. Dev of log(TFPQ) is: 0.26
    - Std. Dev of log(TFPR) is: 0.22
    - Std. Dev of log(P) is: 0.18
    - Corr(log(TFPQ),log(P)) is: -0.54
      - Source: Foster, Haltiwanger and Syverson (2008)

Frictions + Distortions

- Costs of Entry (and exit)
  - Including costs of entering new markets
- Learning (initial conditions and after changing products/processes)
  - Experimentation
- Adjustment costs for factors of production (capital, labor, intangible capital)
  - Convex vs. Nonconvex
- Economies of scope and control
- Product Differentiation:
  - Horizontal (e.g., spatial) vs. Vertical
- Output and input price dispersion and determination
- Imperfections in product, labor, capital, credit markets
- Distortions to all of the above + market institutions
  - Idiosyncratic distortions as in Banerjee and Duflo (2003), Restuccia and Rogerson (2007), Hsieh and Klenow (2007)

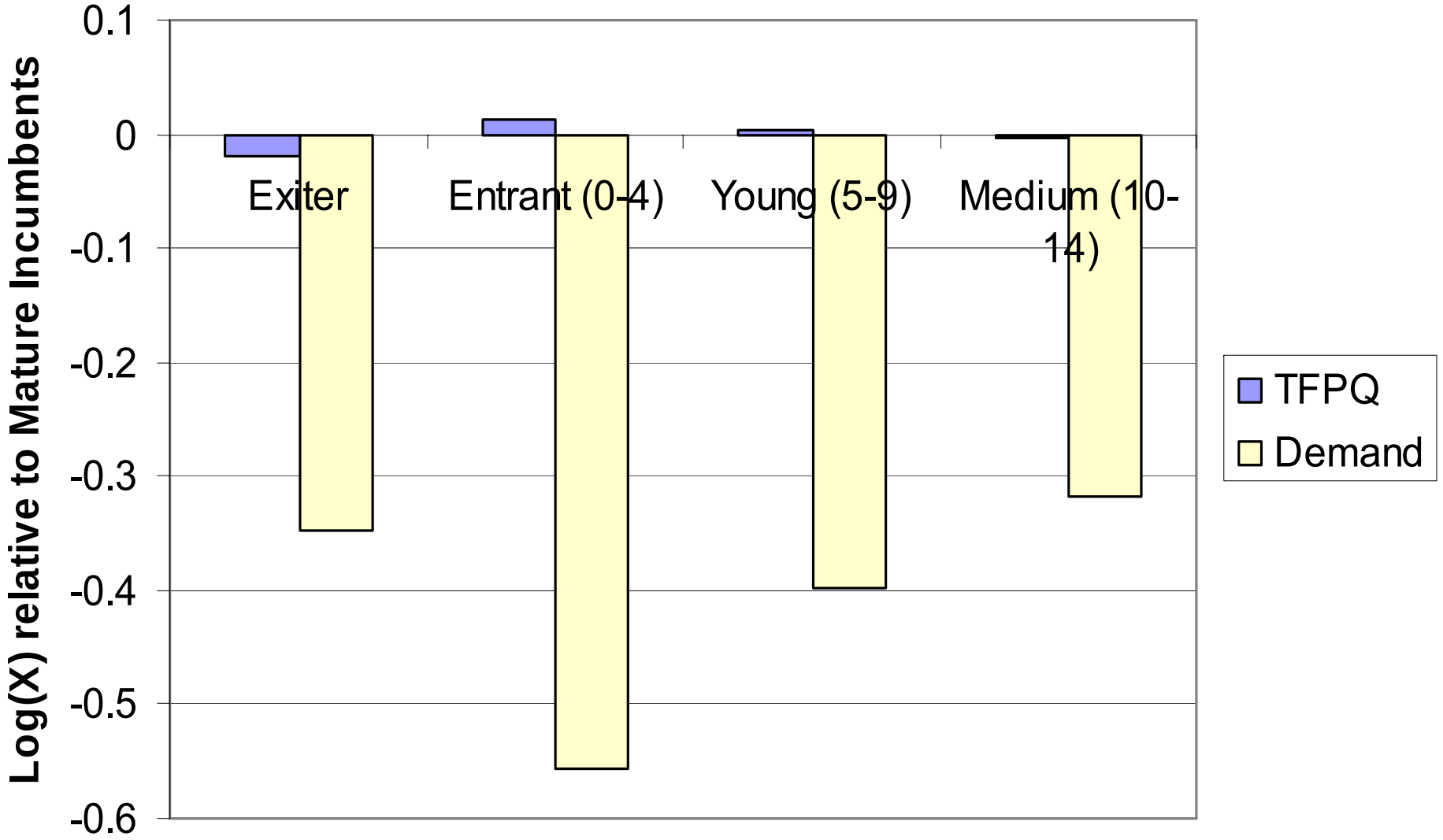
2. What frictions matter the most?

- Many studies showing evidence of entry costs, labor adjustment costs, capital adjustment costs, trade costs, product differentiation, and so on.
- Many open questions and issues:
  - Not practical to include all frictions in all models – but caution about identification since we are all using same data
  - How do frictions vary across advanced vs. emerging vs. transition?
  - Puzzles: What frictions account for "puzzle" of higher dispersion in revenue labor productivity than revenue TFP?
    - Dispersion in wages so that MRP of labor not equalized?
      - Wage dispersion even for ex ante homogenous workers?
      - Need models to account for not only output price dispersion but input price dispersion (likely related to similar frictions)
    - Overhead capital and labor and adjustment costs may be at work as well
- Important to distinguish between those frictions that yield some plants persistently higher productivity than others as opposed to adjustment dynamics

3. What underlies the size distribution of businesses in narrowly defined sectors?

- Economies of scope and control vs. product differentiation
  - For what questions does it matter where we put the "curvature" in the model?
- Even here, is the underlying source of heterogeneity productivity or other idiosyncratic sources of variation?
- Recent evidence suggests demand side effects (and perhaps "learning about demand" side might be quite important)

Demand vs. TFPQ evolution



Source: Foster, Haltiwanger and Syverson (2008)

4. What is the role of creative destruction for productivity growth and innovation?

- Reduction of frictions through market reform
- But more than this – is creative destruction essential for technological progress and innovation?
  - Vintage models
    - New technologies embodied in new establishments or capital (physical or intangible) or both
    - Learning
  - Endogenous innovation
  - Role of experimentation in endogenous innovation?
    - In academia, we go through fads with lots of missteps but think we generally build knowledge capital through this process
- In taking these ideas to the data and trying to account for differences across countries:
  - Important to distinguish between level/transition dynamics vs. differences in steady state growth paths

Suggestive evidence from accounting decompositions of productivity growth

- Dynamic shift-share decompositions suggest that over sufficiently long horizons (e.g., five or ten years) that a large fraction of productivity growth accounted for by entering establishments having higher productivity than exiting establishments.
  - For this to be interesting, must be disproportionate contribution
- Over shorter horizons, learning/selection effects still very much at work making high frequency (e.g., annual or even multi-year) analysis difficult to interpret
    - If using revenue productivity, “learning about demand” appears to be very slow so even more complex.
- Cross country comparisons also difficult given varying quality of dynamic links
- Cross sectional decompositions (Olley-Pakes) show more systematic patterns across countries
  - But caution about what margin is relevant – e.g., better market selection will impact unweighted average term as well as cross term.
  - Recent Melitz and Polanec (2008) paper extends OP along these lines

5. Can we use the accounting decompositions as moments to match?

- Difficult to interpret the accounting decompositions without more structure
  - Example: Lentz and Mortensen (2008) – endogenous innovation model where learning effects dominate so high frequency use of dynamic decomposition not that helpful to understand model or pin down structural parameters
- Distortions may impact many margins:
  - Market selection
  - Entry
  - Post-entry growth
  - Factor mix
- Ideally, structural models confronted more directly with the firm level data
  - But limited access to firm level data and inherent attractiveness of "indicators" for policymakers and analysts makes summary measures (including decompositions) potentially attractive.

Aggregate productivity and allocation

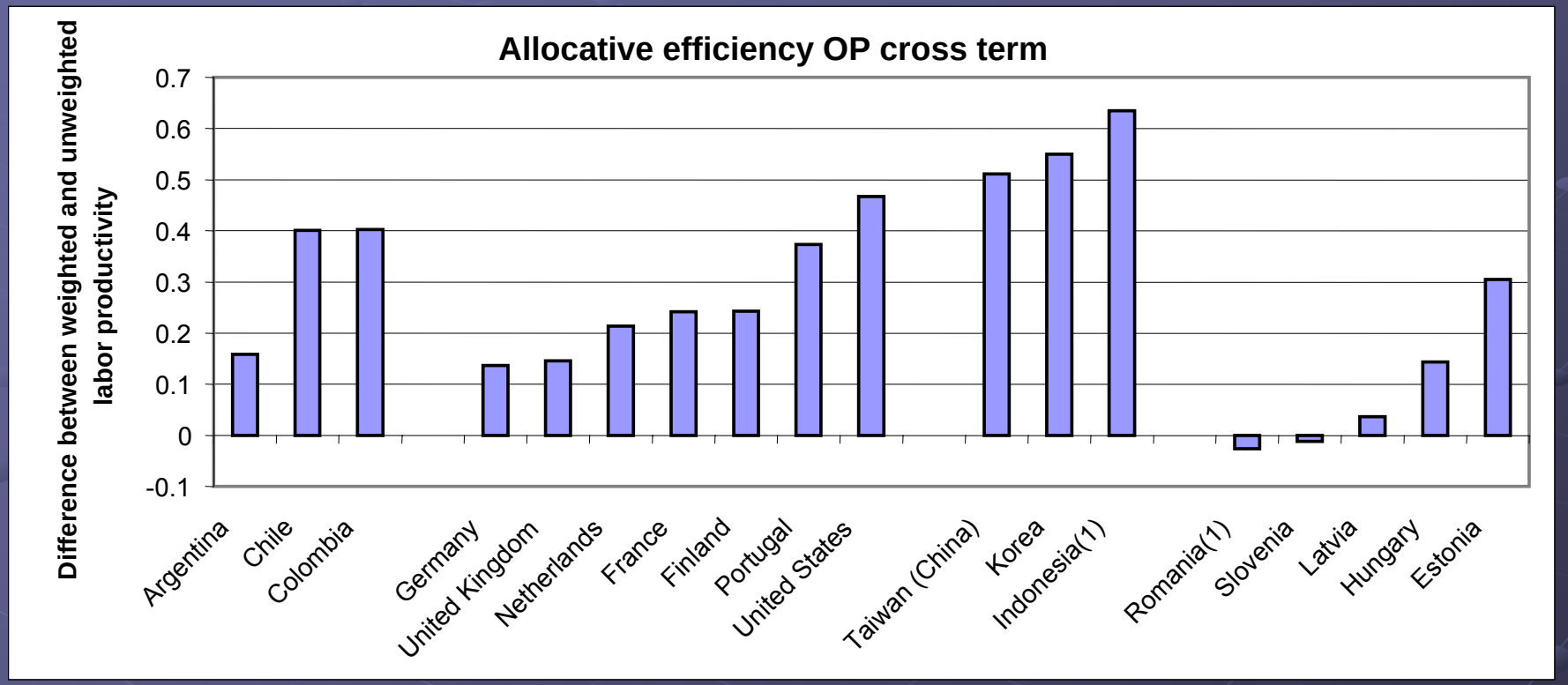
- Olley and Pakes (1996) static decomposition:

$$P_t = (1/N_t)\sum_i p_{it} + \sum_i (\theta_{it} - \bar{\theta}_t)(p_{it} - \bar{P}_t)$$

where: N: # of firms in a sector;

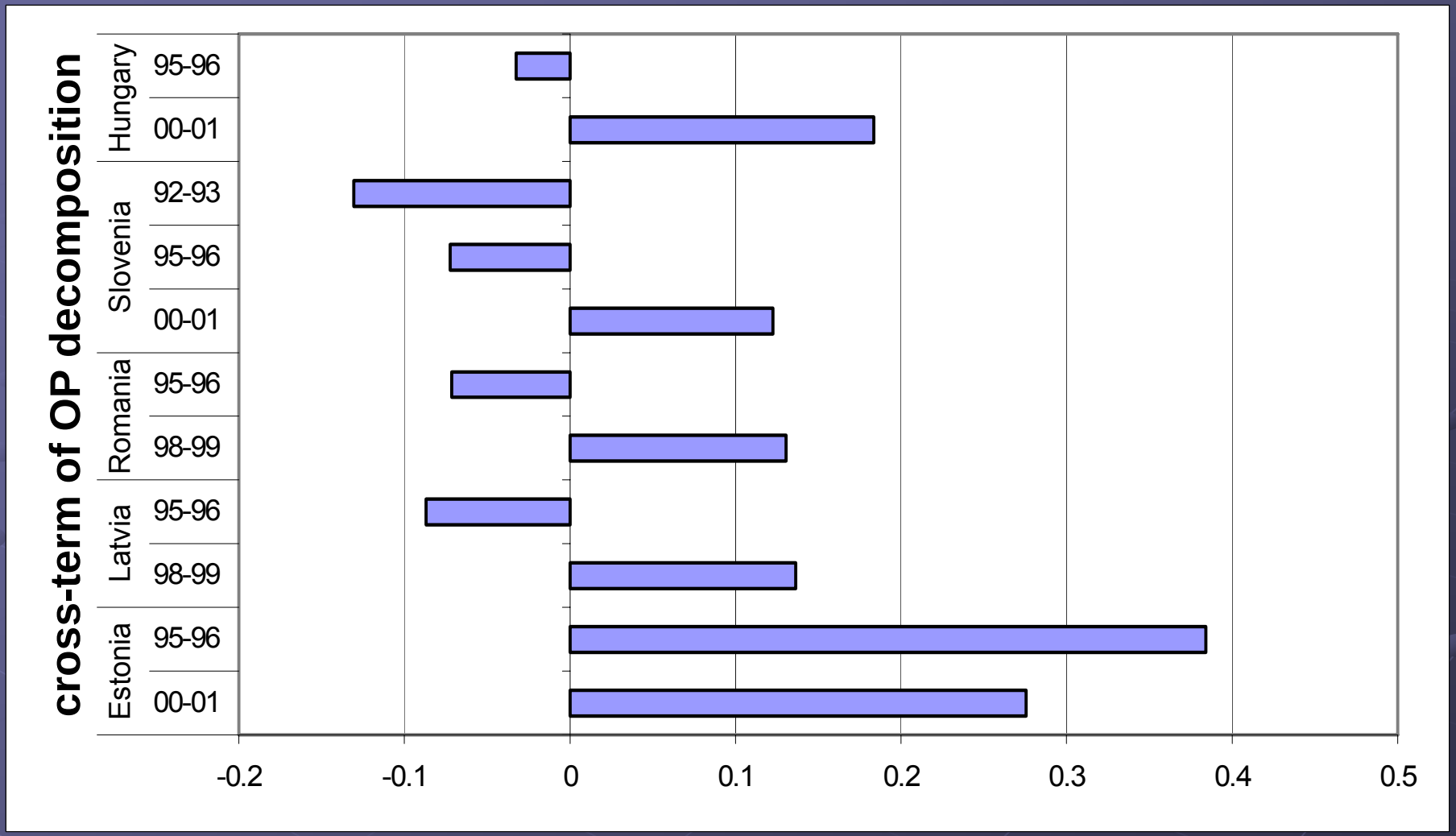
- The first term is the unweighted average of firm-level productivity
- The second term (OP cross term) reflects allocation of resources: do firms with higher productivity have greater market share.
  - OP (1996) showed second term increased rapidly in U.S. telecommunications equipment industry after deregulation
- By construction, cross term takes out country effects in productivity levels, so abstracts from some aspects of measurement error

Allocative efficiency (Olley Pakes decomposition -- cross term)
(weighted averages of industry level cross terms from OP decomposition)



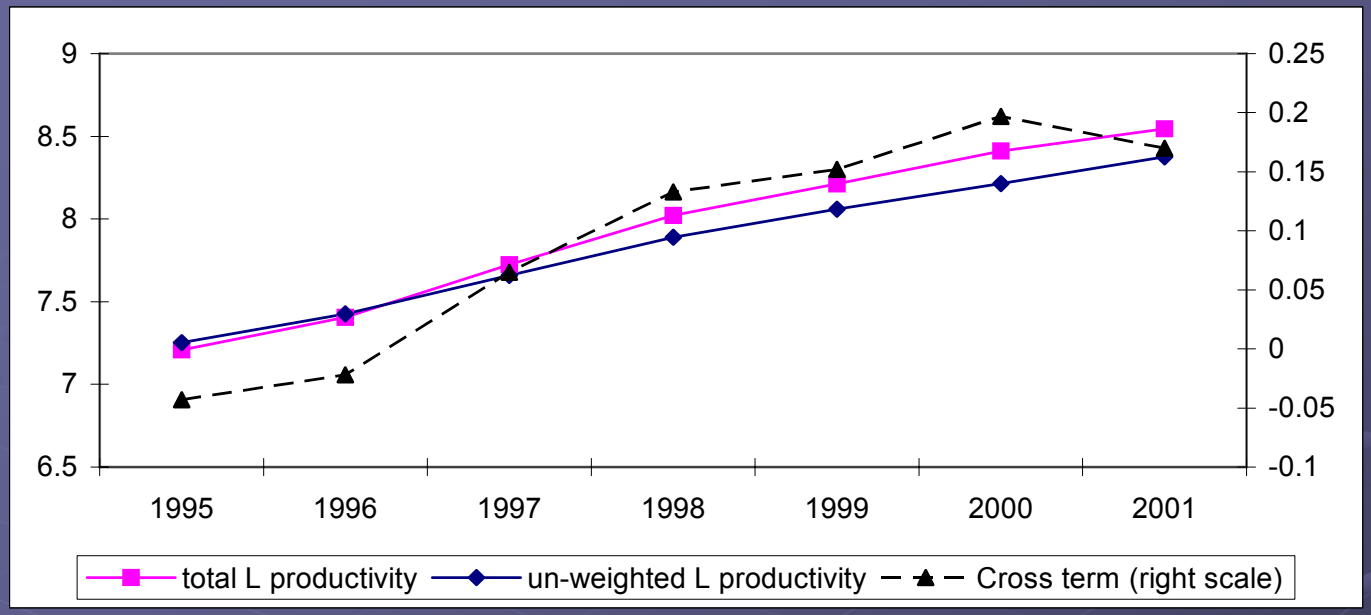
Source: Bartelsman, Haltiwanger and Scarpetta (2007)

Evolution of allocative efficiency during the transition -- Eastern Europe, manufacturing
(weighted averages of industry level cross terms from OP decomposition)

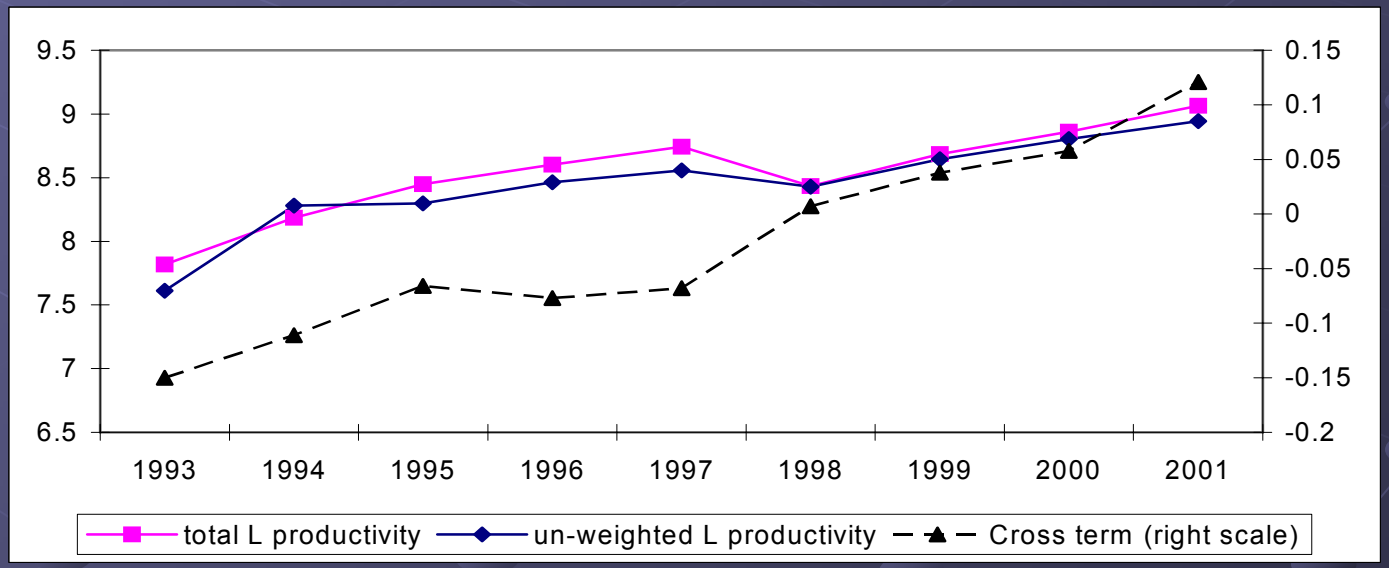


Source: Bartelsman, Haltiwanger and Scarpetta (2007)

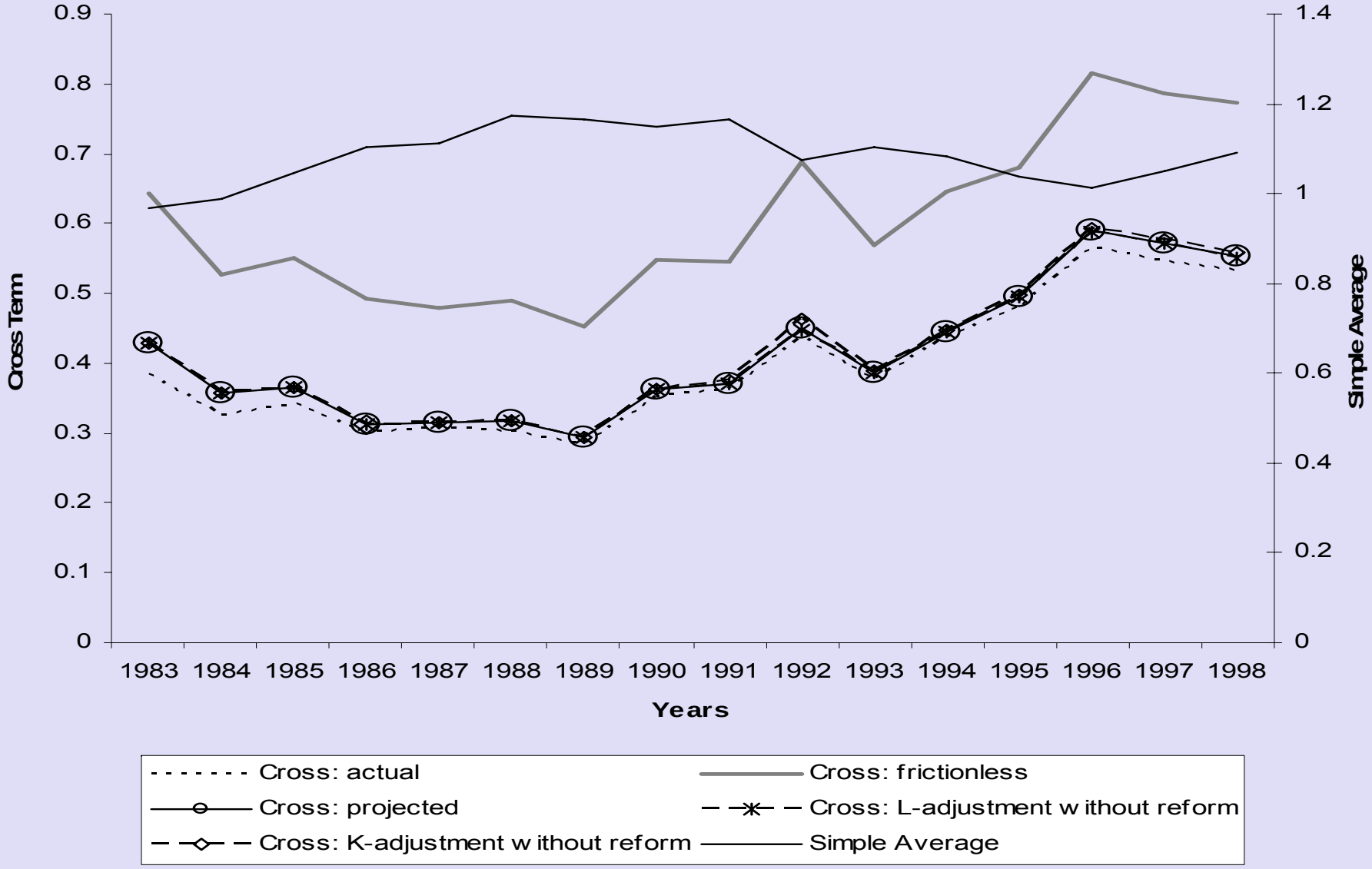
Hungary: allocative efficiency over the transition
(cross-term of the Olley Pakes decomposition, manufacturing)



Slovenia: allocative efficiency over the transition
(cross-term of the Olley Pakes decomposition, manufacturing)



Source: Bartelsman, Haltiwanger and Scarpetta (2007)



Source: Eslava, Haltiwanger, Kugler and Kugler (2006) – Uses TFPQ

A Model of "Mis"-Allocation (Based on Restuccia and Rogerson (2007) (and similar to Hsieh and Klenow (2007))

Consumers supply labor inelastically and maximize utility:

$$\sum_{t=0}^{\infty} \beta^{t} U(C_t)$$

Firms maximize profits where:

$$Y_{it} = A_i \varepsilon_{it} (n_{it} - f)^{\gamma-\alpha} k_{it}^{\alpha}, \gamma < 1$$

$$\pi_{it} = A_i \varepsilon_{it} (1-\tau_i)(n_{it} - f)^{\gamma-\alpha} k_{it}^{\alpha} - w_t n_{it} - r_t k_{it}(1+\kappa_i)$$

Note that TFP = $A_i \varepsilon_{it}$

Optimality requires (note employment contingent on ε):

$$(\gamma-\alpha) A_i \varepsilon_{it} (1-\tau_i)(n_{it} - f)^{\gamma-\alpha-1} k_{it}^{\alpha} = w_t$$

$$k_{it} = [(\alpha A_i (1-\tau_i) E_{\varepsilon}(\varepsilon_{it}(n_{it} - f)^{\gamma-\alpha}))/(r(1+\kappa_i)]^{1/(1-\alpha)}$$

Entry/Selection

$$W^e = \int_{A,\tau,\kappa} \max(0, W(A,\tau,\kappa))\, dG(A,\tau,\kappa) - c_e = 0$$

$G(A,\tau,\kappa)$ Ex Ante Joint Distribution

$$W(A_i,\tau_i,\kappa_i) = E_\varepsilon[\pi(A_i,\tau_i,\kappa_i)]/(1-\rho)$$

$$\rho = (1-\lambda)/(1+R)$$

Exogenous probability of exiting in each period given by λ

Aggregate Relationships and Steady State Equilibrium

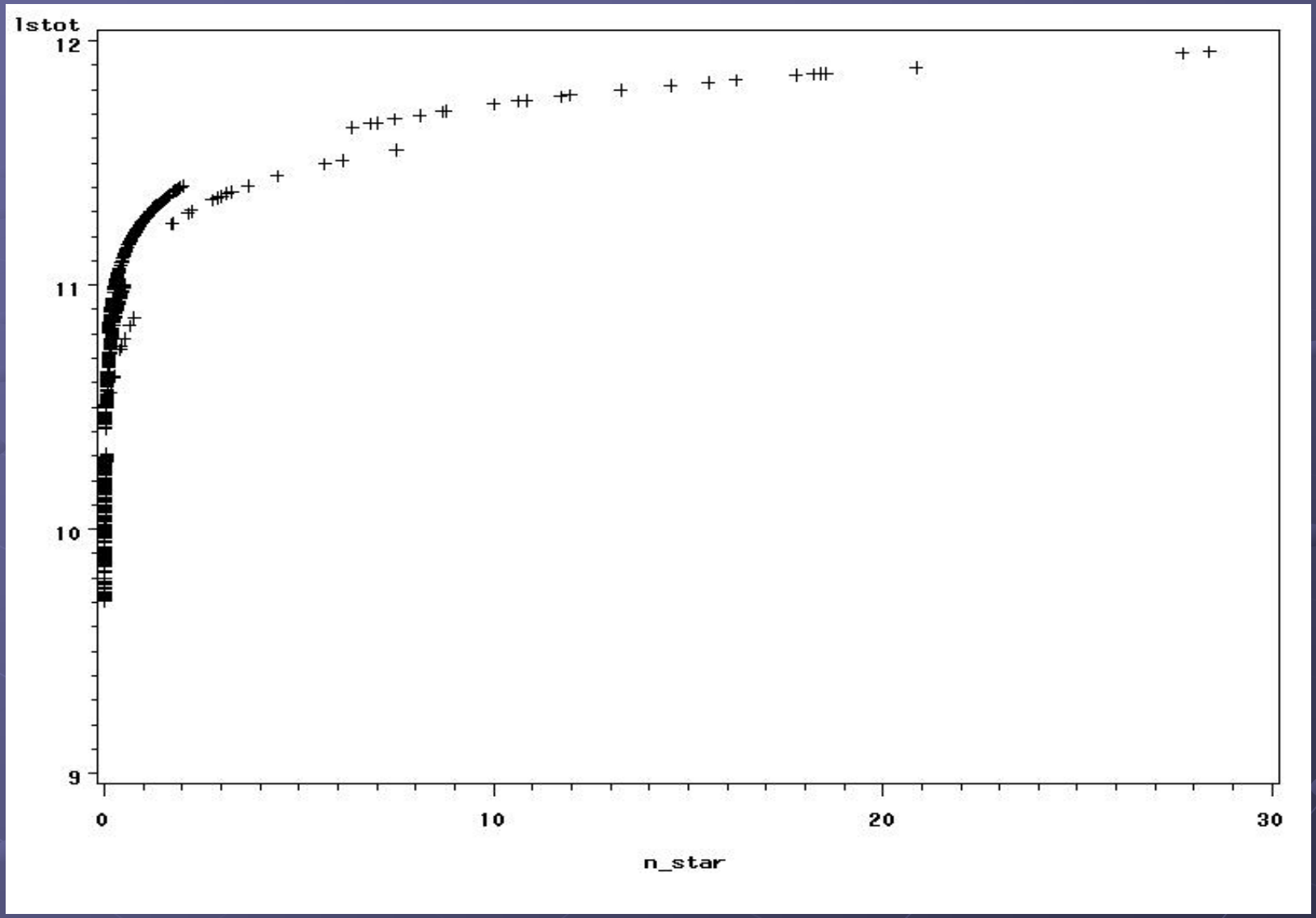
$$C_t + E_t c_e + \delta K_t = Y_t$$

Resources expended on entry/exit impact consumption and welfare

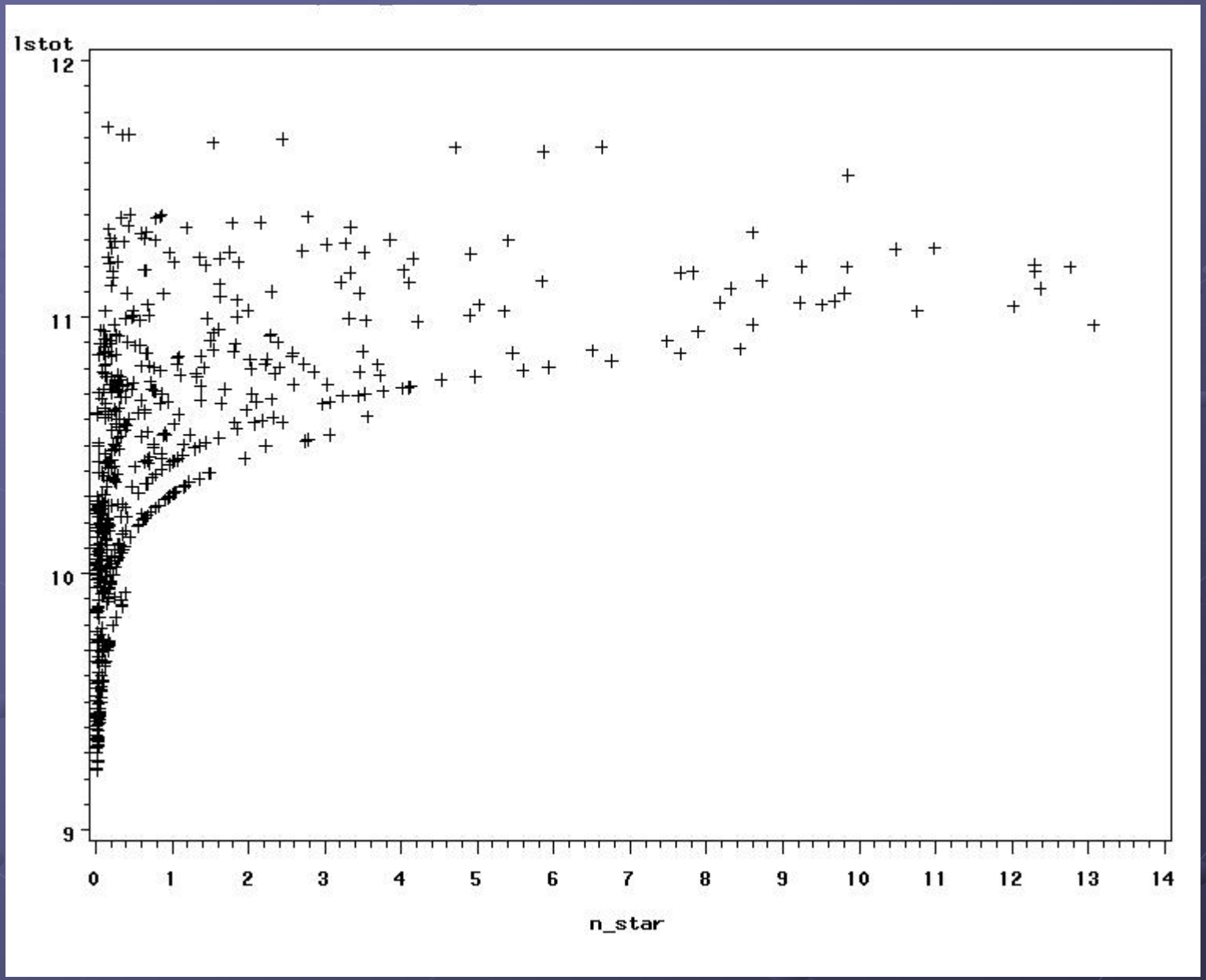
$$W^e = 0, N^d = N^s$$

Free entry condition and equilibrium in labor market

Relationship Between Productivity and Employment: No Institutional Distortions, Permanent and Transitory Shocks, Quasi-fixed capital



Relationship Between Productivity and Employment: Correlated Scale Distortions, Permanent and Transitory Shocks, Quasi-fixed capital



Calibration and Numerical Analysis of Model

Case	*Mean log(LP)*	*Std log(LP)*	*OP cross term log(LP)*	*Mean log(TFP)*	*Std log(TFP)*	*OP cross term log(TFP)*	*Avg(K/L)*	*Diff log(cons)*	*Fraction survive*
Permanent Productivity Shocks Only									
No institutional distortions	12.05	0.06	0.05	10.72	0.27	0.43	114184	N/A	0.77
Permanent and Transitory Productivity Shocks with Quasi-fixed capital									
No institutional distortions	12.13	0.32	0.21	10.70	0.52	0.71	491116	0.00	0.67
Random output distortion	12.15	0.39	0.07	10.71	0.56	0.57	684354	-0.31	0.41
Random capital distortion	12.22	0.34	0.23	10.73	0.52	0.71	2114485	-0.24	0.67
Correlated output distortion	11.77	0.39	0.01	10.41	0.56	0.44	470506	-0.68	0.60

- $\lambda = .10$, this is consistent with evidence of exit rates in the United States and other OECD countries (Bartelsman *et al.* 2004)
- R=.03 and δ=.12, roughly consistent with long run real interest rates and depreciation rates in OECD countries.
- f=.01,log(c_e)=12.43

6. What is the role of misallocation as source of variation in emerging economies?

- No shortage of candidate distortions:
  - Employment protection rules and regulations
  - Poorly functioning credit markets especially for young and small businesses
  - Trade barriers stifling competition and innovation
  - Lack of property rights, weak rule of law, graft and corruption distorting the allocation of activity
- Impact different margins and segments of firm population
  - Many generate incentives to stay small and informal
  - Firm level databases including informal firms rare

7. How can we use firm level studies to increase understanding of process of innovation?

- Longstanding interest in understanding sources of innovation and productivity growth
- What market structure and institutions facilitate innovation and productivity growth?
- What are the role of entrepreneurs and small businesses for innovation?

Traditional approach: Direct measurement of innovation

- R&D surveys, innovation surveys, measures of patents, measures of publications and citations
- All very useful and also useful to integrate these direct measures into firm level data on outcomes like survival and productivity
- But perhaps we should think more broadly as suggested by Corrado, Hulten and Sichel's (2007) ideas about intangible capital?

8. What is the role of firm dynamics for the measurement and understanding of intangible capital?

- Corrado, Hulten and Sichel (2007) take a broad view of intangible capital:
  - Expenditures by firms in current period for enhancing profitability in the future on factors other than tangible capital can be thought of as investment in “intangible capital”.
- Much broader than product/process innovation questions on R&D surveys (or at least what is captured on such surveys).

Many measurement issues for intangible capital

- Currently taking a perpetual inventory approach
- Need expenditures, deflators and depreciation rates
- For intangible capital, difficult measurement and conceptual issues on all of these and many related to firm dynamics:
  - Aren't all firms and especially young firms devoting most of their resources to intangible capital?
  - Most of these firms exit – implications for accumulation/depreciation?
  - But careful, is the experimentation process part of the accumulation of intangible capital?
    - Knowledge capital is accumulated/shared across firms
    - Relationship capital is probably not
      - Although brands is one way that relationship capital is shared
        - Brands live on after exit and re-used ("Nuprin" (CVS), "White Cloud" (Wal-Mart))

9. What is the role of individual innovators/inventors in firm dynamics?

- Rich databases on innovators and inventors have been developed using patent data, citation data and the like.
- What is the role of these innovators/inventors for firm performance, startups, knowledge diffusion?
- Does the flexibility of the labor market, the churning of young and small businesses contribute to innovation and productivity growth via the mobility of innovators?

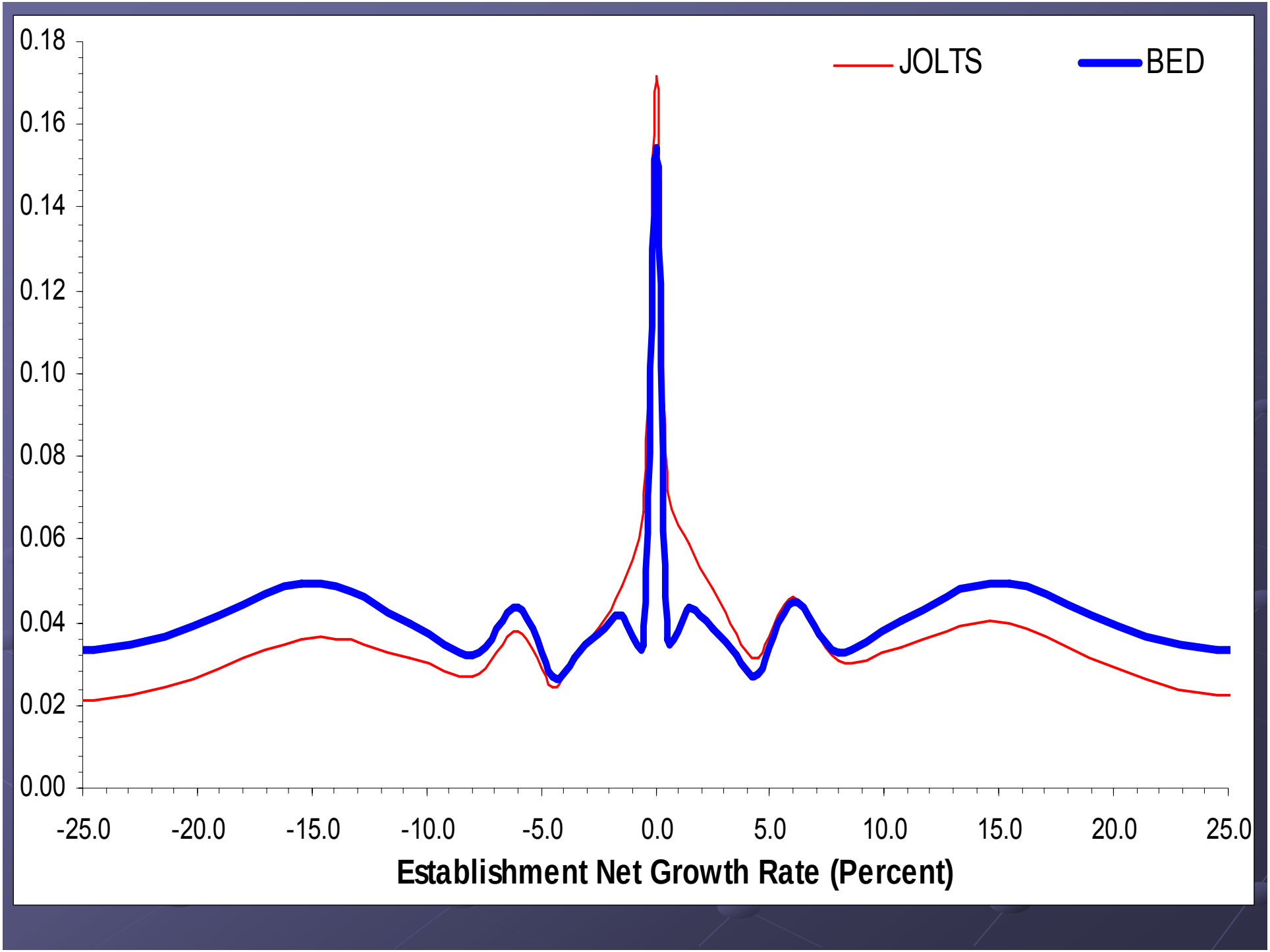
10. What is relationship between macro and micro characterizations of firm dynamics?

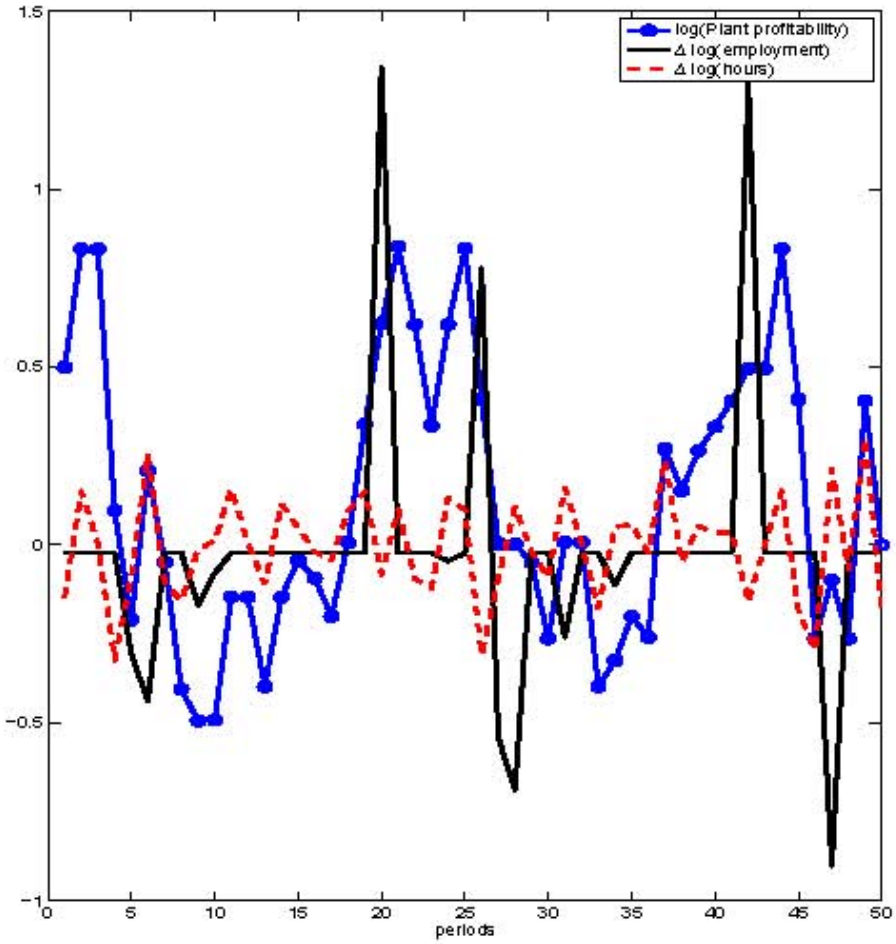
- Macroeconomists often specify models for typical firm or even aggregate firm
- Aggregate production function
- Aggregate adjustment of capital and labor
- Results depend critically on specification of functional forms and parameters of "aggregate functions"
- Is there a micro-macro "Lucas critique"

Hours and Employment Adjustment: Basic Facts from the LRD*

Moment	Plant	Aggregate
$\frac{\sigma_{\Delta h}}{\sigma_{\Delta e}}$	0.96	0.55
$Corr(\Delta h, \Delta e)$	-0.296	0.545
$Corr(\Delta h_{-1}, \Delta e)$	0.184	0.519

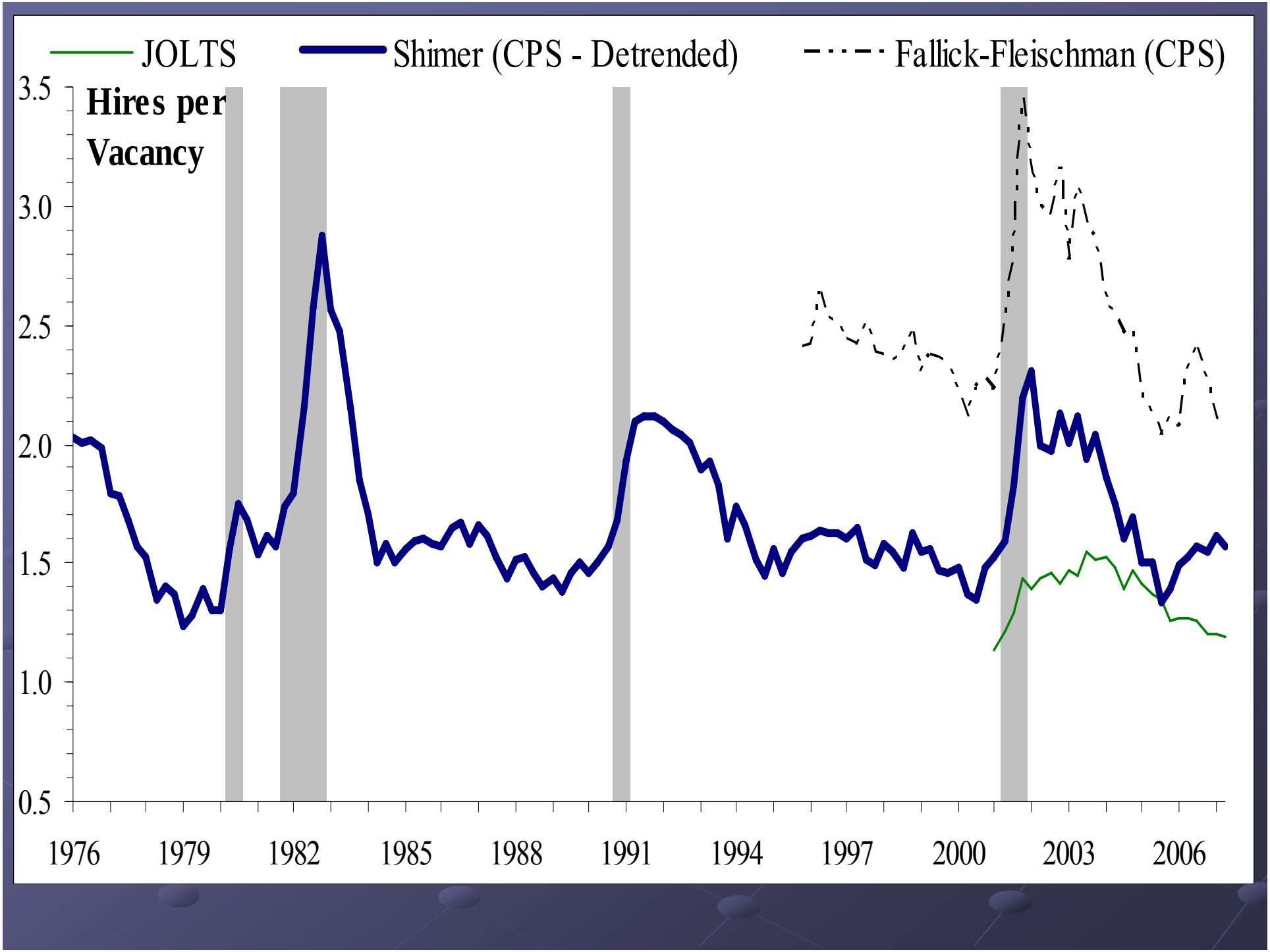
* Seasonal and Aggregate Effects removed from establishment-level moments


JOLTS
BED
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
-25.0
-20.0
-15.0
-10.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
Establishment Net Growth Rate (Percent)

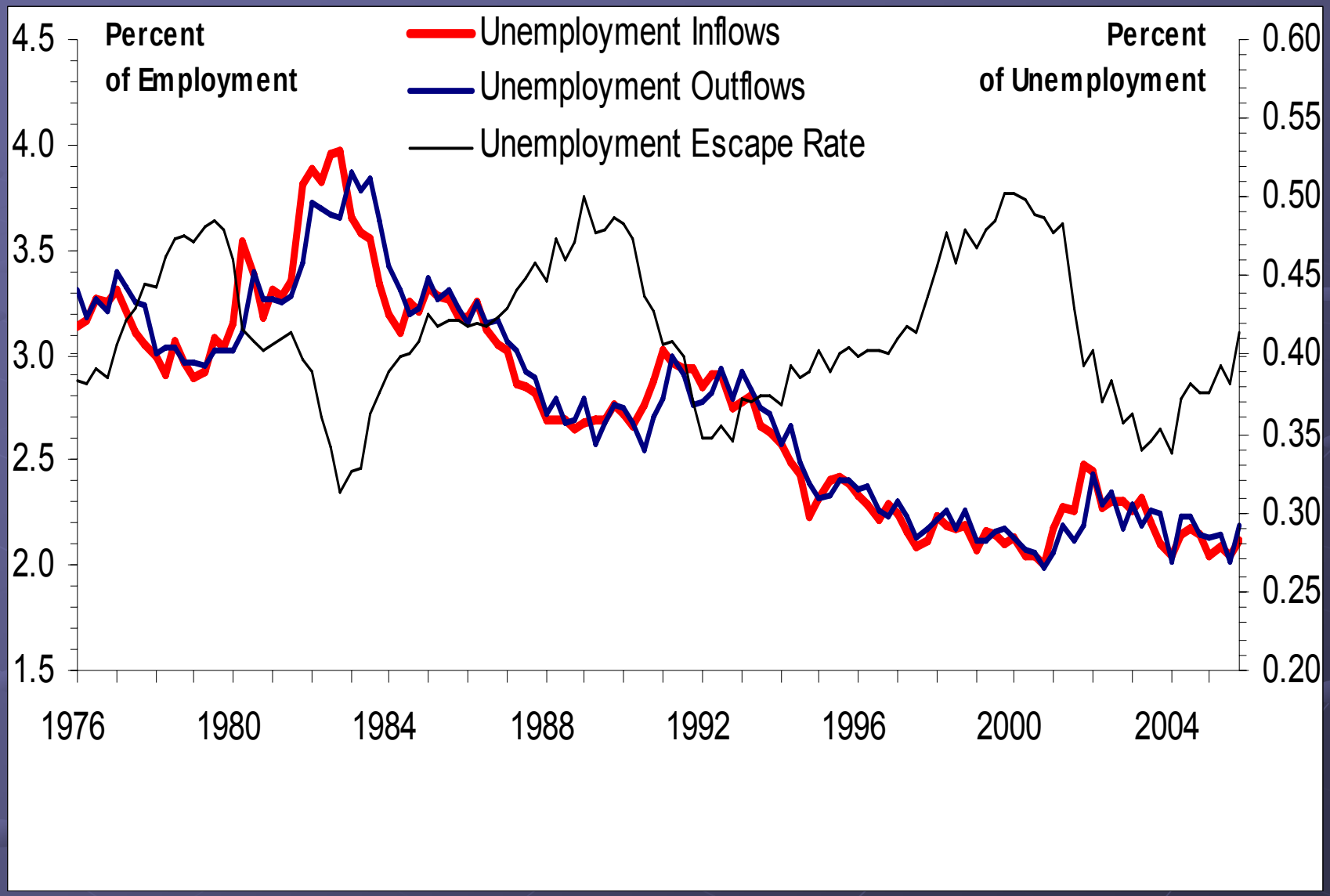

log(Plant profitability)
Δ log(employment)
Δ log(hours)
periods
1.5
1
0.5
0
−0.5
−1
0
5
10
15
20
25
30
35
40
45
50

Monthly Net Employment Growth Rate Distribution

$\dot{e}$	Share.	Hires	Sep.	Layoff	Quits	net
$<$-0.10	0.040	0.025	0.291	0.184	0.090	-0.266
-0.10 to -0.025	0.083	0.023	0.075	0.027	0.0422	-0.052
-.025 to 0.025	0.745	0.015	0.015	0.004	0.010	0.000
0.025 to 0.10	0.092	0.079	0.028	0.007	0.019	0.051
$>$0.10	0.040	0.296	0.041	0.014	0.025	0.266


JOLTS
Shimer (CPS - Detrended)
Fallick-Fleischman (CPS)
Hires per Vacancy
3.5
3.0
2.5
2.0
1.5
1.0
0.5
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006

Trends in Unemployment Inflows, Outflows and Escape Rates (CPS)



Quarterly Averages of Monthly SA values for Experienced Unemployed

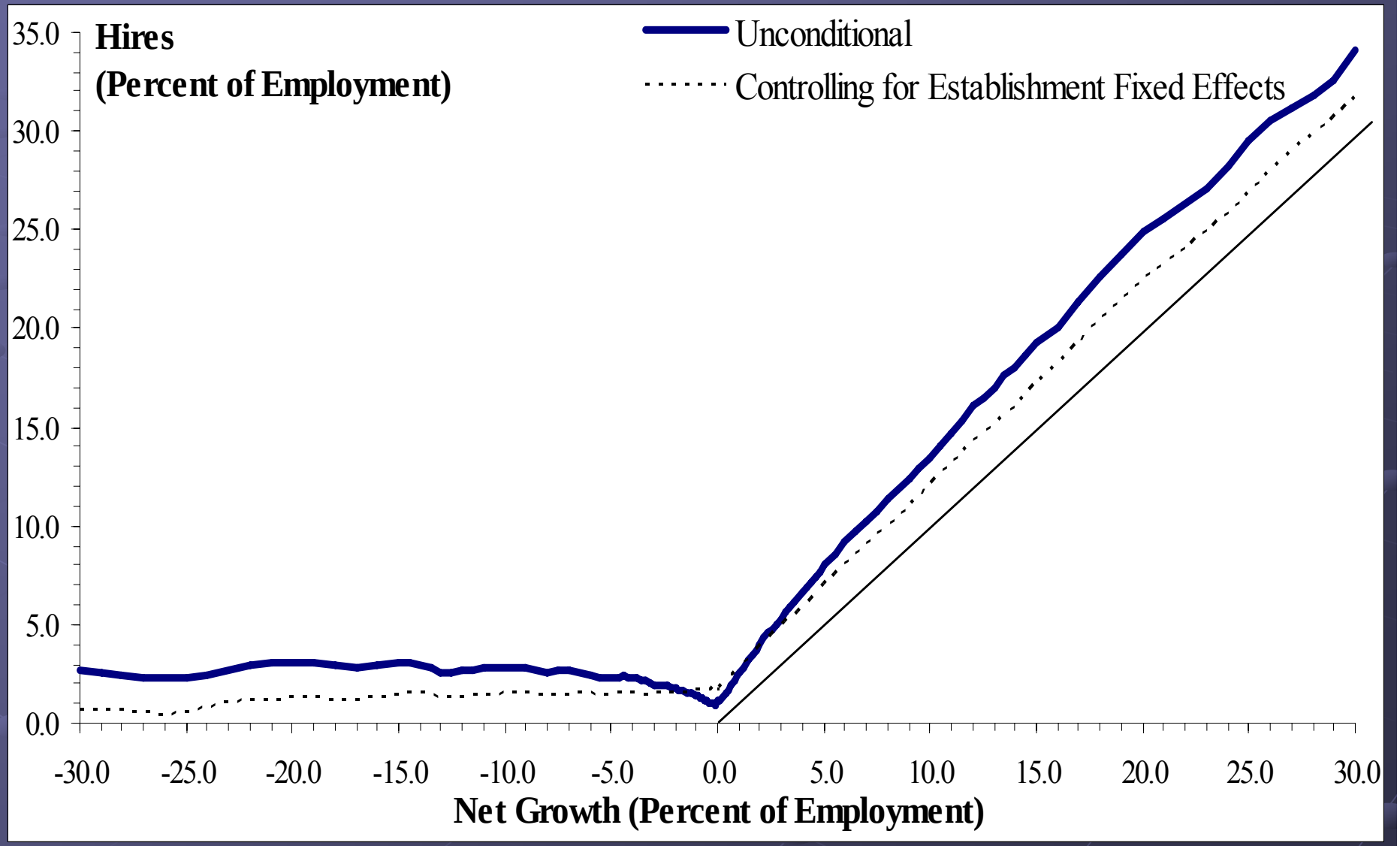
Aggregate Worker Flows: Convolution of hiring/separation micro functions and cross sectional distributions important for hiring Vs. firing view of recessions

$$H_t = \int h_t(n) f_t(n\ ) dn$$

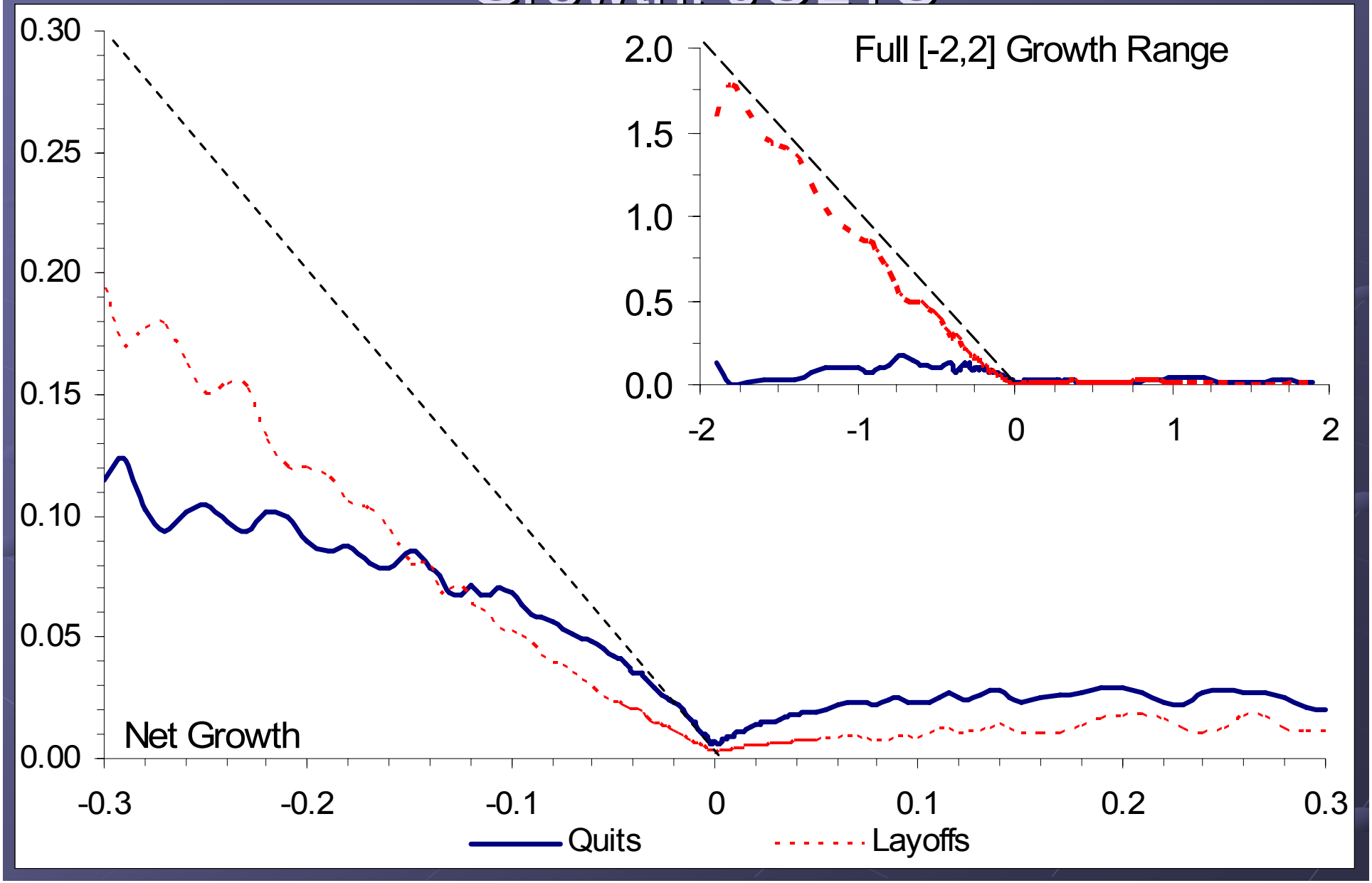
$$S_t = \int s_t(n) f_t(n\ ) dn$$

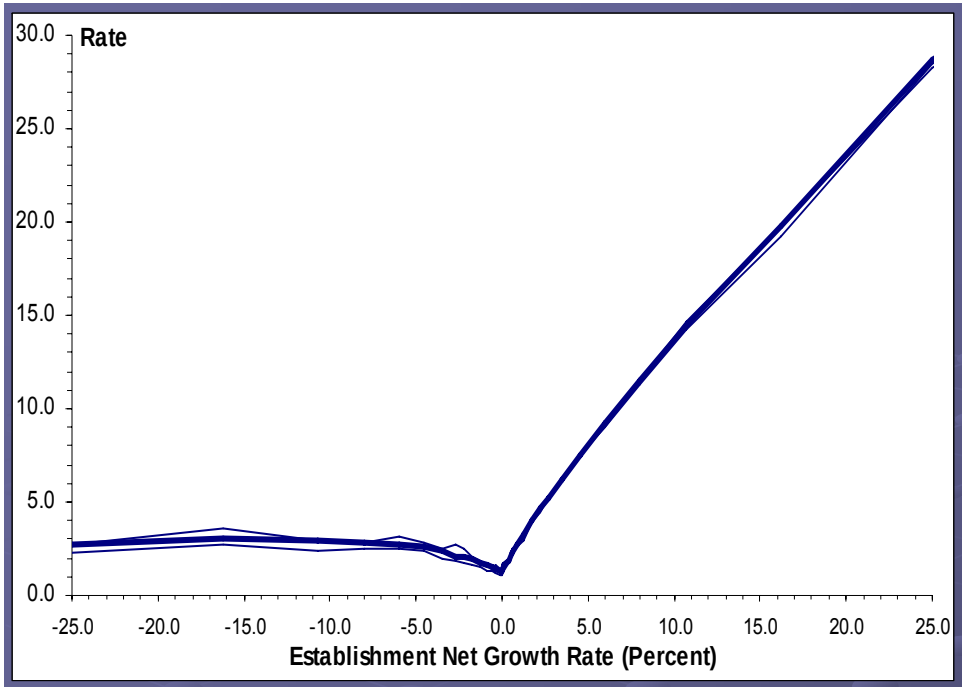
Open theoretical/empirical questions: Properties of h, s and f

Hires and Establishment Growth



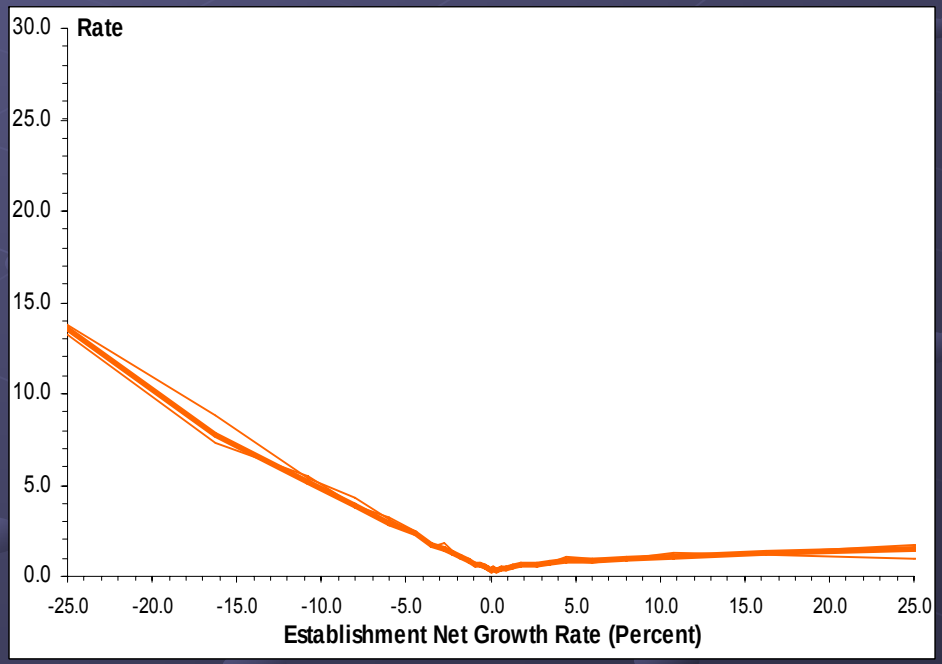
Quits and Layoffs vs Establishment Net Growth, JOLTS



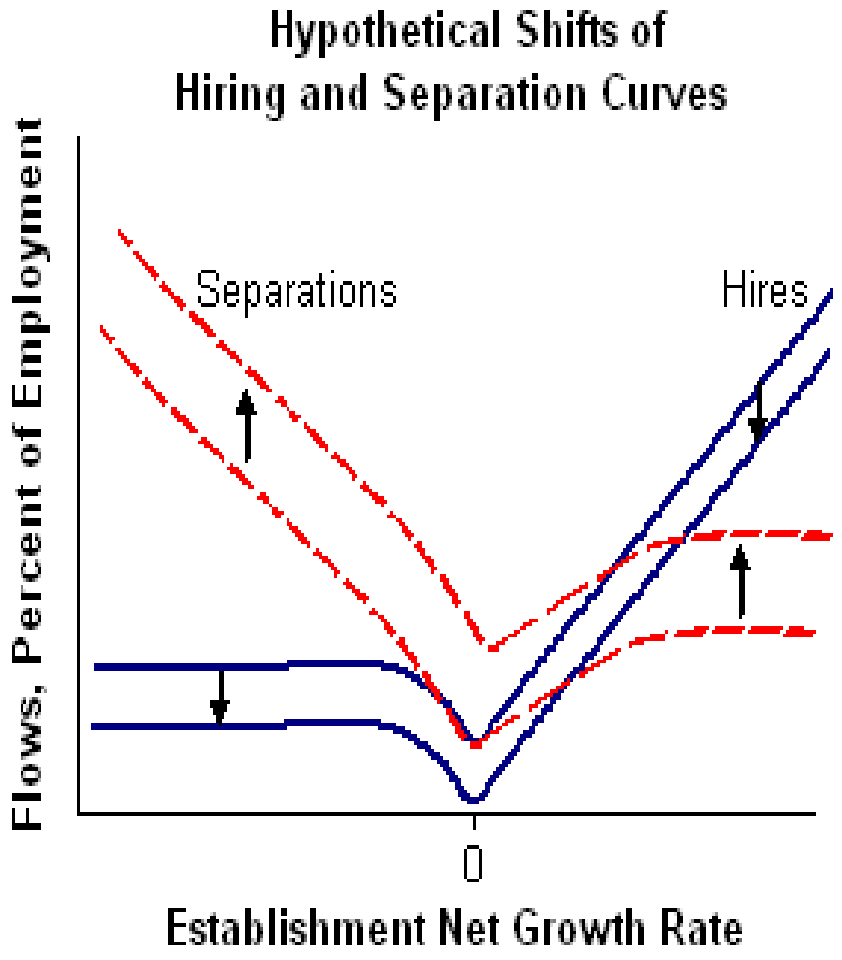


Hiring/net growth micro relationship stable across high and low aggregate growth periods

Layoff/net growth micro relationship stable across high and low aggregate growth periods



Interactions between nonlinearities and cross sectional distribution potentially important for aggregate fluctuations



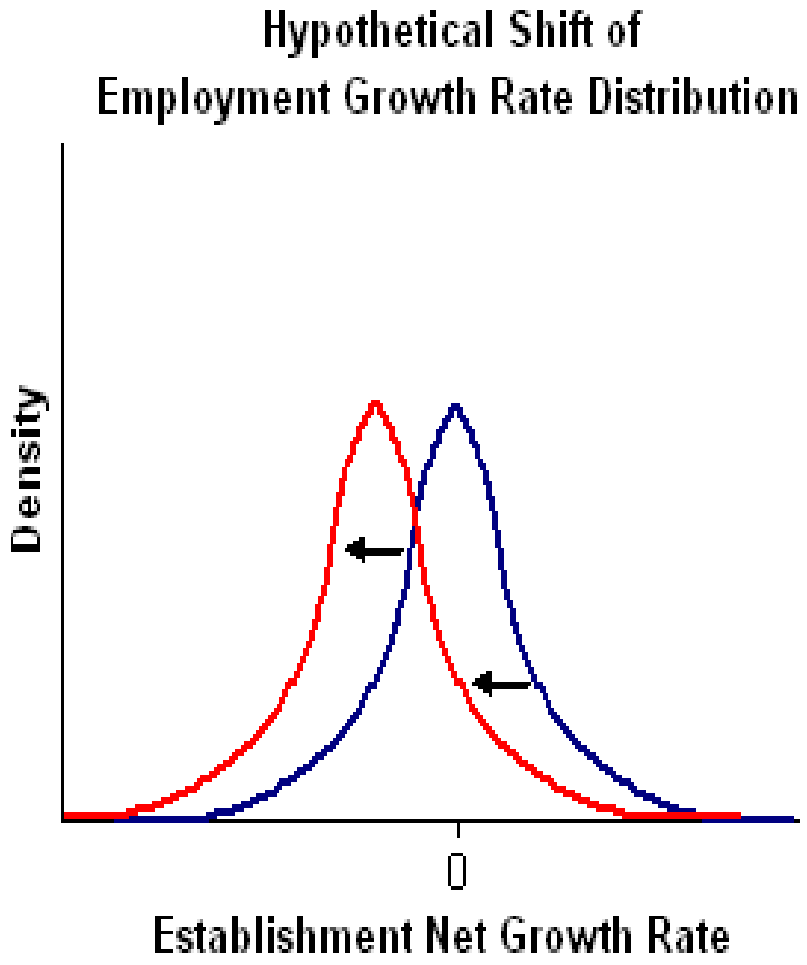
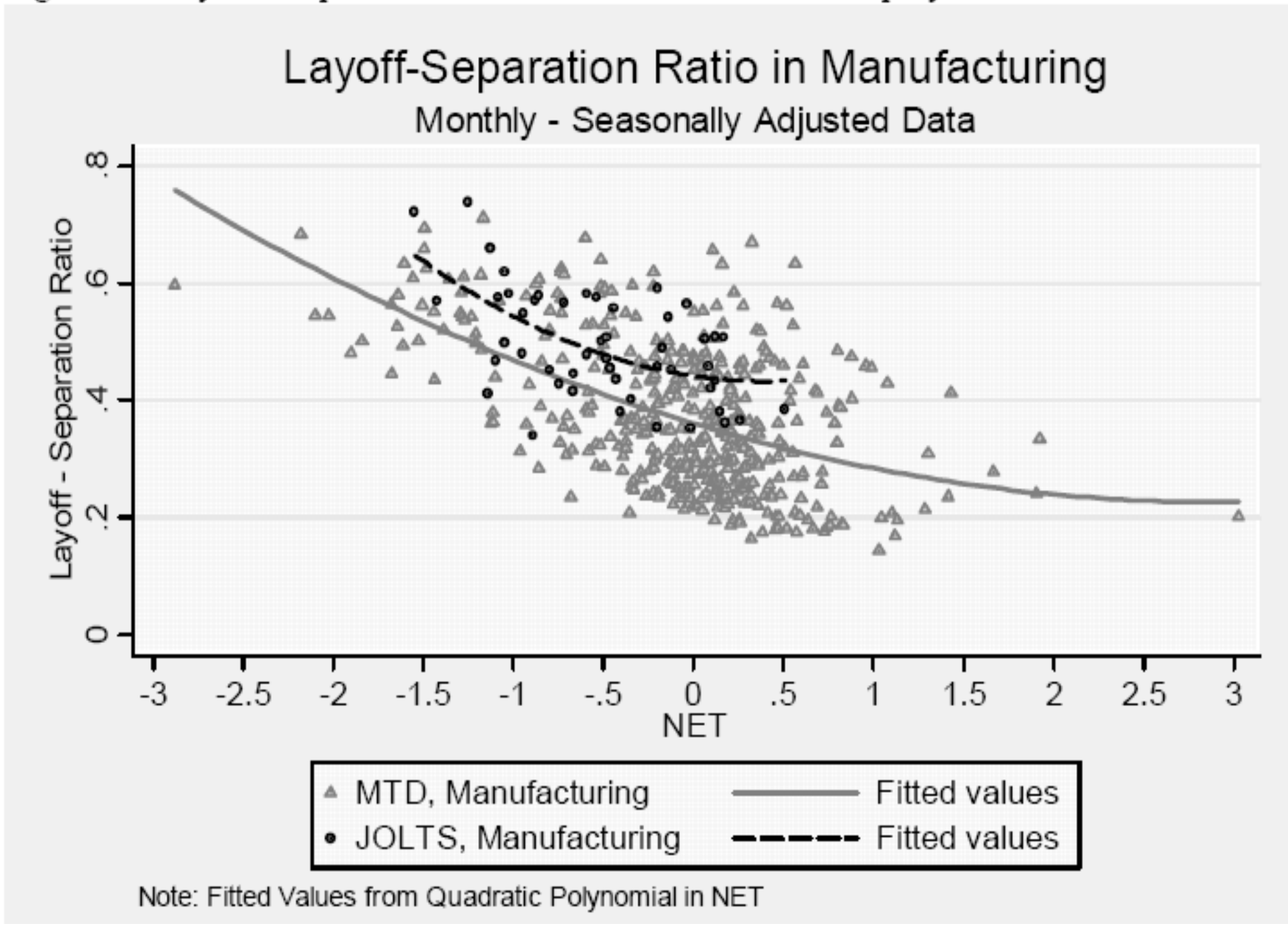


Figure 14. Layoffs-Separation Ratio as a Function of Net Employment Growth Rate



Lumpy micro, smooth macro

- Nonlinear micro
  - Adjustment costs
  - Inherent asymmetries of different margins of adjustment (hiring, layoffs, quits)
- Heterogeneous micro
  - Idiosyncratic shocks are an order of magnitude larger than aggregate shocks
- Aggregate behavior is a complex aggregation of lumpy, nonlinear micro behavior aggregated over heterogeneous units
- Relevant for many issues including helping understand labor market dynamics in last two recessions
- Also important for investment, productivity dynamics, etc.
  - Micro production function limited substitutibility relative to macro production function
  - When do we need to worry about this?
- Micro/Macro “Lucas Critique” – aggregate “parameters” of adjustment costs, production functions, etc. are complex functions of micro parameters that yield fluctuations in aggregate parameters over time (not deep parameters)