R&D Employment and the Business Cycle
(Preliminary–Do not Quote)

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What is the effect of the business cycle on S&E employment?

During recessions, R&D activity may
  - *rise*, because value of capital and S&E employment in other uses falls
  - *fall*, if R&D primarily funded out of firm earnings
During recessions, R&D employment may have its own dynamic, separate from other R&D inputs.

Reasons to believe that R&D employment is less sensitive to downturns than other inputs:

- **Quasi-fixed costs**—hiring costs, for example.
- R&D workers may be special—letting R&D workers go hurts continuity of research programs which have long gestation periods.
- Also firm’s valuable IP is bound up in R&D workers’ human capital: their separation releases this knowledge to employer’s competitors.
This short talk describes work in collaboration with colleagues Erling Barth (University of Oslo), Jim Davis (US Census), Richard Freeman (Harvard), and Andrew Wang (NBER).

We are looking at the cyclicality or R&D, S&E employment (both in R&D and non-R&D jobs), and the effect of government spending (e.g. ARRA) on non-government R&D and S&E employment.

We are using Compustat, public and confidential NSF-Census R&D files, as well as other sources to study these questions.
R&D, R&D Employment, and the Business Cycle

- R&D Employment Growth Rate (left axis)
- R&D Expenditure (Real) Growth Rate (left axis)
- GDP (Real) Growth Rate (right axis)
What we know

- Non-federally funded R&D expenditures are pro-cyclical (NSF and Compustat data both show this; Comin and Gertler, 2006; Rafferty and Funk, 2008)
- But in the recession of the early 1980s, R&D expenditures actually rose relative to GDP
- R&D spending in both NSF and Compustat data is pro-cyclical, and employment of R&D S&E workers is also pro-cyclical but less than R&D spending (Barlevy, 2007).
- At firm level, growth rates of R&D capital in the 1990s show greater serial correlation than growth rates of physical capital, sales, and employment (Bloom, 2007)
Conclusion from previous literature

- R&D activity appears to fall in recessions but not to the degree other activities do.
- In the aggregate, R&D S&E employment is pro-cyclical but less pro-cyclical than R&D expenditures.
What happens to R&D employment at the firm-level?

- Studying R&D employment in the aggregate masks what is happening at the firm level (because some of the R&D response is due to entering and exiting firms).
- How do firms adjust their R&D employment in response to changes in the business climate?
- We use Census-NSF Survey of Industrial Research and Development for 1972-2005
  - About 25,000 companies each year, large companies with over $5 million in R&D are sampled with certainty, smaller firms are sampled with probability < 1.
  - We only study the subset of firms that are sampled with certainty, but they account for over 98% of R&D expenditures and workers.
Preliminary findings from Census-NSF firm-level data

- Using economy-wide measure of business climate (GDP)
  - Sales and R&D expenditures are equally sensitive to changes in GDP: a one percent increase in the GDP growth rate leads to one percent increases in the growth rates of sales and R&D expenditures.
  - Ditto for R&D employment and total employment and GDP.

- Output specific to the firm’s sector better captures the relevant business conditions
  - All firm-level measures are between 2.5 and 3.5 times more sensitive to growth rates in own-sector output than economy-wide output
  - The effect of sector-level output on a firm’s R&D expenditures is a little over 10% lower than its effect on a firm’s sales.
  - However, the effect of sector-level output on R&D employment is over a third smaller than its effect on a firm’s aggregate employment.
  - R&D expenditures are about 15% more sensitive to sectoral cycles than R&D employment
What happens to R&D employment at the firm-level?

Estimation details

- Regressing rates of change in sales, R&D, employment, or R&D employment on rates of changes in macro-variables: GDP, unemployment rate, or industry output, with firm fixed effects.

- Estimation includes only firms that are sampled with certainty and that show positive R&D expenditures in at least one year.

- Sample period is 1972-2005.

- Each regression includes upwards of 85,000 firm-years (unbalanced sample) and all coefficients are statistically significant by conventional standards of significance.
Conclusions

- Both R&D expenditures and R&D employment are pro-cyclical.
- Economy-wide, R&D activities are less pro-cycle than other activities, and R&D employment is less pro-cyclical than R&D expenditures.
- At the firm-level these findings are confirmed when the economic conditions are measured at the sector-level.
- The evidence suggests greater hoarding of R&D S&E workers relative to non-R&D S&E workers (greater quasi-fixed costs? intellectual property concerns?) or marginal product of these workers fall less during downturns (because of greater skills? the opportunity cost story?).