

**Research on Research:  
What We Know and Don't Know  
about the Payoffs to Research**

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# Issues

- **Why do “basic” research?**
- **What is “basic” research?**
- **How do you evaluate the performance of basic research?**

# Overview

- **Basic research and “Pasteur’s Quadrant”**
- **For-profit analogy**
  - research/performance association
  - “two faces” of R&D
  - basic research as job amenity
- **Evaluation issues**
  - measuring output
  - dynamic effects
  - performance compared to whom?

# Basic research and “Pasteur’s Quadrant”

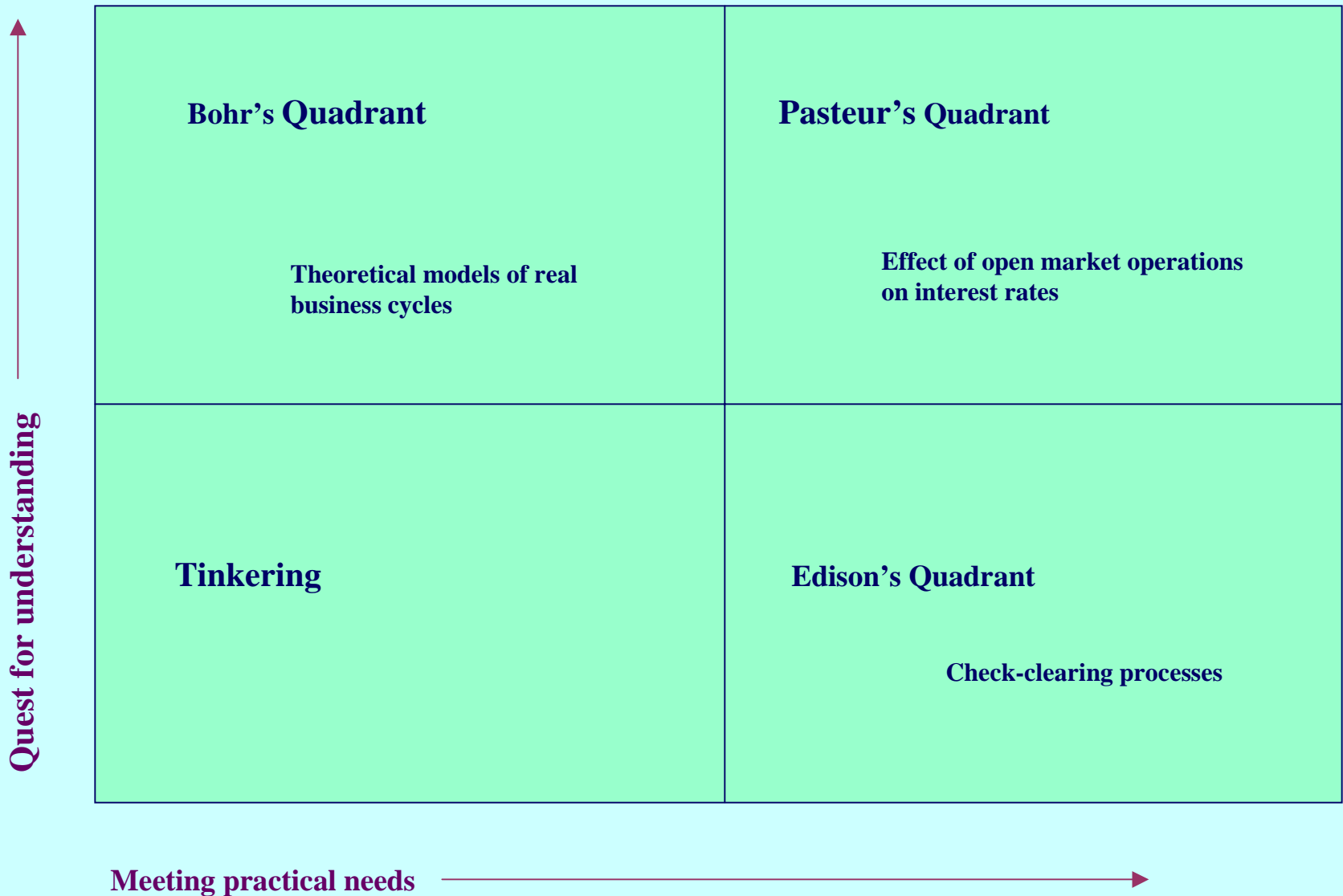
- **NSF Definitions:**

“The objective of basic research is to gain more comprehensive knowledge or understanding of the subject under study, without specific applications in mind.”

“Applied research is aimed at gaining the knowledge or understanding to meet a specific, recognized need.”

- **New paradigm- “Pasteur’s Quadrant” (Stokes, 1997)**

# Stokes' Paradigm for basic/applied research



# **For-profit analogy I**

## **Research/performance association**

- **Griliches model: research creates stock of knowledge that enters production function**
- **Returns to research exceed returns to “traditional” investment.**
- **Premium for basic research**
- **Issues: simultaneity (opportunity)**  
**simultaneity (cash flow constraints)**  
**risk**

# For-profit analogy II

## The “two faces” of R&D

- **Engaging in research at the frontier of the field maintains and builds staff human capital (Cohen and Levinthal).**
- **Gathering of “spillovers” from other firms requires involvement in international research community (C&L; Cockburn and Henderson).**
- ***Research* productivity is higher for firms that have “outward” orientation to research programs (Cockburn and Henderson).**
- **Simultaneity again?**

# For-profit analogy III

## “Science” as job amenity

- If science-orientation (“S-O”) increases productivity, suggests positive correlation across employers between S-O and wages.
- If S-O is a job amenity, then scientists will accept *lower* wages to get S-O.
- Simple correlation is +, but better scientists get paid more *and* care more about S-O.
- Controlling for scientist fixed-effect, S-O firms pay biology post-docs 25% *less* than non S-O firms (Stern, 1999).



# Assessing Research Performance

- **What are the outputs?**
- **What is the time frame?**
- **What is the unit of analysis?**
- **What is the counter-factual?**

# Research Outputs

- **Immediate embodiments (papers, presentations, speeches)**
  - “package size” problem
  - evaluation bias
- **Second-order impacts (citations)**
- **Broader performance indicators**
  - researcher retention
  - profits? Productivity? “presence?”

# Time Horizon

- **Potentially long and highly variable lags in the knowledge production function**
- **Human capital/career trajectory effects**
- **Research creates “capital” of several forms, each of which enters into broader “production” processes in complex ways.**

# Unit of Analysis

- **New York can measure output/input ratio relative to other regions.**
- **But what if you're all terrible (or great)?**
- **Can look at rates of change--but what if you're all pushing to improve?**
- **Is “pool” of relevant research results elastic?**

# What is the counter-factual

- **Non-convexities in payoffs likely make marginal and average returns very different.**
- **Comparisons to other regions beg question of interdependencies.**
- **Other models: contract research, use of consultants**

# Parting thoughts

- **Measurement is difficult, which means that priors have big effect on ultimate assessments.**
- **Objective is highly multidimensional, suggesting that many indicators are needed.**
- **Absolute efficiency measures are hard to come by, so comparisons to others or past is often the best you can do.**
- **Research increases various capital stocks, which are mobile to varying degrees.**