

# The Innovation Deception

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*Innovation is a crucial driver of national growth and competitiveness. As such, policy makers and investors have a strong interest in evaluating innovation in firms and the economy as a whole. The most widely used metric for measuring innovation is the number of patents a firm receives, and to stimulate innovation several countries have recently discussed or enacted policies giving tax deductions for patent-based income. But are such measures accurate? Our findings reveal that a company's patent filings and citations do not reflect R&D success, even when compared to firms in the same industry.*

1. The Importance of Innovation
2. Evaluating Innovation
3. Government Incentives
  - R&D Spending
  - Patent Box
  - Political Choices
4. Policy Implications for Singapore

# Innovation

- Innovative Companies (Forbes, 2018)
  - Easy to see examples
  - China: Tencent Holdings
  - US: Netflix
  - S. Korea: Kakao
  - Japan: Rakuten
- Innovation and Growth
  - Productivity and Efficiency
    - Internet: Global R&D Teams
    - Travel: Ride and Home Sharing
  - Lower Costs: Textiles and clothing
  - New Approaches
    - Credit Scoring: Ant Financial ~ 2 second loan evaluations
    - Air Travel: Automated Check-in; Aggregated Ticket pricing
    - News: Google Aggregator
    - Real Estate: Zillow (Pricing and Flipping)

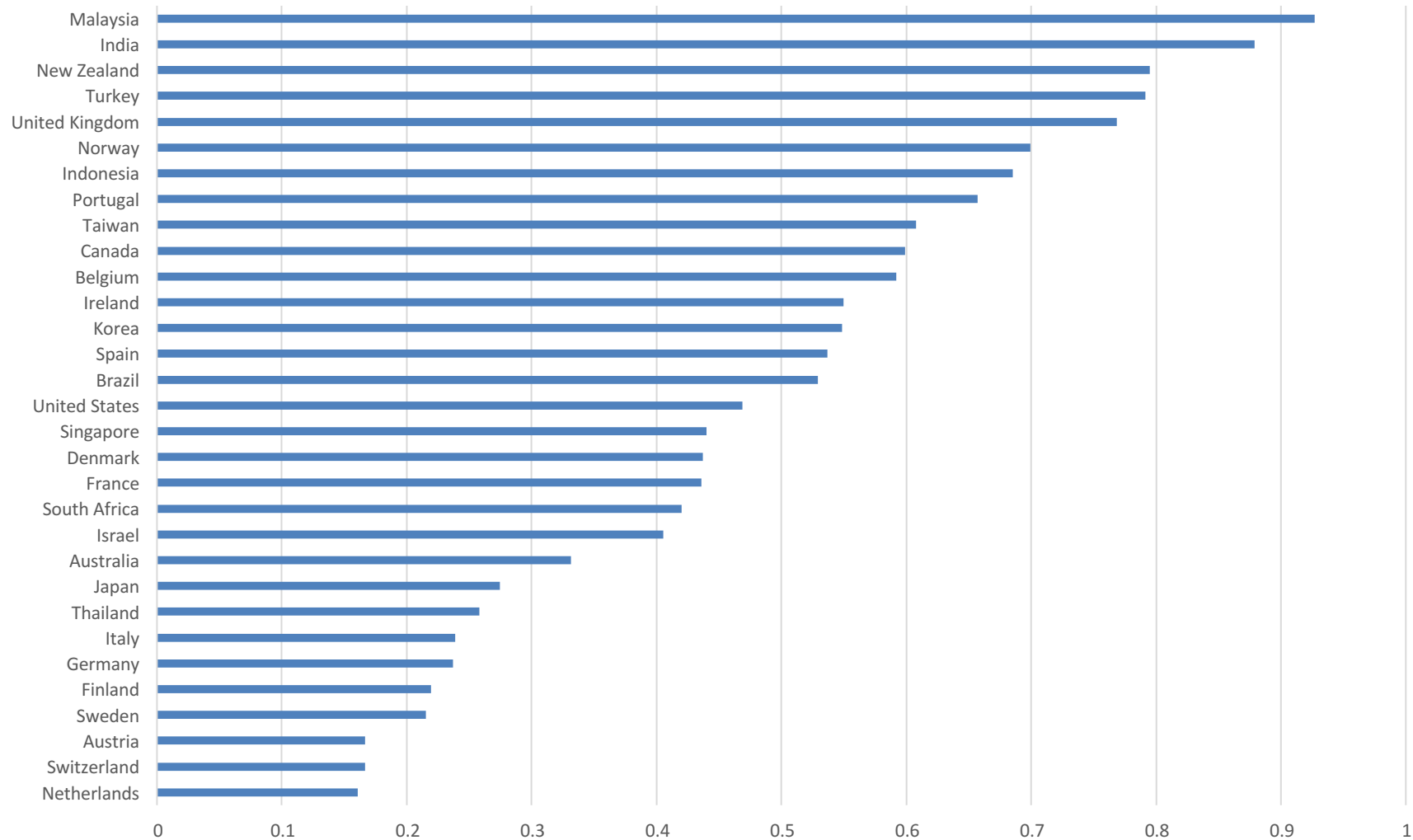


# Disruption (Creative Destruction)

- Schumpeter (1942)
  - Innovative firms bloom
  - Stagnant firms wither
- Economic Growth
  - Per Capita & Productivity Growth
  - Capital Growth
  - Changes in economy
- Existing Top Firms
  - Change is uncomfortable
  - Top firms typically resistant (Existing Taxi firms usually not fans of UBER)
- Relevant Question: How do we encourage innovation?
  - Academic Interest
  - Politicians Interest
  - Disruption varies across countries

# Historical Disruption

Disruption 1975 to 1996



Source Data: Fogel, Morck, and Yeung (2008)

# How to encourage Innovation?

- Requires ability to recognize or measure it
  - R&D Spending
  - Patents & Patent Citations
- Typically, described as:
  - R&D captures innovation inputs
  - Patents measure innovation outputs
  - Citations measure the importance of innovation outputs
- Governments Incentivize
  - Low tax rates
  - R&D tax credits
  - Intellectual Property Boxes
    - Grant lower tax to revenue tied to patents in that country
    - Ferrari patent box in Italy – income from their patents in Italy taxed at low rate
  - Gov Sponsored Accelerator programs
    - Usually with stated goal of generating more patents

# Geography of Innovation

- Not evenly spread within or across countries
- Global Rankings
  - How should we Rank?
  - Analogy: How evaluate Olympic Success?
    - Number of Coaches or Athletes in a Country
    - Number of Athletes sent to the Olympics
    - Number of Medals
  - Output Measures
    - Usually what is Measured:
      - R&D Spending
      - Patents and Patent Clusters
    - What Do Investors Care About?
      - New Products
      - Reduced Production Costs
      - New Technologies and Companies
  - Focus on patents per capita
    - Typically Leaders: Switzerland, Finland, Denmark, Austria, Netherlands
    - Are these the world leaders in innovation?

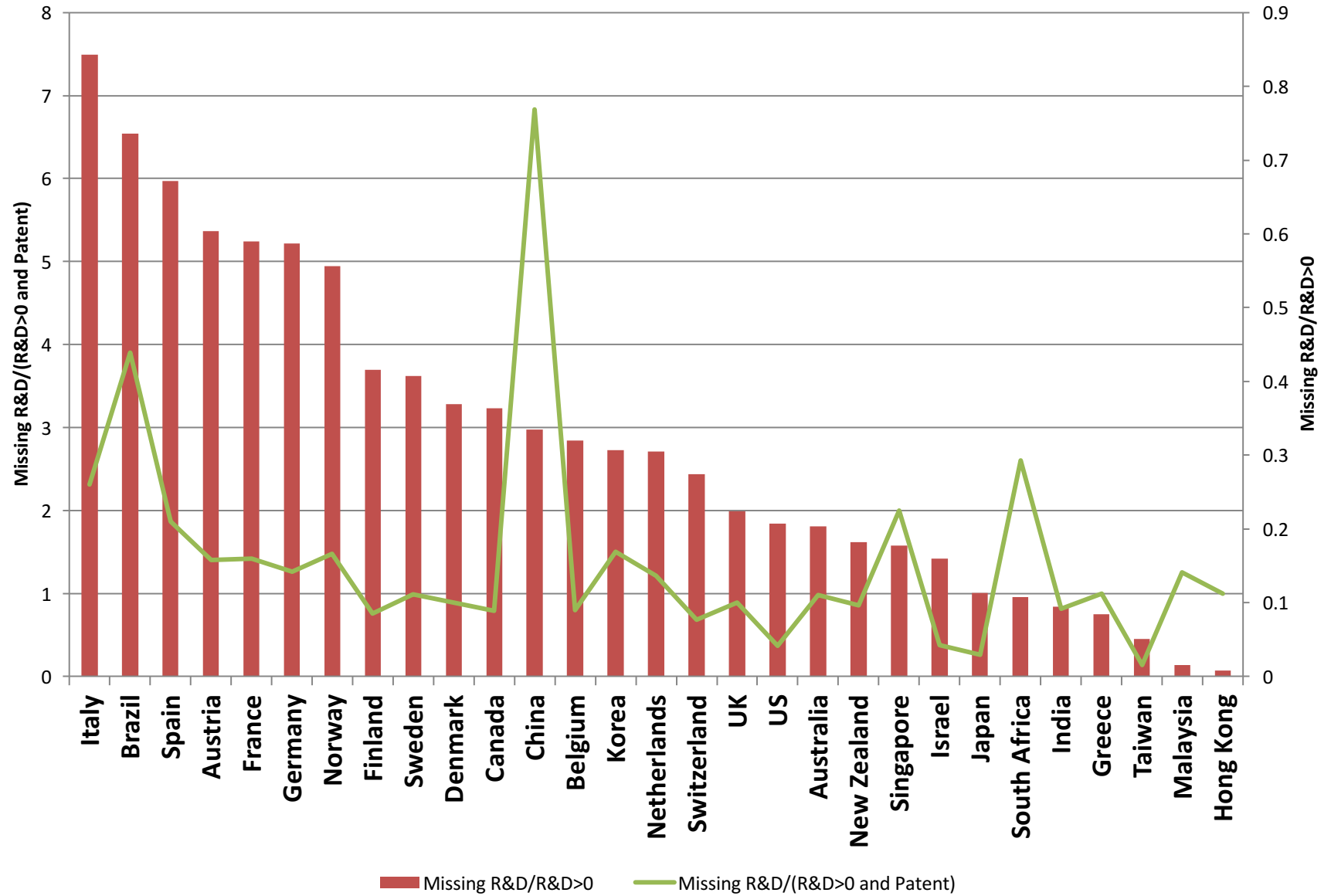
# Does R&D Spending Measure Innovation?



- R&D Expenditures
  - Mandatory Disclosure in most countries
  - Still 40% of NYSE firms don't report any information about R&D
    - Example: Coca – Cola
    - News reports indicate 7 R&D labs around the world
    - Financial Statements: R&D not reported
  - Recent research: More confident CEOs more R&D
- **Missing R&D:** Firms that don't report R&D but get patents
- Our research shows
  - Cautious CEOs: **7.4%** Missing R&D
  - Confident CEOs: **4.8%** Missing R&D
  - Confident CEOs actually do less R&D after adjust for disclosure differences
  - Using R&D to measure innovation, can give wrong inferences
- But these are Audited Firms! Materiality – impact on NI
- Global Patterns in Missing R&D



# R&D Reporting by Country



# Government Incentives: R&D Tax Credits



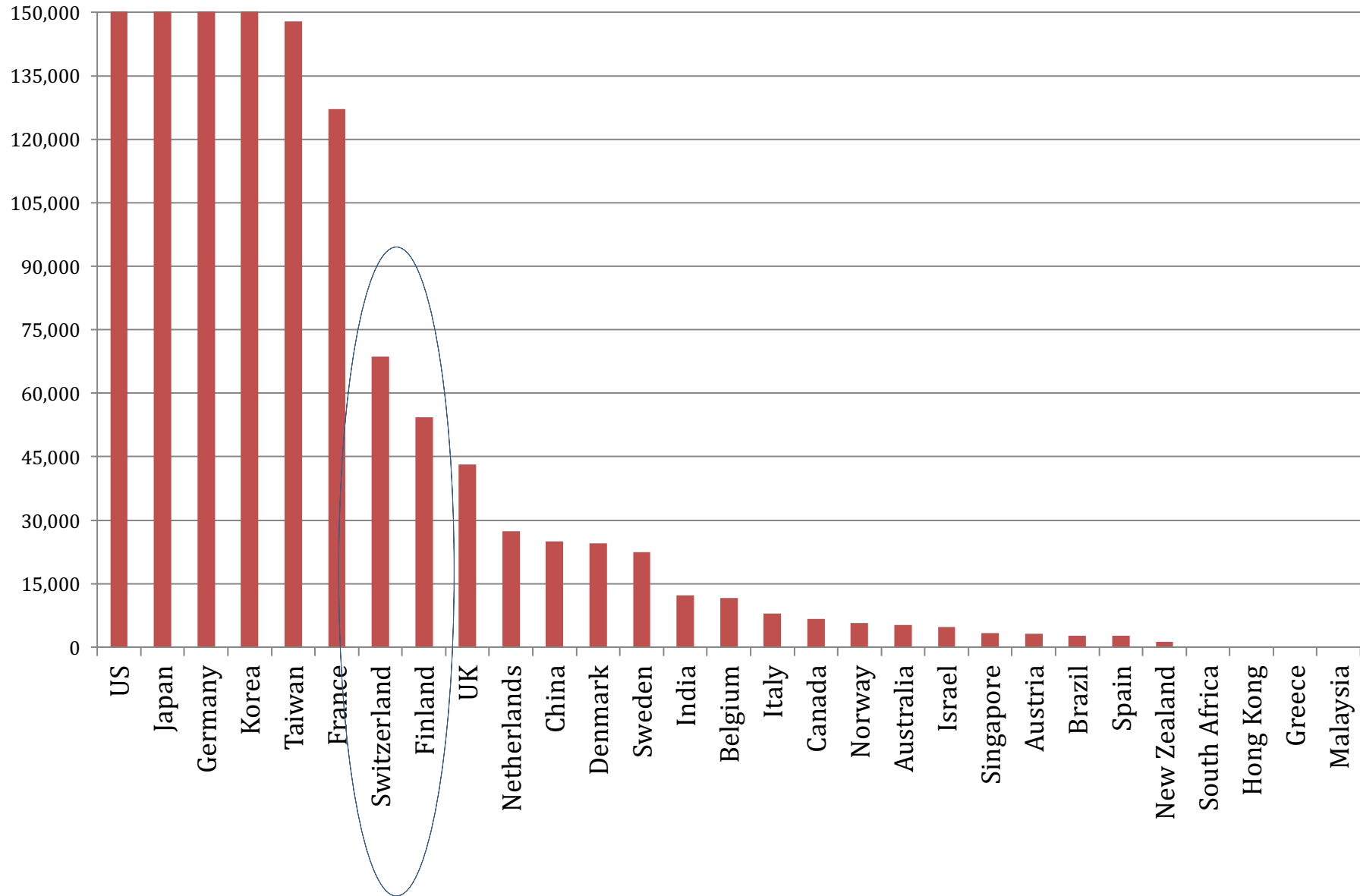
- Tax Primer: Investments
  - Capital Spending
    - Depreciated over life of asset
    - Tax savings spread over several years
  - R&D Spending
    - Immediately expensed in year it occurs
    - Tax savings concentrated in first year
  - Tax treatment favors R&D
    - Time Value of Money
    - Doesn't matter if separately declare or place in COGS
- R&D Tax Credits
  - Give firms additional subsidy for R&D
  - Firm Choices
    - Begin reporting existing R&D
    - Shift reporting of R&D from country x to country y
    - Start new R&D laboratory
      - First order effects: Economic needs and supply of scientists
      - Second order effects: Tax subsidy
    - Evidence of 1 and 2

# Patents: Well-liked Measure of Innovation



- Protecting Innovation
  - Trade secrets
  - Patents
    - Give the owner the right to exclude others from using an invention
    - Granted by government organization
- Patent Applications
  - Describes how to make/use invention
  - Graphs or Diagrams
  - Number of Claims (Scope)
  - Cites prior or related patents
  - Patent examiner reviews (accepts or rejects)
- *Popular* measures of innovation success
  - Patent counts & Patent citations
  - Breadth of patents across technological classes
  - Intuition for Patent Boxes
- Analogy: University Degree
  - Where go to University
  - Field of Study and Grades
  - Presumption:
    - Prefer Dentist with Academic Certificate
    - Avoid Dentist without Academic qualifications

# Patents by Country (1999-2012)



# Most Firms Don't Report Innovation

Report R&D and Patents	Report R&D and No Patents
(10%) Globally (18%) North America	(25%) Globally (28%) North America
Don't Report R&D but get Patents (missing R&D)	Don't Report R&D or seek patents
(4%) Globally (5%) North America	(61%) Globally (49%) North America

# Do patents measure Innovation Success?

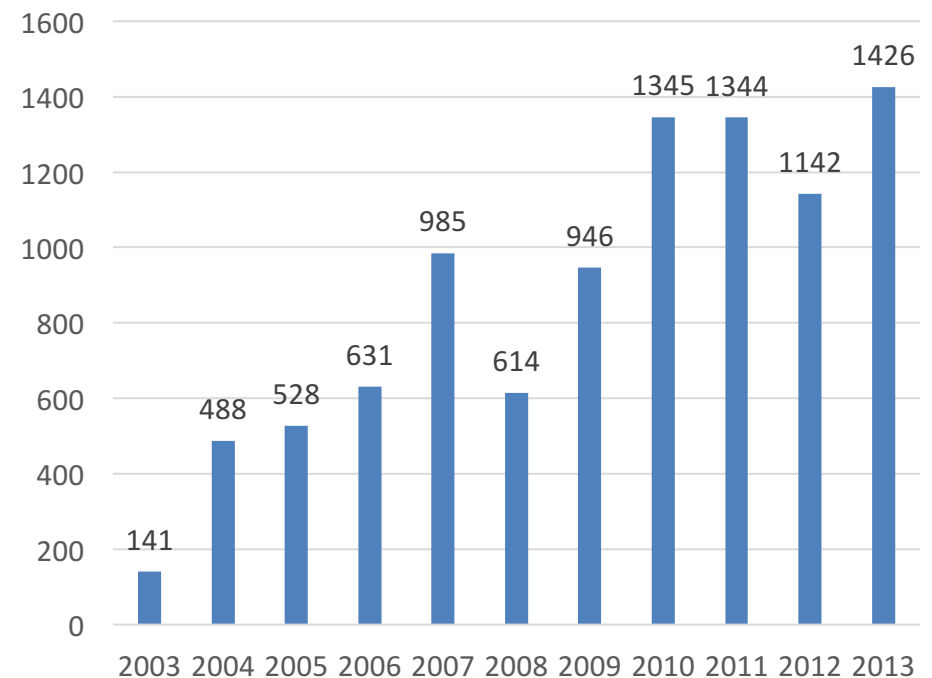


- Are patents like university degrees: Successful in school get one
- Non-Patenting firms
  - 65% of R&D reporting firms don't seek patents
  - Implied: Arises because their R&D is unsuccessful
- How to evaluate if this assertion is true?
  - Go back in time
  - Look at high patent firms
  - Do they subsequently have high innovation success?
    - Lots of new innovations
    - Lots of important innovations

# Example: Research In Motion in 2013

- 2013 RIM: 18<sup>th</sup> most patents by NA firms
- Smart Phone Market (Statista)
  - 2007 : iPhone Introduced
  - 2007: RIM Patenting increases
  - 2009 : RIM 25% Market Share
  - 2011 : RIM 8% Market Share
  - 2013 : RIM 1% Market Share
  - Samsung, Apple, Huawei, Xiaomi, Oppo
    - Over 60% of Market
- Similar Patterns for Nokia
  - 2007 – 48.7 Market Share
  - By 2013
    - About  $\frac{3}{4}$  Number of Patents as RIM
    - 3.4% Market Share

BlackBerry's US Patent Applications 2003-2013



# Xerox: 2013

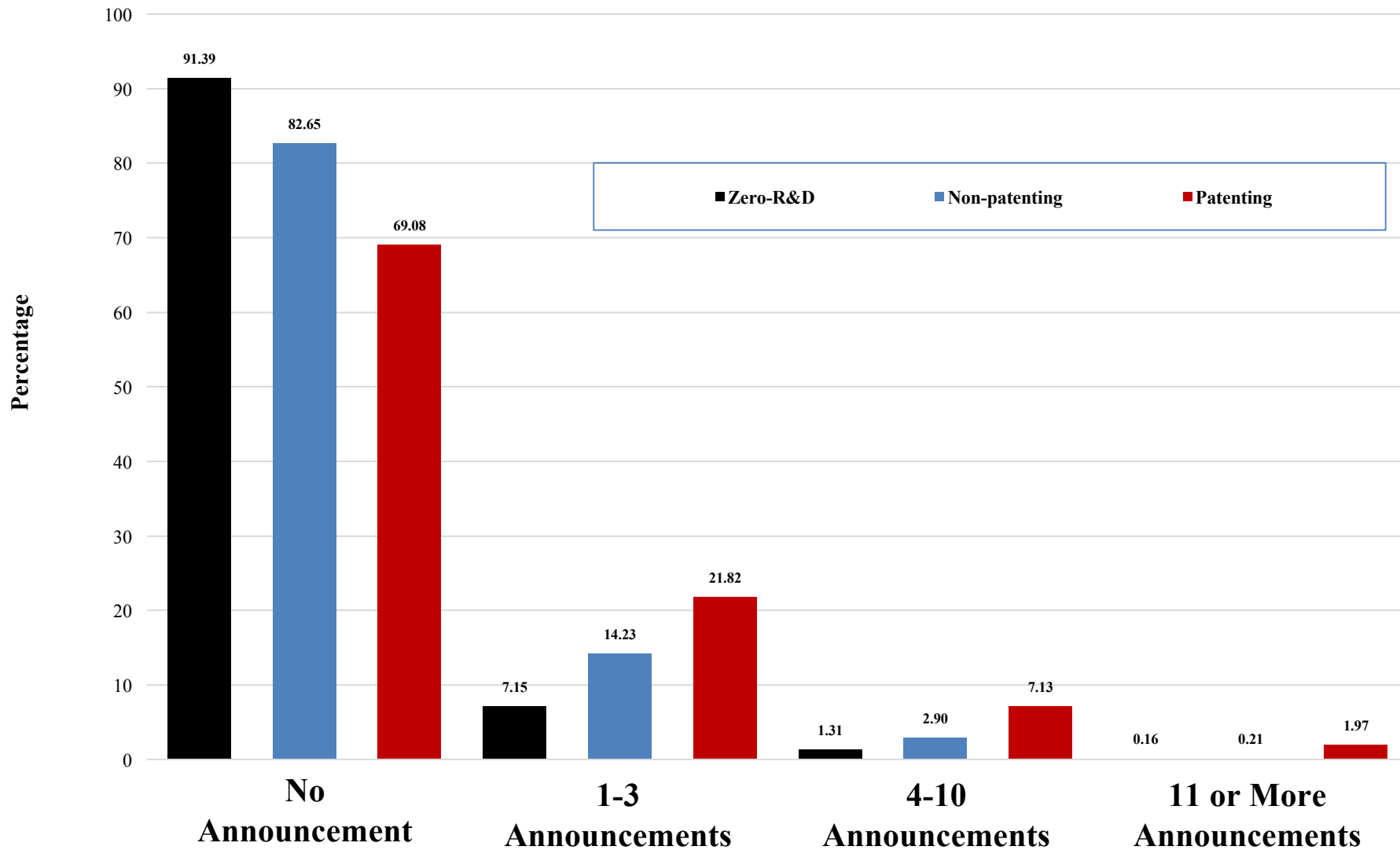
- 2013 Xerox: 9<sup>th</sup> most patents by NA firms
- Did this indicated good times ahead for Xerox?
- Xerox revenue over the next 5 years!





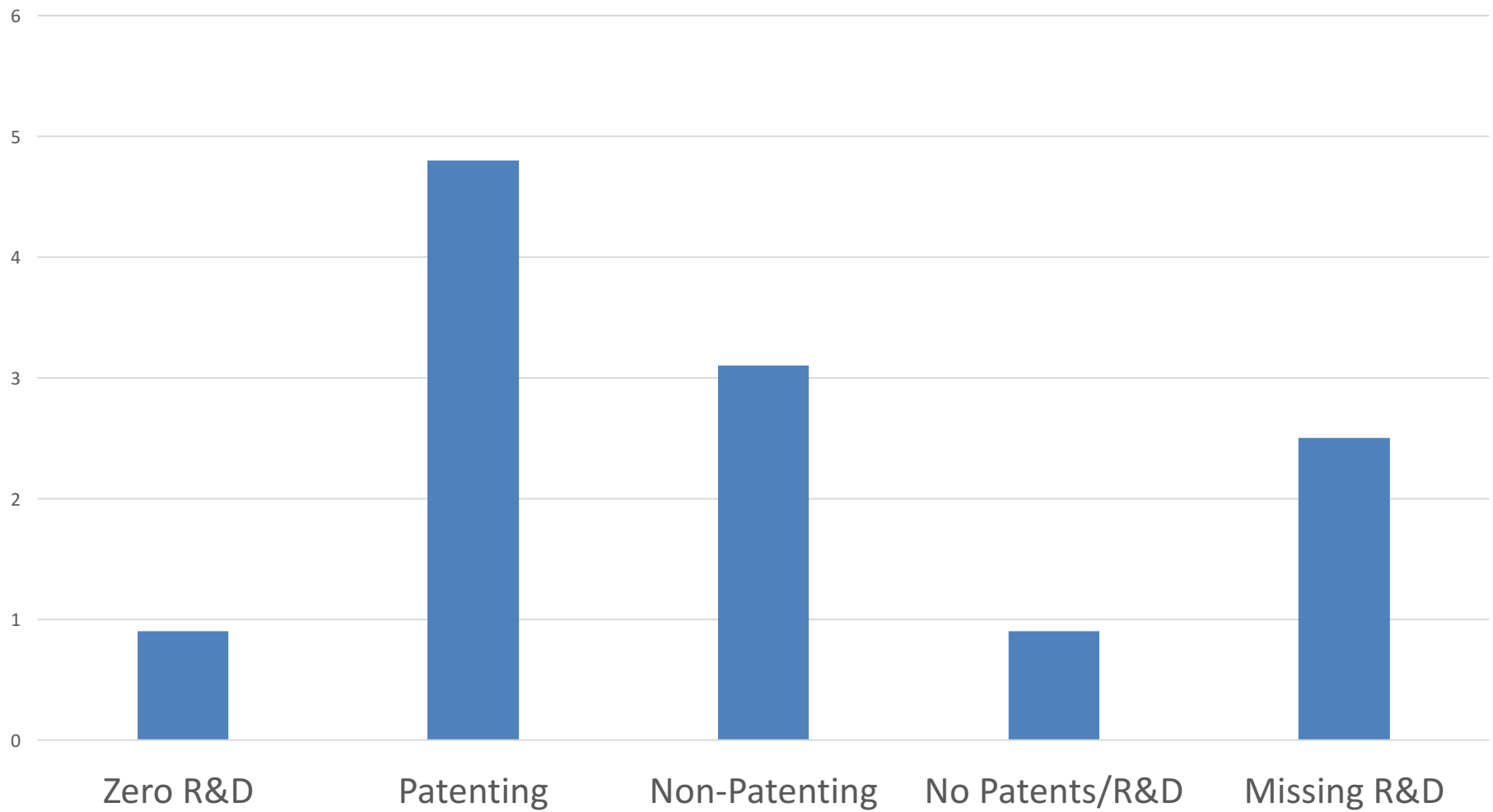
- If patents measure R&D success
  - Non-patenting firms are innovation failures
  - Among the 2,000 largest industrial firms in the US
    - 1/3 never filed a patent
    - These firms spend \$10 billion a year on R&D
  - Typical patenting firm only gets 1 or 2 patents a year
- The Patent Tradeoff
  - Gives competitors guide to replicate innovation
  - Gives applicant property right protection
- Underpin: Government Sponsored Accelerators
  - Stated goal: Success is measured by number of patents
  - Assumes getting patents equals innovation victory
  - Objective of Innovative firms
    - Monetizing innovation
    - New Products or Processes
- Do non-patenting firms introduce new products?

# Rank order by new product announcements



# New Product Announcements

Annual New Products

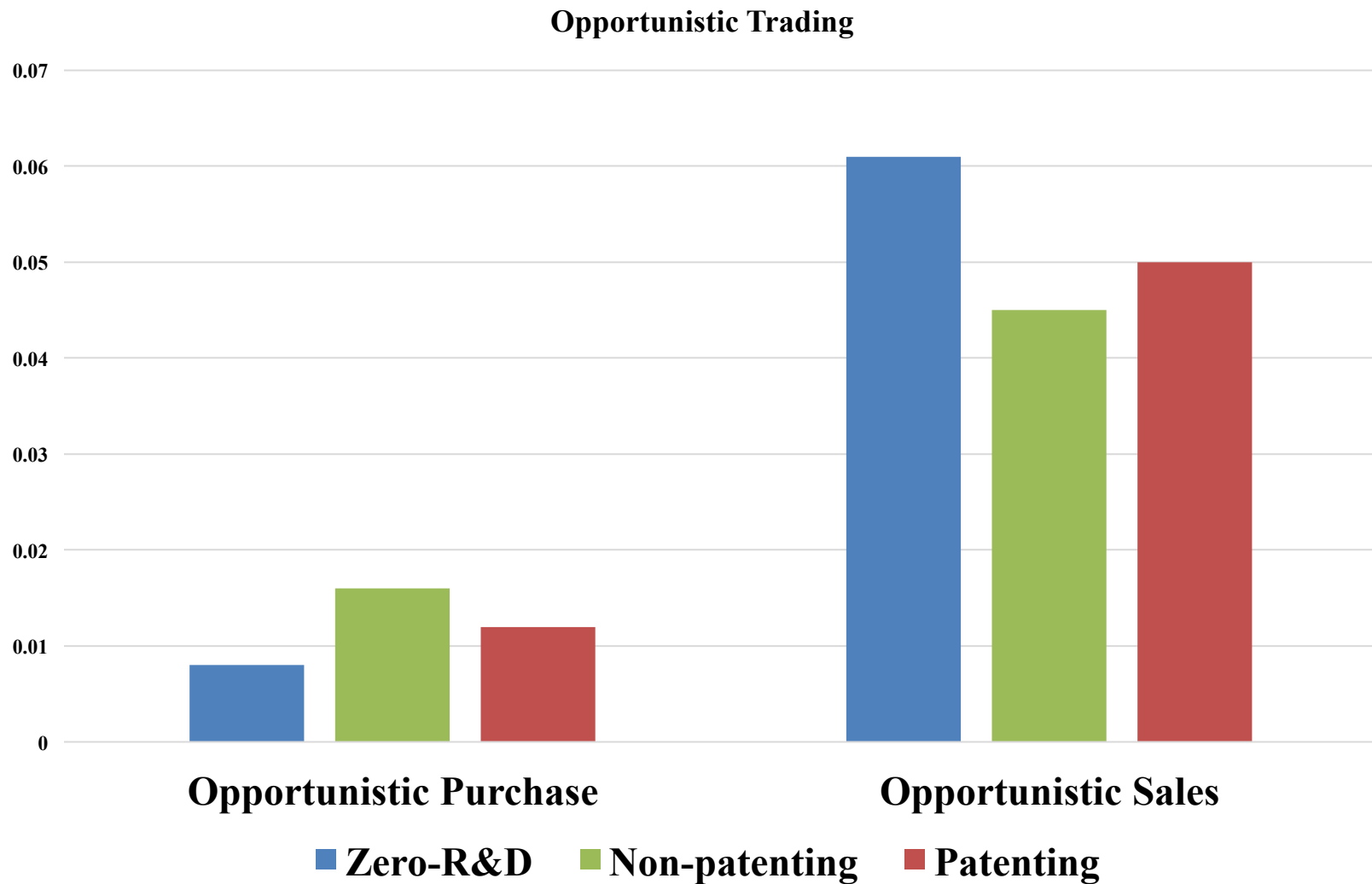


- Non-Patenting Firms
  - 3x more new products than non-innovation firms
  - Fewer new products than patenting firms
  - New Product Values
    - Higher than non-innovative firms
    - Lower than patenting firms
- Inconsistent with failed innovation
  - Systematically different
  - Disclosure choice of seeking patents not random
- R&D reporting firms
  - Substantial new products
  - Patents provide information about new products
  - So far: Patents don't seem to measure R&D success and failure

# What do patents measure?

- Patent Choice: Innovation Mix or Immateriality
  - Perhaps patents just separate levels of success
  - Non-patenting firms less successful
  - Patenting firms more successful
- Use Insider Trading to Test
  - Regular vs Opportunistic
    - Opportunistic Insider trading is profitable
    - Empirically: Buy before price goes up and sell before declines
  - If non-patenting R&D firms less successful
    - Should impact opportunistic insider trading
    - Limited opportunistic buys
    - Lost of opportunistic sells

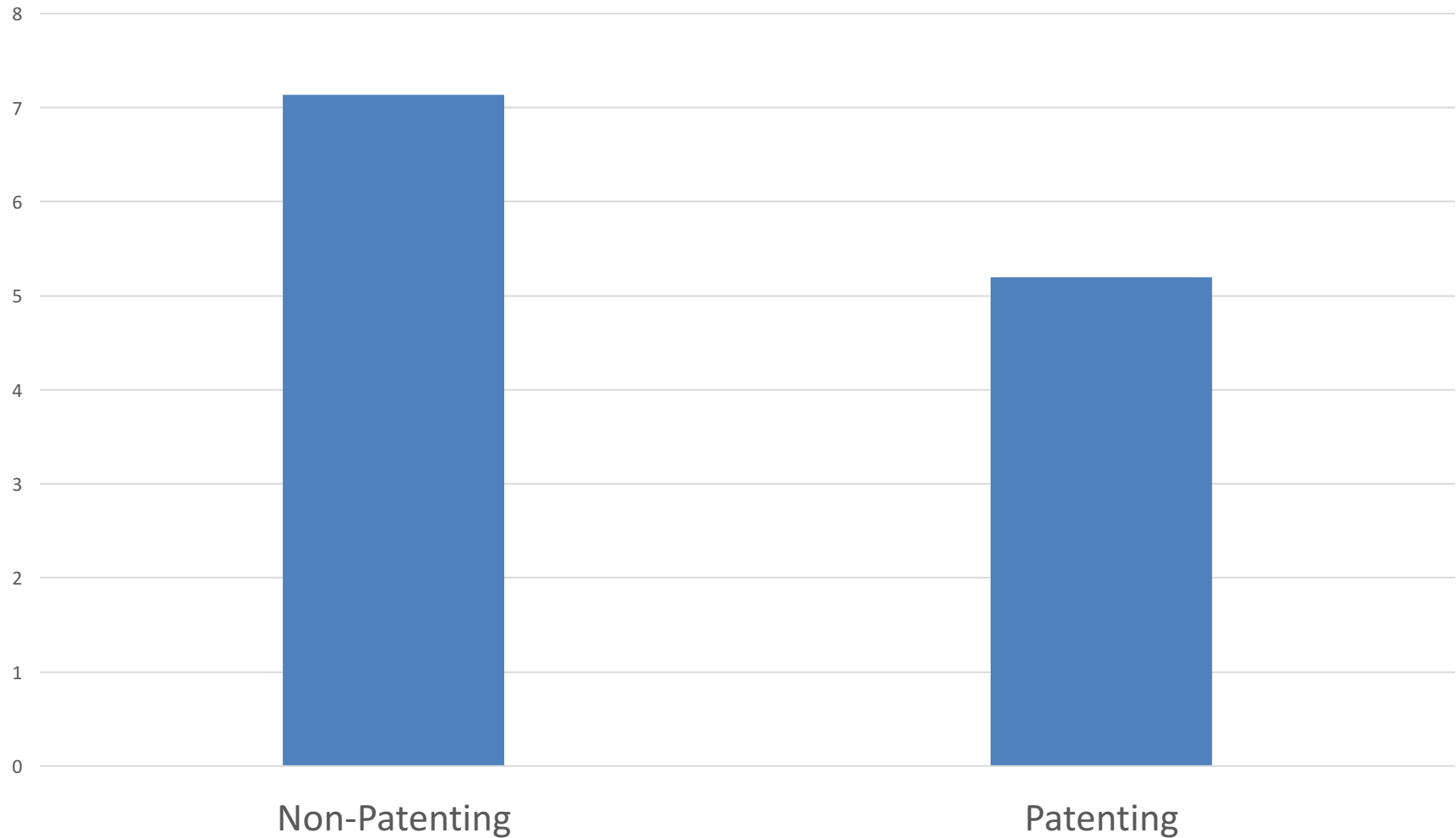
# Opportunistic Insider Trading



- Do Patents reflect type of Innovation?
  - Product Innovation
  - Patents give ability to defend against duplication
  - If competitor can reverse engineer, then seek a patent
- Process Innovation
  - Production or cost reducing innovations
  - Difficult to reverse engineer
  - Difficult to detect infringement of patent
  - Keep details of successful innovation secret
- Patents Measure the mix of innovation rather than innovation success or failure

# Process Innovation

Future Process Costs Savings





# Government Incentives: Patents



- Patent Boxes
  - a tax scheme to incentivize research and development by taxing **patent** revenues lower than other commercial revenues
  - Implicit Assumption: Patents measure success
- Politicians and voters: Support innovation
- Rise of Patent Boxes
  - France (2001); Belgium (2007); UK (2013); Italy (2015); Poland (2019)
  - Turkey (2014); Israel and S. Korea (2014)
  - Patent Box tax rates: 5% - 17.1%
- Singapore: IP Development Incentive (under Economic Development Board)
  - Tax rate of 5% or 10%
  - Qualifying IP income
  - Recent updates: R&D to produce IP undertaken in Singapore

# Patent Boxes: Tax Patent Income at lower rate



- Best Case Scenario
  - Change incentives to favor product over process innovation
  - Don't make it better or less expensively
  - Make a new product!
- Alternative Scenario 1
  - Change incentive to disclose true innovation
  - Increase disclosure of innovation not the level
- Alternative Scenario 2
  - Increase low claim patents
  - No increase in innovation, no increase in real disclosure, simply get patents for patent sake
- Alternative Scenario 3
  - Shift income from jurisdiction A to jurisdiction B
  - Encouraging Tax Shifting
- Empirical Evidence on Patent Boxes
  - Fail to incentivize local R&D development
  - Attract high value patent from one patent office to another
  - Incentivize Patent Trading

# Taking Stock of Innovation Incentives



- Marginal Corporate Tax Rate
  - Low Tax Rates increases R&D Spending
  - Increases new product announcements
- Innovation Incentives with Limited Impact
  - R&D Tax Credits
    - Increase the disclosure of R&D
    - Increase the classification of R&D
  - Patent Boxes
    - Increase the incentive to patent
    - Increase the trading of patents
    - Currently, no evidence they increase innovation
- What about Government Accelerators and Incubators?
  - Presumably implemented due credit market imperfections
  - Some friction keeps funds from good innovators
  - Discrimination against certain types of innovators

# Incentivizing Grass Root Innovation

- Incubators: Co-Working spaces with shared resources
- Accelerators:
  - Help innovators define their product or process
  - Identify customers & secure financing
  - Limited Duration Program
  - Usually cohort based & Finish with a Demo Day
- Accelerator History
  - 2005: Y Combinator in Cambridge Massachusetts (Dropbox and Airbnb)
  - 2007: TechStars in Denver Colorado
  - Appealing success stories
    - Match entrepreneurs from elite universities with talented investors
    - Intuitively, early stage VCs
  - Now: Thousands of accelerators around the world
  - Accelerator survival: Either profitable or more donations



# Government Sponsored Accelerators



- 90% of Accelerators are non-profit
  - Government sponsored: Focused on community economic development
  - Implicit idea: Market impediment limits private accelerators
  - Government seeks to solve this financial market break down
  - Singapore: Numerous private accelerators (e.g. Paypal Innovation Lab)
- Accelerator Success
  - Top programs: Help raise capital and accelerate customer acquisition
  - Other programs: No evidence they accelerate startup development
- Evidence on government funding of accelerators
  - What is the metric of success? Patents? Jobs?
  - Missing data problem rises again
  - Missing data not random: Better data for successes
  - Accelerator Prospectus on measuring success
    - For Profit: Usually described as attracting VC financing or customers gained
    - Not-for-profit: Usually discuss something about patents or jobs created

# Conclusions

- Goal: Foster Corporate Innovation
- Policy tools require method to measure corporate innovation
  - R&D Spending & Patents
    - Most firms don't report or seek
    - They represents a disclosure choice of the firm
  - Keep it secret to mitigate competitor risk
  - Cost of increasing innovation disclosure
    - Inform foreign competitors
    - Foreign competitors respond with increased innovation intensity
- Patents: Don't measure innovation success
  - Impact on Patent-Tax incentives
  - Impact on accelerator performance assessment
  - Gives deceptive sense of success
- Spending Public Money
  - R&D Spending tax credits
  - Patent Box Tax Regimes
  - Government financed innovation accelerators