

**Measuring the impact of quantitative
metrics on Global Firm Innovation
Rankings: The case of R&D intensity and
patents**

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Introduction

During the literature review, we identifies several metrics to measure innovation within companies:

Conventional Metrics: - Patents - R&D (R&D spending, R&D intensity)

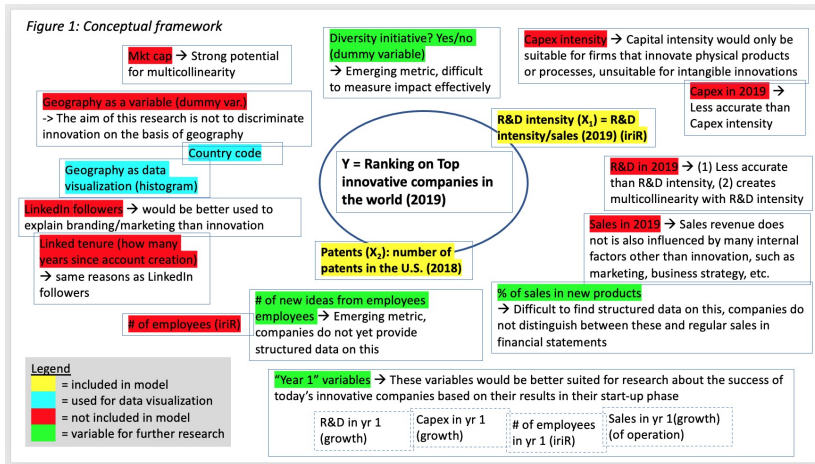
Emerging metrics: - Subjective surveys - Market cap - Serving end users with innovations & other metrics

Research Question

“What is the Impact of number of patents granted in the U.S. and R&D intensity on the ranking of the Top 30 innovative companies”

Conceptual framework

Figure 1: Conceptual framework



variables

| Variable | Description |
|------------------|---|
| rank | ranking of most innovative companies (1 to 30) |
| country code | ISO code of country |
| company name | name of the companies |
| year | time of the ranking (2019) |
| RD_intensity | R&D intensity of companies in 2019 () |
| Patents_2018 | number of patents granted to the companies in the US in 2018 (1 = 1000 patents) |
| indicator | 2 = Top 10, 1 = Top 20 & 0 = Top 30 |
| geographical_loc | geographical location of the companies |

Models

In an ordinal logistical regression, the output is the **Odds** of the a giving possible outcome as demonstrate in the following formula:

$$\text{logit}(P(Y < i)) = \beta_0 - \beta_1.x_1 - \beta_2.x_2 - \beta_3.x_3 - \epsilon$$

Checking for quadratic effect and interrraction in variables:

- ▶ Model 1: $\text{logit}(P(\text{indicator})) = \beta_0 - \beta_1.RD - \beta_2.patent$
- ▶ Model 2: $\text{logit}(P(\text{indicator})) = \beta_0 - \beta_1.(RD)^2 - \beta_2.patents$
- ▶ Model 3: $\text{logit}(P(\text{indicator})) = \beta_0 - \beta_1.RD - \beta_2.(patents)^2$
- ▶ Model 4: $\text{logit}(P(\text{indicator})) = \beta_0 - \beta_1.RD - \beta_2.patents - \beta_3.(RD.patents)$

R result

| | Dependent Variables: | | | |
|----------------------------|----------------------|----------|----------|-----------|
| | Indicator | | | |
| | Model 1 | Model 2 | Model 3 | Model 4 |
| RD_intensity | -0.05697 | -0.05697 | -0.05697 | -0.069308 |
| Patent_2018 | 0.72495 | 0.72495 | 0.72495 | 0.63663 |
| RD_intensity . Patent_2018 | | | | 0.007523 |
| Intercept: | | | | |
| 0 1 | -0.2799 | -0.2799 | -0.2799 | -0.4325 |
| 1 2 | 1.167 | 1.167 | 1.167 | 1.0157 |
| Observation | 30 | 30 | 30 | 30 |
| Residual Deviance | 59.8637 | 59.8637 | 59.8637 | 59.85396 |
| AIC | 67.8937 | 67.8937 | 67.8937 | 69.85396 |

Interpretation

Since model 1,2 & 3, AIC score is lower than model 4's (**67.8637** < **69.85396**), therefore any of the first 3 model can be consider as the “best” model

With this knowledge, the following statements can be made:

- ▶ For every one unit increase in R&D intensity, the odds of being in the upper rank (top 10 or top 20 versus top 30) is multiplied **0.06** (1-0.94)times, holding constant all other variables.
- ▶ For every one unit increase in patent, the odds of being in the upper rank (top 10 or top 20 versus top 30) is multiplied **2.06** times, holding constant all other variables.

Discussion

- ▶ In addition to our research question, we have run a research to understand the state of art of the initiatives that could foment innovation and help the countries push up their companies on this list.
- ▶ Our findings show as the main important constructs to be considered: The Triple Helix Theory, Diversity incentive, and Open Innovation adoption

The Triple Helix Theory

Diversity incentive Studies have shown that:

- ▶ eliminating the patenting gap of female holders of science and engineering degrees would increase gross domestic product (GDP) per capita by 2.7%
- ▶ including more women and African Americans in the initial stage of the innovation process would increase GDP between 0.64 and 3.3% per capita

Open Innovation adoption

- ▶ OI represents a shift from that old industry practice, driven by the new increasing opportunities to collaborate with external partners and individuals to find new innovative ideas. Some countries such as the USA, Australia and Singapore established open innovation policies at the national level to leverage an innovation culture.