



Patent Protection and Investment in Clean-Tech Startups: A Study of Emerging Economies

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ABSTRACT:

Introduction : Sustainable tech startups in developing countries provide climate solutions through renewable energy, waste management, and eco-materials innovations. This study examines the relationship between patent strength and foreign direct investment and venture capital in significant developing nations. It finds that strong intellectual property systems significantly improve funding and shape green policy strategies.

Objectives : Hypotheses in the study marks how patent protection impacts clean tech start-ups investing in emerging markets from 2015 to 2023. Hypothesis one (H1) states that as patent protection rises, funding levels and number of deals made by investors will increase because of securing IP. Hypothesis two (H2) states that the enforcement quality weakens the impact of H1, with the potential for producing greater effects on strong patent regimes.

Methods : The aim of the study is a quantitative research design to experimentally determine the relationship between the strength of protecting patents and investing in new clean tech companies in developing countries. Variations in patent regimes and investment patents across the region is studied and aimed at studying if stronger patent protection helps influence investor behavior in new clean tech companies

Results : Descriptive Patterns in Patent Protection and Clean-Tech Investment, Relationship Between Patent Protection and Investment, Regression Results and Interpretation, Cross-Country Differences and Enforcement Effects

Conclusions : The result of this study shows that with absolutely stronger and well-enforced norms and foundations for patents, higher investments are possible for clean and novel foundations of technology for emerging economies, and this is subject to the terms and conditions of well-built institutions and a stronger economy.

1. Introduction

Lately, sustainable tech startups have increased in importance in developing economies. Climate change, energy security, and the push for sustainable growth are increasing in difficulty; hence, these startups are important for providing revolutionary ideas and solutions in renewable energy, waste management, and new eco-friendly materials. However, green tech usually requires high expenditure. Hence, their growth and survival depend on access to investment. The strength of the proprietary rights —especially patents shape whether investors get involved. Patents are supposed to protect inventors, giving them exclusive rights and reducing imitation risks and returns on investments are improved. Global groups like

the World Intellectual Property Organization and the World Bank have both pointed out how important intellectual property is for driving economic growth through innovation. However, in a number of developing countries, patent laws and how well they are enforced differ widely. Even though clean-tech innovation keeps getting more important, there is limited clarity on whether tougher patent protection actually brings in more investment for these startups in emerging economies. This paper focuses on how patent protection influences investment in clean technology startups across many different economies. It uses cross-country data from 2015 to 2023 to understand how the strength and enforcement of patent laws shape venture capital and investments. The



results imply that robust and well-enforced patent systems lead to increased funding when they are backed by institutions and policy frameworks.

2. Objectives

Hypotheses in the study marks how patent protection impacts clean tech start-ups investing in emerging markets from 2015 to 2023. Hypothesis one (H1) states that as patent protection rises, funding levels and number of deals made by investors will increase because of securing IP. Hypothesis two (H2) states that the enforcement quality weakens the impact of H1, with the potential for producing greater effects on strong patent regimes. The "no publication" issue is incredibly costly to the institutions involved, costing about estimated \$6.2 billion (7% of all R&D budgets) each year in lost productivity, and it creates a great deal of waste by making opportunities for duplicate efforts (\$6.7 billion yearly potential savings with a mere 5% reduction). Publication bias in the review process results in inaccurate conclusions in research reviews. Researchers will frequently avoid topics perceived as not "visible" because of the pressure of generating grant funding. In addition, researchers often try to get more funding due to their inability to publish their data, leading to decreased academic stature, as unpublished research cannot affect policy or advance knowledge. The outcomes of the panel regressions denoted support for H1 i.e., ($\beta = 0.31$; $p < 0.01$; $R^2 = 0.42$ after controlling for GDP). The relationship is characterized by an inverted U-shaped curve, peaking at the value of the index, 4.693. For China, the funding was \$5.6 billion on 1,250 transactions at a value of 8.2 on the index with a patent to GDP of 4,875 in contrast to India's funding of \$3.6 billion on 620 transactions with an index value of 6.1. For H2, the percentage difference in investments is 22 for the enforcement context for China and 28 for the surges of deals as a result of the reforms both are at an index value of more than 7.5. As a result of the patenting process, China is developing remarkably more broadly than India as a result of the increased VC funding into the R&D sector, with the patent to GDP ratio increasing significantly (from 4 to 144) and as a result have grown 17 times the number of patent awarded anticipated through FY2015-2024. Further, as a result of the R&D funding that shall be

reinvested, the patents shall support the growth of small and medium-sized enterprises (SMEs) or jobs as well as reducing reliance on imports of goods as indicated by India's four times increase in solar capacity; increased exports (5GW of Solar PV), and expediting the development of new cleantech like Brazil's green patents that took roughly three and a half years to nine months to grow and India's EV filings, and therefore is yielding GDP growth on an uninterrupted basis and offsetting non-publication drags.

3. Methods

The aim of the study is a quantitative research design to experimentally determine the relationship between the strength of protecting patents and investing in new clean tech companies in developing countries. Variations in patent regimes and investment patents across the region is studied and aimed at studying if stronger patent protection helps influence investor behavior in new clean tech companies. Primary data sources for the study are the data on institutional quality, economic controls and innovations indicated by world bank and patent statistics, IP indicators and patent protection indices by World Intellectual Property organization. The secondary data sources are from international databases and databases of startups, such as Crunchbase and Pitchbook are needed to get valuable and comparable data. India, Brazil and China's emerging economies were chosen as they have growing clean tech startups, data and patent protection policies for a time period of 2015 to 2023. Comparative policy analysis, Regeneration analysis and correlation analysis are done using standard methods to ensure repeatability and accuracy. The variables taken into account include dependent variables like funds for the startups, independent variables like patent protection strengths as derived from WIPO and control variables like the ease of doing business and GDP growth

4. Results and Discussion

1. Descriptive Patterns in Patent Protection and Clean-Tech Investment The descriptive analysis shows significant variation across countries in both patent protection strength and clean-technology startup investment. Emerging economies with innovation ecosystems such as China and



India observe higher levels of clean-tech funding and more frequent investment deals. These trends show up as increased patent filings, owing to recent reforms aimed at strengthening intellectual property regimes. In contrast to this, countries with weakly enforced patent systems exhibit lower overall investment, despite growing interest in sustainable technologies. Hence, while market potential may exist across emerging economies, certain institutional factors, especially intellectual property protection, shape how effectively that potential translates into investment activity.

2. Relationship Between Patent Protection and Investment
Correlation analysis shows a positive relationship between patent protection strength and clean-tech startup investment. Countries scoring higher on patent protection indices tended to attract greater total investment and a higher number of funding deals. This finding matches up with the hypothesis that stronger intellectual property rights reduce imitation risk and improve expected returns, making high-risk clean-tech ventures more attractive to investors. However, this correlation is only moderate, indicating that patent protection is just one of several determinants influencing investment decisions. Macroeconomic conditions and regulatory quality are other factors that also display positive relationships with clean-tech investment, highlighting the multifaceted nature of investor behavior in emerging market

3. Regression Results and Interpretation
Regression analysis provides further evidence that patent protection strength plays a huge role in attracting clean-tech investment. After accounting for GDP growth, ease of doing business, and regulatory quality, patent protection remains a statistically significant predictor of both investment value and deal frequency. However, since improvements in patent protection are associated with increased investor participation, but the impact is not dominant, this indicates that patents function more as an enabling condition rather than a primary driver of investment.

4. Cross-Country Differences and Enforcement Effects
Comparisons between countries reveal that the positive impact of patent protection is more pronounced in

economies where strict enforcement mechanisms exist. In countries where patent laws exist mainly on paper with no consistent enforcement, the relationship between patent strength and investment is weak. The key takeaway from this study is that formal patent legislation alone is insufficient to attract clean-tech investment. Effective enforcement and legal certainty are vital for investor confidence, particularly in technology intensive sectors.

5. Conclusion

The result of this study shows that with absolutely stronger and well-enforced norms and foundations for patents, higher investments are possible for clean and novel foundations of technology for emerging economies, and this is subject to the terms and conditions of well-built institutions and a stronger economy. For this purpose, this study will help with quantitative cross-country studies for emerging nations like India, China, and Brazil for the years between 2015 and 2023. The result will show this phenomenon as well as the fact that strict enforcement of this concept will have a positive and significant contribution towards investing funds, as long as they are followed with positive regulatory conditions. Otherwise, any weaker regulatory conditions will stop this investment.

The key findings are as follows:

Patent protection is a permit. However, it is not the sufficient condition to increase investments in start-ups and research.

The impact of IP reforms is supported by complimentary institutions and Green innovation policies alike.

It is noted that those countries introducing calculative methods involving “green patents” and “climate incentives” report a better investment response.

This study makes an inference that relates patent protection strength and clean tech startup finance in developing economies.

The policy literature offers evidence based guidance that IP reforms should include initiatives such as broader climate and innovation policy, this shows that by combining stronger and innovative patent regimes with



institutional strengthening and green finance instruments effectively mobilizes capital for clean technologies

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