Estimating the 'Investible Space' in Macro Investment Environments for Renewable Energy Technologies

Sumit Kothari, UCL Institute for Sustainable Resources, +44 7491 496 467, sumit.kothari@ucl.ac.uk
Nadia Ameli, UCL Institute for Sustainable Resources, n.ameli@ucl.ac.uk

Overview

The prodigious fall in the cost of renewable energy technologies, particularly solar photovoltaics and wind energy, over the last two decades has made them cost-competitive with fossil fuel based energy in countries around the world. However, across both developed and emerging economies, it has been observed that the declines in technology costs have not translated to adequate investment in and deployment of these technologies. Much of the financing by public and private actors to mainstream renewable energy projects is currently delivered at 'market-rate' and depends on the financial market's assessment of risks associated with these projects. Since the capital investment in renewable energy projects is almost entirely at the initial stages, any future variability in project parameters directly impacts the returns that investors can expect over its lifetime. Projects that are perceived as inherently risky struggle to raise sufficient capital or must contend with high costs of capital that may render the project unviable. And beyond certain thresholds of risk, projects may become simply uninvestible.

The accumulation of experience with the increasing deployment of renewable energy technologies in regions across the world has resulted in declining technological and project-specific idiosyncratic risks. As a result, 'macro' risks have become key determinants of renewable energy investments. These are a product of the investment environment created by the economic, political and governance context in a country alongside the institutional conditions for renewable energy deployment. These risks are difficult to transfer, diversify or mitigate completely while creating a substantial impact on project outcomes. The joint perception of these risks by financial actors may render the investment environment conducive or otherwise affecting the flow of investments in renewable energy, irrespective of technological suitability and market viability. A variety of macro risks characterise a complex investment environment defining its suitability for investment. Inducing private and developmental capital for investments in profitable renewable energy projects, particularly in emerging economies, requires that influential macro risks are identified and mitigated using domestic and international financial policies. A conducive investment environment will attract domestic and foreign flows at lower costs of capital and at the scale needed to achieve large volumes of renewables deployment.

Methods

Quantitative characterisation of the investment environment in terms of its major component risks can identify the independent and joint effect that these have on making a country conducive for investment. This study describes the influence of eight major macro/meso risks on the investment environment: foreign exchange risk, interest rate risk, growth risk, sovereign credit risk, political risk, institutional risk, off-taker credit risk and renewable energy policy risk. It computes indicators to measure the levels of these risks across countries and time, and uses project-level investment data from the Bloomberg New Energy Finance database to identify the risk environments corresponding with project investments in solar and wind energy. The successful financing of a project constitutes an acceptance of the level of macro risks facing investors and therefore a funded project's risk profile can be considered suitable for investment. Using machine learning models, this study aggregates the risk environments of funded solar energy projects to construct an 'investible space' i.e. the set of environments perceived to be most suitable for investments by financial markets.

To achieve this, the macro investment environment is characterised as a geometric space with the component risk factors as its dimensions or axes. These axes define a n-dimensional Euclidean space within which a geometric shape can identify the combination of risk factor values that constitute a conducive investment environment for renewable energy projects, i.e. the investible space. The features of this geometric shape, such as its frontiers, surface and volume, provide information about the investible environment in terms of the relative acceptability of different risks and their patterns of co-occurrence. Machine learning algorithms, one-sided support vector machines and Gaussian kernel density estimation are used to delineate this geometric space by classifying sample points around the known discrete points of investments.

Results

Different levels of individual risks create non-linear outcomes for investment suitability. Examining the distribution of different macro risks within the investible space provides insight into their relative acceptability to investors. This analysis goes beyond a simple understanding of the risk envelope i.e. a range of acceptable values, by indicating the relative probability of different levels of risk to be considered suitable for investments. For instance, moderately high values of foreign exchange, interest rate and growth risks are acceptable but they need to be confined within a fairly narrow range as higher values lead to a rapid decline in investment suitability. Sovereign, political and institutional risks, on the other hand, need to be at relatively low levels overall, although acceptable values are spread across a wider range. Growth and institutional risks, meanwhile, have low upper limits indicating limited investor tolerance for low-growth economies and weak governance contexts.

Investment suitability ultimately depends on how investors respond to collective risk configurations. Different risk factors combine to form a risk landscape that determines the investment suitability of macro environments. Risks balance, accentuate, correlate and combine in distinct ways to produce non-linearity in investment outcomes. For instance, foreign exchange, interest rate and sovereign risks combine to create a high-risk environment for investments and thus need to be managed collectively. High growth risk (i.e. low growth environment) needs to be balanced by low institutional, political, foreign exchange and sovereign risks to be suitable for investments. High levels of sovereign credit risk are mitigated by low counterparty credit risk within the energy sector and a supportive renewable energy policy setting can further improve investment suitability by offsetting the impact of high institutional risk. Additionally, different socio-economic contexts across countries exhibit distinctive risk profiles and interactions.

A systemic assessment can indicate the importance of individual risk factors for investment suitability. Such a systemic risk measure captures the contribution of individual macro risks to the overall size of the investible space i.e. it can indicate to what extent the presence of a particular risk constrains the acceptable levels of other risks within a conducive investment environment. This measure considers both the range of acceptable values for a particular risk and the nature of its complex interactions with other risks. It thus goes beyond the traditional conception of risk analysis that takes a linear additive approach to risks and captures the interactions of macro risks as well as the non-linearity of investor response to risk combinations. Institutional risk, interest rate risk and foreign exchange risk emerge as the most impactful in creating a ‘headroom’ for other risks and thus mitigating these risks can significantly enhance overall investment suitability.

Conclusions

The complexity of risk interactions in investment environments provides opportunities to mitigate and balance risks more effectively. Foreign exchange, interest rate and sovereign credit risks are systemically important financial risks that combine to create a non-linear impact on investment suitability. It is technically possible to hedge these risks, for example through financial derivatives, insurance products, dollar denomination, sovereign guarantees, bilateral swaps or international debt guarantees. However, many of these options prove economically unviable, have capacity constraints or simply do not exist at the moment for long-term risk mitigation. This presents an opportunity to establish international mechanisms and create financial instruments that mitigate these risks more sustainably and efficiently. Strong economic growth and low levels of political and institutional risks can effectively counterbalance high levels of other risks but are challenging to achieve in the short run or through simple policy fixes. However, domestic energy policies can curtail counterparty credit risks and establish a favourable policy environment for renewable energy projects, which can combine to offset sovereign credit risks and counteract the effects of a weak institutional environment and higher political risks. In the case of middle and low income countries, creating conducive investment environments may thus require a combination of international mechanisms that can efficiently mitigate foreign exchange, interest rate and sovereign debt risks, coupled with domestic policies to curtail credit risks and provide strong institutional support to the renewable energy sector.

Understanding macro risk interactions provides opportunities to design de-risking strategies that are effective in different economic and governance environments across countries. The design of such de-risking ‘packages' however must consider the interactions between different risks. For instance, stable growing economies reduce the need for broad mitigation efforts and can instead focus on reducing key risks like foreign exchange risks. Conversely, countries struggling with sluggish economic growth may require more comprehensive solutions or substantial public finance support than a focus on individual risk mitigation measures. Solutions can then be designed to target different acceptable combinations of risks based on the criteria of viability, affordability, efficiency and effectiveness. Such strategies can be used to enhance investment environments in individual countries by strategically focusing on the specific risk interactions and create conditions for the rapid growth of renewable energy technologies across countries.