



Environmental policies and risk finance in the green sector: Cross-country evidence



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HIGHLIGHTS

- Risk-finance in the green sector is likely to face more challenges than in other hi-tech sectors.
- Supply and deployment policies are associated with more investments relative to fiscal policies.
- FITs have a positive effect, but in the solar sector very generous FITs discourage investments.

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ABSTRACT

This paper provides a detailed description of venture capital investment in the green sector across 29 countries over the period 2005–2010, and identifies the role that policies might play in explaining observed cross-country differences. The analysis is based on a deal-level database of businesses seeking financing, combined with indicators of renewable policies and government R&D expenditures. The econometric analysis relates the number of deals and their volumes in a country to deployment and supply policies using count data and limited dependent variable (Tobit) models. The results suggest that both supply side policies and environmental deployment policies, designed with a long-term perspective of creating a market for environmental technologies, are associated with higher levels of venture capital relative to more short-term fiscal policies. When focusing on policies related to renewable energy generation, the results confirm the positive association of generous feed-in tariffs (FITs) with venture capital investment. However, in the solar sector excessively generous FITs tend to discourage investment, perhaps reflecting a lack of credibility over the longer term. Thus, both sets of results point to long-term policy stability, sustainability and credibility as important policy features to ensure Venture capital backing of innovative and risky ventures in a country's green sector.

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1. Introduction

Shifting economies from environment- and resource-intensive trajectories to 'green growth' will require structural transformation and technological innovation. For this reason, start-up companies play a crucial role in moving towards green growth, as they often exploit opportunities ignored by incumbent firms.

Venture Capital (VC)¹ is essential to enable new businesses to

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¹ In this paper, venture capital includes all forms of financing other than traditional corporate finance tools (e.g., banking loans, corporate bonds, public equity). Therefore it also includes angel finance, public investments and grants, and private equity.

grow in emerging sectors such as Information and Communication Technologies (ICT), software and biotech, but also in environmental technology (hereafter referred to as the *green sector*).² However, VC backing of green sector companies faces more challenges than other sectors, due to gaps in managerial skills, the long term investment period, risky exit opportunities, and regulatory

² In this paper, the classification of economic activities into the "green sector" is based on the original selection in the source database maintained by the Cleantech Group called "Cleantech", and refers to a broad part of the economy. According to the data provider, "Cleantech is new technology and related business models that offer competitive returns for investors and customers", while "greatly reducing or eliminating negative ecological impact, at the same time as improving the productive and responsible use of natural resources". We also on occasion employ the term "environmental technologies" to identify the same subset of activities.

uncertainty (Wustenhagen and Teppo, 2006). The latter sources of risk are particularly relevant, as environmental policy has proved, over the last decade, to be remarkably volatile in many countries. This can be a crucial issue for green sector ventures, as their profitability prospects often depend on public regulation. This is probably the most distinctive characteristic of green investments, as compared to VC deals in other sectors (e.g., ICT or medical devices).

In fact the most common valuation method used by venture capitalists when deciding whether to invest in a venture is the Discounted Cash Flow analysis (DCF) which is a net present value method (Messica, 2008) based on cash flow projections. Those are highly speculative for non-public and non-traded companies in high risk high technology ventures, which makes the use of DCF extremely uncertain. This is going to be even more so in the case of green deals that have a long time to maturity, high capital intensity and often relate to new goods for which a market might not yet exist (Elton et al., 2009). In this case, valuation becomes more of an art and is based on a variety of metrics (e.g. Baum and Silverman, for the biotech case) but also on gut feelings (Messica, 2008), thus the importance of the perception of political risk when VC invest in the green sector.

However, the level of VC in the green sector differs significantly across countries, stages of financing, and sectors. The empirical evidence on what drives these differences is somewhat limited. Most of the discussion on the gaps in VC investment in the green sector is based on case studies, anecdotal and/or survey evidence, but is not supported by econometric analysis. This paper aims to fill this gap by providing new evidence on the national-level determinants of VC investment in the green sector. It investigates the relationship between national level “environmental” policies and VC investment in the green sector using cross-country, cross-industry micro-aggregated data.

In particular, the empirical analysis estimates the relation between national level policies, the number of green sector ventures obtaining VC backing, and the amount of funding received. The included policies are both supply-side, such as public Research and Development (R&D), as well as deployment policies, such as regulations and standards. The analysis encompasses different fields and stages of investment, and covers the period 2005–2010. By doing so, the paper is complementary to the recent analysis of Cumming et al. (2013), who explore the role played by oil price, media coverage, and other legal, cultural, and governance variables in explaining the diffusion of Cleantech VC investments around the world.

National environmental policies might strongly affect the expected commercial viability and future profitability of nascent ventures in the green energy sector. Although part of the goods and services produced by the green sector are in principle tradable, the domestic policy environment still plays a prominent role, for several reasons. First, barriers to technology diffusion hinder knowledge transfer across borders: for instance, empirical evidence on the wind power sector shows that the marginal effect of domestic policies on innovation is 25 times stronger than that of foreign policies (Dechezleprêtre and Glachant, 2013). Similarly, it is well known that the energy market is heavily regulated in many countries, and there are non-trivial costs in the storage and transfer of electricity; this also limits the international tradability of (electric) energy. As a consequence, domestic policies are of prime importance in the energy generation sector, and are likely to be even more so in some of the other domains considered in the analysis, e.g. wastewater treatment, soil remediation, etc.

The analysis exploits comprehensive deal-level information on VC activity and on businesses seeking risk capital in environmental technologies over the period 2005–2010 in 29 OECD and emerging

economies,³ combined with indicators of government renewable policies and government R&D expenditures.

2. Methods

2.1. Start-UPS and venture capital investment in the green sector

Start-ups have been the engine behind growth and breakthrough innovations in sectors such as software, nanotechnology and biotechnology. More recently the importance of start-ups as a source of radical and architectural innovations⁴ has also become evident in the green sector.⁵ While large incumbents are better at, and more likely to, introduce incremental and modular green innovations, start-ups play a crucial role in ensuring the shift to a greener growth paradigm and are complementary to “greening Goliaths” (i.e., incumbent large companies; Hockerts and Wustenhagen, 2010).

In recent years, VC/PE (private equity) also played an increasingly important role especially in the United States, the United Kingdom and more recently in China, although – as shown in Fig. 1 – VC/PE represent only a small percentage of overall funding sources for the green sector.⁶ These funding sources are relatively more important in countries where VC is already developed, such as the United States, but they are also growing in importance in emerging economies, such as Brazil and China. The largest sources of funding, however, remain asset finance⁷ and public markets.

This is in line with the fact that VC backing is focused on a particular type of project, characterised by high technology risk and low capital intensity. In fact, as exemplified in the typology outlined in Fig. 2, bank loans might be the more appropriate source of funding for projects with low capital intensity and low risk profiles, while project finance is better suited for projects with high capital intensity and low risk profiles (Kerr and Nanda, 2009; Ghosh and Nanda, 2015).

On the other hand, venture capitalists are crucial investors for entrepreneurial high growth start-ups operating in young, dynamic and uncertain industries where the selection process of an investment is based on an uncertain valuation, with a lack of a clear performance history and a very high technology risk. In software and biotech sectors, they have been key providers of finance, but have generally financed projects with low capital intensity that can show rapid commercial viability (3–5 years), and can be sold within the life of a fund (about 10 years). This is motivated by the need to diversify their high-risk portfolio and increase the chances of positive “tail” outcomes in their investments' portfolio. Venture capitalists are therefore more likely to finance projects in the bottom right panel of the diagram in Fig. 2.

VC is becoming increasingly important for the green industry. Figures for the United States market show that, since 2004, VC in

³ These are Australia, Austria, Belgium, Canada, China, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Russia, South Africa, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

⁴ For a general discussion of entrepreneurship and radical innovation see Squicciarini et al. (2013).

⁵ The definition of the Green sector includes clean energy generation, infrastructure and storage; energy efficiency; land management; natural pesticides; emissions control; recycling and waste, transportation and water conservation and treatment. However, some of the figures presented refer only to clean energy due to a lack of comprehensive data.

⁶ Note that the figure reports data only for the clean energy sector rather than the whole green sector.

⁷ Asset finance is defined as “all money invested in renewable energy generation projects, whether from internal company balance sheets, from debt finance, or from equity finance. This excludes re-financings” (Bloomberg New Energy Finance, 2010).

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