Intellectual property and environmental innovation: an explanation using the institutional and resource-based theories

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Abstract: Various studies have examined the relationship between intellectual property, Environmental Management Systems (EMSs) and innovation. Some of these studies have focused on identifying internal factors that provide competitive advantages to firms, which adopt EMS, while others examine external factors that promote environmental innovation to firms. This paper proposes a framework that encompasses internal and external factors to identify how EMS promotes innovation to firms, at the same time bearing the need to protect intellectual property. This framework is based on the institutional and resource-based theories and explains how firms may gain competitive advantage and enhance innovation from EMS implementation.

Keywords: EMSs; environmental management systems; corporate sustainability; competitive advantage; innovation.

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1 Introduction

The nature of technology and its developments in various sectors such as the environmental field mean that a new understanding of the status of protection of intellectual property and of copyrights is needed. This discussion includes a debate on how intellectual rights can be expressed and protected and how enforcement can take place. From a broad perspective, the means of fostering and enforcing the protection of intellectual property commonly entail:

- the use of patents and registrations
- the use of trademarks.

In the European Union (EU), the fight against piracy and counterfeiting is regulated by specific pieces of legislation (e.g., the Intellectual Property Rights Act, the Patents Act, etc.), as well by a specific EU directive on the enforcement of such rights titled “Directive 2004/48/EC of the European Parliament and of the Council of 29th April 2004 on the enforcement of intellectual property rights” (also known as ‘(IPRs) Enforcement Directive’ or ‘IPRED’). The directive covers the remedies that are available in the civil courts, but not criminal offences. Similarly, in Germany, the central body dealing with industrial property rights is the German Patent and Trademark Office, or DPMA, which works under the auspices of the German “Intellectual Property Rights Act”. In practice, the protection of intellectual property covers a broad range of different ministries.

In addition, business is also asked to take its own steps to combat piracy. A cross-sector joint initiative of leading industrial and trade associations (the Action Group against Product and Trademark Counterfeiting, or ‘APM’) was set up to provide help for businesses as well as information for consumers. The protection of intellectual property is especially relevant in the field of environment as a whole and environmental technology in particular, since it often includes various elements of the innovation cycle. The search for technical solutions to environmental problems sometimes leads to new developments not only in terms of technology and equipment, but also in manufacturing, in waste management, the utilities sector and the environmental service industry.

The debate of intellectual property has lately transferred to environmental innovation, which is at the top of the policy agenda of a number of countries in Europe and the USA. EU environmental policy focuses on influencing the innovation process and technological changes of firms in the environmental area (Hilliard and Jacobson, 2003). Similarly, the
Environmental Protection Agency presents the periodical progress of innovating practices of US firms (EPA, 2004). Environmental innovation focuses on the fact that the environmentally friendly technologies and environmental innovation issues can improve resource productivity and simultaneously the enhancement of environmental protection and economic performance of firms (the win-win theory) (Porter and van der Linde, 1995).

To examine and identify environmental innovations, authors have examined, either at the theoretical or at the empirical level, the relationship between the environmental policy and environmental innovation of firms (Porter and van der Linde, 1995; Wagner, 2009). At a theoretical level, Porter and van der Linde (1995) claim that firms may financially benefit from adopting environmental management practices to improve environmental processes beyond the environmental regulatory requirements. Ambec and Barla (2002) identify that with low agency costs, an environmental regulation may enhance environmental innovation, while simultaneously increasing the economic benefits of firms. Mohr (2002) tests a hypothesis based on Porter’s theory by employing a general equilibrium framework and identifying that this hypothesis may be achieved when there is endogenous technical change. Similarly, Fischer et al. (2003) examine the influence of market-based instruments on the decisions of firms regarding environmental strategies adoption and recognise some important factors such as the costs of innovation, the level of imitation of innovations and the number of polluting firms.

At the empirical level, Wagner (2009) examines how social and environmental strategies influence the competitive advantages and innovation activities of firms. Brunnermeier and Cohen (2003) found that firms with environmental innovation associated with increased pollution abatement expenditures do not have any additional incentive to innovate and, finally, internationally competitive firms have more incentives to carry out environmental innovation. Similarly, Jaffe and Palmer (1997) found that reduced environmental compliance expenditures have a significantly positive influence on R&D expenditures. They also found that there is a little evidence for the relationship between firms’ inventive output and compliance costs.

Rennings et al. (2006) identify a positive relationship between EMSs and environmental process innovations. They also identify that the higher the involvement of different departments in the implementation of EMAS (e.g., the R&D department), the higher the environmental innovation process results. Similarly, Ziegler and Rennings (2004) claim that former certification to some type of EMS (e.g., ISO 14001) has been positively associated with environmental product and process innovations. The majority of these theoretical and empirical studies aim to identify the determinants that influence environmental product and process innovations of firms (Brunnermeier and Cohen, 2003; Rehfeld et al., 2007). Some studies focus mainly on external determinants such as environmental policy instruments (e.g., command and control instruments and market-based instruments), while some studies examine internal determinants and incentives of firms to focus on environmental innovation such as cost-savings. However, there has been little research on examining both internal and external determinants that influence the investments of firms in environmental innovations as well as establishing an intellectual property regime for environmental innovation. Thus, this paper aims to develop an integrated framework to identify the most important internal and external determinants that motivate firms to invest in environmental innovation under an efficient intellectual property regime. This framework is based on a combination of the institutional theory and resource-based view of firms to
develop an integrated explanatory tool for assisting the business community, academics and governments to recognise the basic determinants and the relationships that motivate firms to invest in environmental innovation. Finally, a classification of incentives based on the critical factors arising from the proposed framework has been developed.

The remainder of the paper is separated in three sections. Section 2 includes the literature review, including information on environmental innovation, EMS and the relationship between EMS and environmental innovation. Section 3 presents the proposed integrated framework for analysing the basic determinants, their relationships and their influences on the decisions of firms to invest in environmental innovation. Section 4 presents a discussion for the contribution of the framework and the conclusions.

2 Literature review

2.1 Environmental innovation

OECD (1997) classifies innovation in three categories: process innovations, product innovations and organisational innovations. In particular, process innovations can occur when a good is produced with less input, product innovation can occur when new product or improvements of current product are achieved and organisational innovations can occur through new forms of management. Similarly, the European Commission Green Paper describes innovative firms as those that have, as a minimum, the following categories of skills:

- strategic skills that include a long-term view – the ability to identify and even anticipate market trends
- organisational skills that include the ability to collect, process and assimilate technological and economic information.

However, lately some authors examine how these general characteristics of innovation theories are associated with environmental management, environmental economics and sustainable development. Following the OECD general framework of innovation, Rennings et al. (2006) present the types of environmental innovations as follows:

- environmental process innovations that includes the production of a given amount of a good with less input and may be subdivided into innovations in end-of-pipe technologies and innovation in integrated technologies (e.g., cleaner technologies)
- environmental product innovations encompasses new environmentally friendly goods or environmental improvements of current goods
- environmental organisational innovations include new forms of management such as EMS and quality management.

The concept of environmental innovation usually includes several types of innovations such as technical, economic, legal, institutional, organisational and behavioural that contribute both to environmental prevention and to economic benefits. Rennings (2000, p.322) defines environmental innovations as “measures of relevant actors” (firms, private households), which:
develop new ideas, behaviours, products and processes
• contribute to a reduction of environmental burdens or to ecologically specified sustainability targets.

Hemmelskamp (1997) defines environmental innovation as an innovation, which prevent or reduce anthropogenic burdens on the environment, cleaning environmental damage or monitor environmental problems. He also makes a distinction between end-of-pipe and integrated environmental technologies. Kemp (1998) claims that environmental innovations may be associated with organisational changes and he provides some examples of such innovations as follows: corporate environmental statements, development of environmental programmers and introduction of methods promoting environmental learning.

2.2 Environmental management systems

Over the last decades, EMSs are usually used as a process for incorporating environmental concerns into corporate strategies (Morrow and Rondinelli, 2002). EMSs assist in developing, implementing, managing, coordinating and monitoring the corporate environmental performance of firms. There are two EMS categories, ISO 14001 and EMAS, developed to evaluate and improve the environmental behaviour of organisations. These EMSs have some standard steps as follows:

• development of an environmental policy of the organisation, including plans with policies and objectives of the organisation and legislative requirements relating to the environment
• specific programmes to implement these policies and objectives with a disciplined process of evaluating and achieving target performance levels while seeking improvements where appropriate
• development of a plan for employees to assist in the implementation of EMSs
• development of a plan for eliminating the environmental impacts of an organisation’s operations
• establishment of a process to review and audit the performance of the organisation from EMS implementation
• recording and disclosure of appropriate communications regarding EMSs within internal and external parties.

The implementation of EMSs has brought benefits to firms adopting them. Melnyk et al. (2003) and Zutshi and Sohal (2004) state that firms adopting EMSs gain external recognition and market benefits. Rondinelli and Vastag (2000) believe that EMS adoption assists firms to develop communication channels, skills and knowledge. Other benefits have arisen from improved relationships between staff and management as well as cost-savings and better lending procedures. However, there are problems associated with EMSs implementation such as a high-capital expenditure amount of financial resources, strict legislative requirements, and high employee skills.
2.3 Environmental management systems and environmental innovation

Several studies have examined the determinants that stimulate environmental innovation (Rennings et al., 2006; Konnola and Unruh, 2007). At the theoretical level, some authors try to identify the optimal policy instruments to stimulate environmental innovation. In this sense, environmental taxes and tradable permits are considered very important and appropriate to stimulate firms to invest in environmental management practices and exploit environmental innovations (Cleff and Rennings, 1999). However, Downing and White (1986) and Millimand and Prince (1989) point out that market-based instruments (e.g., environmental taxes and tradable permits) could stimulate environmental innovations when there are conditions of perfect competition. Wagner (2009) believes that although there may be market-based incentives to improve environmental performance, nevertheless the environmental innovations have the characteristics of a ‘public good’ and that may require governmental intervention for their stimulation.

In this sense, a number of authors maintain that stricter environmental regulations by government can affect the decisions of firms and lead them to adopt innovative strategies (Ashford et al., 1985; Porter and van der Linde, 1995). However, Frindek et al. (2008) argue that environmental regulations have generally stimulated firms to invest in end-of-pipe technologies and not on preventing pollution practices.

At the empirical level, authors have identified that environmental expenditures are positively associated with environmental innovation (Brunnermeier and Cohen, 2003; Jaffe and Palmer, 1997). Jaffe and Palmer (1997) identify that although firms with higher abatement costs have an increase of R&D expenditures, these firms have no significant relationship between environmental regulations and environmental innovation output. Similarly, Carraro and Siniscalco (1992) identify that emission-reducing innovations are costly and require both fixed investments and R&D, which have an impact on the firm’s operating costs.

Similarly, some studies have recently examined how EMSs influence less tangible factors such as the innovation practice and the reputation of firms (Rennings et al., 2006; Wagner, 2006). Wagner (2006) examines the relationship between the high level of EMS implementation by a firm and the propensity of such firms to carry out environmental processes or product innovation. He finds that there is a positive relationship between EMS and environmental innovations. Rennings et al. (2006) also analyse the effects of EMS on firm-level innovation activities and competitiveness. Mainly focusing on firms that adopt EMAS, they found that there is a stronger integration of innovation and environmental management can increase the competitiveness of firms. Similarly, Ziegler and Rennings (2004) examined a sample of 588 German firms regarding the influence of some specific EMSs (e.g., life-cycle analysis and recycling systems) on environmental innovation finding no significant effect of EMS on environmental innovation.

Konnola and Unruh (2007) focus on the lock-in theory to explain how EMS may stimulate environmental innovation. In particular, they argue that while EMS may initially produce improvements in environmental performance, EMS may also constrain organisational focus to the exploitation of present production systems, rather than exploring for superior innovations that are discontinuous. Rehfeld et al. (2007) examine the relationship of EMSs and environmental innovation based on five measures, i.e., environmental criteria in the product design, formal EMSs (e.g., ISO 14001 and EMAS), life-cycle systems, green supply chain strategies and eco-labelling. They identify a positive correlation of formal EMSs with product environmental innovation.
Wagner (2008) examines how EMSs and other management practices of firms have a positive influence on the propensity of firms to carry out environmental innovations. He finds that EMSs are associated only with process innovations and there is no correlation between EMSs with product innovations.

3 An integrative framework for environmental innovation

The majority of the studies analysed in the previous section shows that there are various determinants that affect firms in relation to environmental innovation. Some of them are internal factors such as cost-savings and productivity improvements, while some are external such as regulatory requirements and market-based incentives. Horbach (2008) classifies the determinants of environmental innovation in the following categories:

- **supply side**: technological capabilities, appropriation problems and market characteristics
- **demand side**: market demand and social awareness of the need for clean production
- **institutional and political influences**: environmental policy and institutional structures.

However, limited work has been carried out on presenting an integrative framework encompassing the most important determinants of environmental innovation.

Figure 1 shows an integrative framework for environmental innovation. The framework shows that the level of environmental innovation is associated with the level of institutional and resource-based factors of firms as well as factors associated with intellectual property.

**Figure 1** An integrative framework for environmental innovation

![Diagram of an integrative framework for environmental innovation](image)
3.1 The institutional theory and environmental innovations

Institutional theory examines factors beyond the boundary of an organisation (DiMaggio and Powell, 1983). The actions of firms are not seen as internal arrangements, but as a choice among a various set of legitimate options determined by a range of actors (Scott, 1991). These legitimate options include rules, norms and beliefs that portray the borders in which a firm can be operated. Institutions mainly pressure firms to seek legitimacy and social acceptance.

There are several ways in which institutional factors influence the decision of a firm to implement specific strategies and management practices. Scott (1995) distinguishes these in three general categories as follows:

- the regulative that includes firms’ actions associated with the threat of legal sanctions
- the normative that encompasses standards and guides with organisation procedures provided by industrial associations
- the cognitive that focuses on symbols and cultural rules.

On the basis of the institutional theory, Delmas (2002) examine how the national environment of a country can affect the environmental behaviour of firms, especially through distinct institutional, legal, political and cultural factors. Furthermore, a number of authors have examined the effect of environmental regulations on the behaviour of firms in implementing EMS and in carrying out environmental innovation (Buysse and Verbeke, 2003; Cabugueira, 2004). They focus on the relationship between environmental regulation and competitiveness. Similarly, Cannon-de-Francia et al. (2007) identify that new environmental regulations do not affect firms that have already developed proactive environmental practices. Those proactive practices lead firms to carry out either organisational or production innovations.

According to the second and third categories of the institutional theory (normative), Delmas (2002) considers the impact of the normative and cognitive institutional environment as firms and stakeholders will take a message of approval or ignorance of the standard. In this sense, he presents two other sets of actions that a government can use to transform the normative and cognitive environment linked to ISO 14001. First, government can provide information to firms for the technical assistance of ISO 14001 and EMAS. Second, government can promote EMS by rewarding the first adopters. Hoffman (2001) provides nine institutional actors that are most likely to directly influence the environmental practices of firms, for example politicians, regulators, customers, competitors and local communities. Rennings (2000) notes that eco-innovations may be the result of different institutional factors such as open access regimes and inappropriate institutional arrangements.

3.2 The resource-based view of firms and environmental innovations

The resource-based theory maintains that valuable firm resources and capabilities could be key sources for a firm to gain sustainable competitive advantage. This theory identifies the relationship between firm resources, capabilities and competitive advantage. According to the resource-based theory, Hart (1995) proposes the natural-resource-based view of the firm relating the theory of competitive advantage with natural environment.
He proposes a conceptual model including three basic strategies: pollution prevention, product stewardship and sustainable development. He notes that these strategies may be key resources and sources of competitive advantage of firms in the future.

Similarly, Russo and Fouts (1997) argue, based on the resource-based view of the firm, that there is a positive relationship between environmental performance and economic performance. According to Hart (1995), the resource associated with environmental management practices of firms may be either tacit (causally ambiguous), socially complex, or rare. The concept of tacit resources encompasses skill-based and people intensive resources. For example, tacit resources may be those that are developed through the employees’ learning skills associated with EMS implementation. The majority of firms that implement environmental management practices have mainly invested in training their employees and therefore can apply their skills towards more advanced forms of environmental management (Kunes, 2001). The tacit resources associated with EMS can mainly help first adopters to carry out environmental innovation and sustainable advantage. Hart (1995) maintains that the adoption of environmental management practices may provide the opportunity for a sustained competitive advantage owing to the need for large numbers of people to implement efficiently.

Socially complex resources are enhanced when a large number of people are engaged in a coordinated action of such complexity that few individuals, if any, have sufficient breadth of knowledge to grasp the overall phenomenon (Barney, 1991). In particular, socially complex means that many social phenomena are so complex that it is impossible to systematically manage or influence them. The competitive advantage associated with social complexity is difficult to be imitated. Such resources may arise from environmental business networks and association.

### 3.3 Intellectual property regime and environmental innovation

The idea of business eco-systems and the knowledge-based economy consider that external knowledge sources are a very important factor in stimulating innovation. To this end, a range of authors argue the importance of external knowledge certified under publicly funded R&D centres to stimulate firms to carry out innovation (Debackere and Veugelers, 2005; Graversen et al., 2005). To stimulate such intellectual innovation, both innovators and entrepreneurs who are interested in carrying out such innovation need to be assured that a mechanism exists to reap financial returns from their investments. Bhat notes that

> “the development of new sources of production material, energy substitutes, computers, efficient industrial equipment, chemicals based on renewable resources, and biotechnology are some examples of technologies with a high degree of intellectual content.” (Bhat, 1996, p.206)

He also proposes that the establishment of IPRs for environmentally friendly products (e.g., genetic and biochemical resources) is necessary. The IPRs are associated with the intangible assets of firms such as those arising from EMS including legal intangibles (e.g., environmental copyrights, patents and trademarks) and competitive intangibles (e.g., environmental know-how, knowledge).

As discussed previously, firms that adopt EMS may have environmental innovations. When taking into account the intellectual property idea, some of these studies examine how environmental innovations are associated with patents and copyrights (Wagner,
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2006, 2009) and identify a weak positive relationship. However, the problem is how those environmental innovations may be assured under IPRs. Mandel (2005) points out that the absence of efficient patent rewards related to environmental innovation is a result of market failure and proposes a patent rewards system for environmental innovation. He also states that the absence of a patent law on environmental innovation allows competitors the capability to free ride on other firms’ inventive efforts and expenses, reducing the incentive to innovate below its socially optimal level. For this purpose, a well-organised intellectual property regime for environmental innovation is necessary (Figure 1: box 4)

3.4 A classification of environmental innovation factors

Figure 2 shows how the factors analysed in the previous sections can assist in classifying the relationship between environmental innovations and critical factors such as those that are associated with the institutional theory, the resource-based view and the intellectual property regime. The horizontal axis depicts the weak effect of external (institutional) and internal (resource-based) factors on environmental innovations. The vertical axis shows the level of environmental innovations.

**Figure 2** Classification of environmental innovation factors

First, firms may have a low level of EMSs implementation, environmental performance and environmental innovations when a range of institutional and resource-based factors exist. Such factors may be low environmental regulations, low resources arising from environmental management implementation and an absence of environmental intellectual property (Quadrant 1). Second, the low level of environmental innovation may be associated with low environmental awareness of consumers and firms. In this case,
although several institutional factors, resource-based factors and an intellectual property regime seemed to exist, firms nevertheless viewed environmental policy as barrier (Quadrant 4).

Third, although there are low environmental regulations and internal benefits, some firms first move to adopt a high level of EMS and carry out environmental innovation (Quadrant 2). Finally, a high level of EMS implementation and environmental innovation may be associated with strong environmental regulation, high mimetic results, costs-savings and strong environmental intellectual property regime (Quadrant 3).

4 Discussion and conclusions

This paper contributes in two ways to the current literature. First, it proposes a new theoretical framework in explaining the possible factors that affect firms’ decision to adopt EMS and carry out environmental innovations. In particular, this framework is built on three theories: the institutional theory, the resource-based view of firms and intellectual property. First, the institutional theory provides a context to examine the external institutional factors that affect EMS and environmental innovations such as regulatory, normative and cognitive factors (Scott, 1995). This idea is compatible with the work of Delmas (2002) who provides a framework to explain the mechanism that affects firms to adopt EMS. These factors can also explain why firms may carry out environmental innovation as a result of regulatory, normative and cognitive factors.

Although these factors are important and necessary for motivating firms to carry out environmental innovations, they are not efficient. A range of internal factors affect the decision of firms to carry out environmental innovations. For example, cost-savings, high productivity and intangible recourses (e.g., goodwill) may be significant incentives for firms to carry out environmental innovations. These factors may be seen in the resource-based view of firms. According to this theory, firms may carry out environmental innovations in the case that they may develop tacit and socially complex resources. This theoretical context is associated with the work of Hart (1995) and Russo and Fouts (1997) who consider such factors very important for firms to adopt EMS and environmental innovations.

Finally, these internal and external incentives need an institutional assurance system to be more attractive for firms. For example, a governmental intellectual property regime is necessary to assure firms that their investments in environmental innovations, including environmental copyrights and patents are safe and worthwhile.

The second contribution of the paper is the presentation of a classification of such factors in four categories to assist current understanding regarding environmental innovations. The categories are based on the weak or strong character of those factors and how they are associated with the decision of firms to carry out environmental innovations.

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