



# Green product development and environmental performance: Investigating the role of government regulations<sup>☆</sup>



Maryam Hafezi<sup>a,b</sup>, Hossein Zolfagharinia<sup>c,\*</sup>

<sup>a</sup> Pilon School of Business, Sheridan College, 1430 Trafalgar Rd, Oakville, ON, Canada

<sup>b</sup> Department of Finance and Operations, Laurentian University, F432, Sudbury, ON, Canada

<sup>c</sup> Global Management Studies Department, Ted Rogers School of Management, Ryerson University, 575 Bay Street, TRS 1-111 (7th Floor), Toronto, ON, Canada

## ARTICLE INFO

### Keywords:

Development cost  
Government regulations  
Product development  
Green product  
Sustainability

## ABSTRACT

We study a problem where a firm must decide on its product types, market price(s), and quality dimensions. Given that consumers' willingness to pay for an environmental quality dimension (e.g., energy efficiency) varies, the firm makes the above-mentioned decisions to improve its performance. Since the outcomes of such decisions directly influence the firm's environmental performance, our primary goal is to understand how governmental regulations can be set as a driver of green product development and ultimately benefit the environment. Our investigation captures quality-based development costs while incorporating the environmental quality dimension. The findings reveal that the government should impose regulations with caution as firms may opt for a strategy that provides a larger profit at the expense of lower total environmental performance. Moreover, under some conditions, strict regulations can cause firms to be reluctant to innovate by producing a single standard product rather than distinct products for different market segments.

## 1. Introduction

To satisfy consumer demands, the environment has been over-exploited, which has led to the depletion of natural resources, global warming, and pollution. Although there are various ways to address these concerns, one significant method of improving the environment is through the production of green products.

While green is usually associated with nature, it also offers business opportunities, improves corporate image and reputation, and creates a competitive advantage (Albino et al., 2009; Dangelico and Pujari, 2010; Wong, 2012; Zolfagharinia et al., 2014). The decision for companies to produce more green products stems from their desire to raise revenue through improving customer satisfaction. A survey conducted by Nielsen in 2015 on 30,000 online consumers in 60 countries revealed that 51% of seniors were willing to pay more for green products. Furthermore, in 2015, 72% of Millennials said that they would pay more for eco-friendly products compared to 55% in 2014. Results from other surveys indicate that the reported statistic are country dependent. For example, the tendency to purchase green products in Canada is higher among seniors than Millennials; 52% compared to 39% (SCA, 2014). In addition to these purchasing behaviors, factors such as age, gender and

income also affect consumer purchasing decisions (Cone Communications, 2015).

### 1.1. Development cost: a big challenge

Despite growing consumer demands, companies face numerous challenges in entering the green industry. One of the most significant barriers that prevents firms from developing green products is the high research and development cost found specifically in the pharmaceutical, automobile, electronic, and software industries. For example, Volkswagen spent \$13.5 billion in research and development, which represented 5.2% of the company's revenue. A significant portion of their investment was dedicated to producing hybrid and electric vehicles as well as reducing carbon dioxide emissions. Intel invested 20.1% of its revenue into research and development in 2013 (\$10.6 billion). As a result of the company's R&D program, "the 14 nm Intel Core M processor, which is half the size of the previous generation of chips with 20% longer battery life and 60% less energy expenditure" was created (Casey and Hackett, 2014). As evidenced by these examples, green products are research intensive and require a great deal of financial resources.

<sup>☆</sup> Both authors contributed equally to this paper with their names appearing in alphabetical order.

\* Corresponding author.

E-mail addresses: [Mhafezi@laurentian.ca](mailto:Mhafezi@laurentian.ca), [Mhafezi@laurentian.ca](mailto:Mhafezi@laurentian.ca) (M. Hafezi), [h.zolfagharinia@ryerson.ca](mailto:h.zolfagharinia@ryerson.ca) (H. Zolfagharinia).

URL: <http://www.ryerson.ca/tedrogersschool/h-zolfagharinia> (H. Zolfagharinia).

Another challenge that companies face is the risk of investing tremendous amounts of money into research and development without the guarantee of their product's success. For instance, one of Nokia's research projects was on solar powered cellular phones, which unfortunately did not pass the beta phase. The mobile maker tested the prototype in the Kenyan, Baltic Sea, Arctic Circle, and Sweden market to ensure a variety of sunlight conditions. After three months of testing however, Nokia revealed that "the prototype phones were able, at best, to harvest enough energy to keep the phone on standby mode but with a very restricted amount of talk time". This was due to the limited space available on the mobile phones for solar panels (Lomas, 2012). Although the phones were not mass produced, the time and effort that Nokia put into researching the technology were not compensated. Since companies have to spend a significant amount of money on a product without any guarantees of return, many hesitate to enter the green industry.

### 1.2. The role of government

During the last two decades, a number of government regulations were enacted to protect the environment and curb emissions. For example, the Canadian federal government banned incandescent light bulbs from being manufactured or imported into Canada; however, a few specialty incandescent light bulbs were exempted. The policy was intended to reduce energy consumption. As a result, the policy led to the increased usage of compact fluorescent light bulbs (CFLs) and Light Emitting Diodes (LED) light bulbs, which are more energy efficient (Blackwell, 2015). Another example of how the government plays a role in protecting the environment is demonstrated through the ban of plastic foam containers in Zimbabwe due to the item emitting toxic chemicals when heated. Due to these concerns, Zimbabwe's Environment Management Agency ordered restaurants to use recyclable or biodegradable packages (Mhofu, 2017). Other examples include the U.S. Acid Rain Program, the Kyoto Protocol that imposed quantitative limitations on greenhouse gases (GHG) such as carbon dioxide, and the European Community's restriction on the use of certain hazardous substances (RoHs) and wastes in electrical and electronic equipment (WEEE).

While stricter regulations (e.g. emission standards enacted by the European Union (EU) on vehicles<sup>1</sup>) seem to be desirable from an environmental standpoint, the incentive to develop green products for profit-oriented firms should also be considered. The complex trade-off between a firm's profitability and environmental responsibility raises important questions of how strict government regulations should be to achieve a balance between the two. Regulations should not be too loose to encourage a firm that is eager to develop green products, nor too tight to be implemented by a firm reluctant to innovate. An example of a poorly crafted environmental strategy is the EU's renewable energy policy. Countries in the EU were subsidized for the burning of wood as a source of energy; since this is more harmful to the environment than burning coal or gas, the level of carbon dioxide increased as a result (Page, 2017).

According to the evidence mentioned above, the government's role on the environment is undeniable. However, governmental regulations must explicitly address the development cost of new products as it is often one of the major challenges firms face. As we will discuss in the literature review, most studies overlook this important cost factor. To fill existing gaps in the literature on green product development, this

<sup>1</sup> EU Regulation No 443/2009 sets an average CO<sub>2</sub> emissions target for new passenger cars of 130 g per kilometer. The target is gradually being phased in between 2012 and 2015. A target of 95 g per kilometer will apply from 2021. For light commercial vehicle, an emissions target of 175 g/km applies from 2017, to 147 g/km from 2020 a reduction of 16% ([http://ec.europa.eu/clima/policies/transport/vehicles/cars/documentation\\_en.htm](http://ec.europa.eu/clima/policies/transport/vehicles/cars/documentation_en.htm)).

study carefully examines the role of government regulations. To assess the government's role, we develop a mathematical model for green product development by simultaneously considering (a) consumer preferences, (b) a firm's product line design strategies, and (c) environmental standards imposed by governments. Our main goal is to answer the following research questions while incorporating the cost of green product development:

- (1) When are regulations a strategic decision changer for the firm?
- (2) How strict should environmental standards be to motivate a firm's innovation (i.e. producing different products)?

The rest of this article is organized as follows. In Section 2, we review the literature to position our work against relevant studies in order to illustrate novel aspects of our work. In Section 3, the problem is clearly defined alongside the underlying assumptions. Section 4 is devoted to developing a mathematical model for mass-marketing and market segmentation strategies. Furthermore, in this section, we introduce our approach to studying the government regulations. All details on the impact of environmental standards are analyzed and discussed in Section 5. Lastly, conclusions and avenues for future research are presented in Section 6.

## 2. Literature review

Growing demands for natural resources (i.e. water, gas, metal, oil, wood, etc.) amongst limited supplies, vast waste and pollution generated by industries have made governments aware of the dangers that threaten the earth. In response to these issues, governments, organizations and unions have tried to impose regulations and legislations to curb emissions and force firms to be more environmentally conscious. The complex trade-off between firms' profitability and environmental practices has attracted the attention of several authors (e.g., Tang and Zhou, 2012; Gouda et al., 2016).

Some academic and practice-oriented literature believe that stricter pressures through regulations, boundaries and legislation can have positive effects on the environmental performance of firms (e.g., Porter and van der Linde, 1995; Geffen and Rothenberg, 2000; Kleindorfer et al., 2005; Simpson et al., 2007; Zhu and Sarkis, 2007; Chan et al., 2016), while others argue that this may not always be the case as it will depend on various factors (Palmer et al., 1995; Bansal and Gangopadhyay, 2003; Brunnermeier and Cohen, 2003). Furthermore, some authors warn that tight regulatory standards may make firms reluctant to innovate (McCain, 1978; Chen, 2001; Gouda et al., 2016).

Our study will focus on three important aspects: green product development, market segmentation, and government regulations. There are many studies that investigate at least one of these factors. Some examples include McCain (1978), Palmer et al. (1995), Geffen and Rothenberg (2000), King and Lenox (2001), Bansal and Gangopadhyay (2003), Brunnermeier and Cohen (2003), Pujari et al. (2003), Kammerer (2009), Dangelico and Pujari (2010), Kleindorfer et al. (2005), Simpson et al. (2007), Zhao and Sun (2015), Chan et al. (2016), Gouda et al. (2016), Zhou and Huang (2016), and Hong et al. (2017). To keep our review manageable and focused, we discuss only the most relevant studies. These studies can be classified into two broad categories based on whether they conduct their investigations in a competitive environment or not. Regardless of the category, the literature discusses the importance of considering a variety of characteristics such as the quality-based development cost and the role of government regulations in product design decisions.

The most relevant studies in the first category are: Hua et al. (2011), Sun (2012), and Zhou (2018), who all conducted their investigations in a competitive environment. Hua et al. (2011) examined the optimal product-design decision in a distribution channel setting that consists of a manufacturer and a retailer, where interactions between both parties are critical to determining the most effective product design strategy.

Download English Version:

<https://daneshyari.com/en/article/11004800>

Download Persian Version:

<https://daneshyari.com/article/11004800>

[Daneshyari.com](https://daneshyari.com)