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Strategic quality competition and the Porter Hypothesis

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ABSTRACT

This paper offers new support for the Porter Hypothesis within the context of a quality competition framework. We use a duopoly model of vertical product differentiation in which two firms simultaneously choose to produce either a high (environmentally friendly) quality or low (standard) quality variant of a good, before engaging in price competition. In this simple setting, we show that a Nash equilibrium of the game featuring the low-quality good can be Pareto dominated by a different strategy profile, in which both firms opt in favour of the "green" product. Our analysis demonstrates that, in such a case, both firms stand to profit from the introduction of a rule penalizing any firm refusing to produce the environmentally friendly product. We also find that consumers themselves may benefit from such regulations. This is always the case when shifting from low quality to high-quality production brings about a cost-efficiency improvement.

1. Introduction

Conventional economic thinking suggests that introducing more stringent environmental regulations always implies some private costs, since it displaces firms from their first-best and forces them into a more compromised position. Porter [18–20] challenged this view, claiming that just the opposite might be true. His main argument was that environmental regulations can open up new investment opportunities, encourage companies to innovate and generate long-term gains that can partly or more than fully offset the costs of complying with them. This claim is now widely known as the Porter Hypothesis.

Porter's view has received a skeptical response from economists working within the bounds of standard economic theory [16]. The idea that firms might systematically overlook opportunities to innovate or routinely undermine their own efforts to improve results is difficult to reconcile with the neoclassical view of the firm as a rational profit-maximizing entity. Since firms are always willing to implement changes that they see as beneficial, if producing environmentally friendly products were really as profit-enhancing as Porter claims it to be, then they would have moved in that direction on their own and would need no governmental prompting.

In the face of such scepticism, other economists have recently depicted a number of scenarios for which the Porter result may hold. All of these studies point to the existence of some market failure that offers a field for environmental regulation, although different authors locate this failure at different levels in accordance with their specific interpretations of the Porter Hypothesis. Hart [10], for example, has shown that environmental regulations may help foster R&D activities and thus stimulate economic growth, while Simpson and Bradford [25] use an international trade model to show that

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tightening regulations may help shift profits from foreign to domestic firms because of the presence of international externalities. Similarly, Rothfels [23] demonstrates that enforced compliance with an environmental standard can push domestic firms to become leaders in the "green" market, thereby boosting their competitiveness vis-a-vis foreign rivals.

Some intra-firm mechanisms through which environmental regulations can induce firms to make use of profit-enhancing innovations have also been studied. In this vein, Xepapadeas and de Zeeuw [27] conclude that more stringent environmental regulations can induce firms to downsize and modernize, while Popp [17] shows that firms tend to undertake risky R&D projects (many of which turn out to be ex post profitable) only when regulations are in place. Ambec and Barla [2] suggest that environmental regulations can help narrow the information gap between firms and managers. Finally, Mohr [14] and Greaker [9] discuss inter-firm mechanisms through which tougher environmental policies can push a group of firms to invest in new pollution abatement techniques. In their papers environmental policy can benefit competitiveness by solving a coordination failure among firms. The economic forces behind the results in [14,9] are the closest to ours in the literature. As we will see, the mechanism behind our Porter-type result also rests on a coordination failure, that is, on the disparity between individual firms' incentives for adopting the new technology and the interests of the industry as a whole.

All these studies, like most of the related literature concerning the effects of environmental standards in industries (and most of the theoretical contributions to the Porter Hypothesis), have tended to focus exclusively on the supply side of the market.[1] By contrast, we suggest here that market demand—consumer preferences—may also favour the creation of a regulated environment in which firms stand to benefit from the sale of higher quality products at higher prices.

We use a standard Bertrand duopoly model of vertical product differentiation in which two firms must simultaneously choose to produce either the environmentally friendly or the standard variant of a given product, and then engage in price competition. This model is similar to the one used by Gabszewick and Thisse [8] and Shaked and Sutton [24],[2] except that here we treat environmental quality as a discrete variable rather than a continuous one. This would seem to be in keeping with our application context, since firms usually determine the environmental quality of their products through a series of discrete decisions (regarding whether to use conventional or recycled paper, fossil fuels or renewable energy, etc.). Since firms only have access to a discrete set of options and thus cannot be perfectly precise when adjusting their quality choices to those of their competitors, in many cases all of the firms in the market will set exactly the same quality standard at equilibrium.[3] This feature of the model is a key determining factor to the emergence of a result in line with the Porter Hypothesis.

The economic rationale behind our findings can be summarized as follows. Let us assume that the firms are producing the standard variant (low environmental quality) of the good and that a new technique or innovation has recently become available, allowing for the production of the new, more environmentally friendly variant. In this context, each firm must decide whether to adopt the new technology or to stick with the old one. Since environmentally friendly products typically cost more to produce than do their standard variants, in an unregulated market many individual firms would most likely want to avoid making the foray into "green" production. While consumers are often willing to pay more for a cleaner product [26], the higher production costs would still put these firms at a price disadvantage vis-a-vis their competitors, since the latter would then be free to capture a large portion of the market by offering cheaper, low-quality variants of the same good. Were this same case to unfold in the context of a regulated market in which all firms adopted the high-quality good, the result would be radically different. In this case, all of the firms would benefit from consumer willingness to pay higher prices and none would run the risk of being exploited by their competitors.

This situation corresponds to a prisoner's dilemma: the Nash equilibrium of the game is Pareto dominated by a different strategy profile that is not an equilibrium. In the framework presented here, environmental regulation can motivate all firms to shift into "green" production in such a way that both the environment and the firms themselves are better off (hereafter denoted as a win–win situation).[4]

Economists have tended to support the Porter Hypothesis on the grounds that innovation sometimes leads to less costly production methods [20]. However, we suggest here that a win–win situation can arise even when the switch to environmentally friendly goods causes an increase in production costs. "Green" goods can be more expensive to produce, either because they require an initial investment in new materials and technologies or because they yield higher marginal costs. While the nature of the cost change is not crucial to obtain a win–win result, it is influential in determining to what extent regulation will ultimately have an impact on consumers. If firms incur higher marginal costs as a result of their decision to improve the environmental quality of their products, then prices will increase reflecting both the larger willingness to pay by consumers and the cost increment. Thus, in certain situations the improved quality of the

[1] See, e.g., [22, p. 281]. One exception is [23], where the valuation of environmental quality by consumers is explicitly considered.

[2] This kind of model has recently been applied to the study of environmental quality [1,11].

[3] This contrasts with the results for models of price-quality competition with continuous quality, in which the equilibrium always involves a certain degree of product differentiation [8,24].

[4] The following scenario can serve to illustrate our mechanism. In the late 1990s, the European Union prohibited the production of leaded-petrol cars in Europe. Prior to that event, any manufacturer was free to focus its production exclusively on unleaded-petrol cars. Those who did so may have been putting themselves at a competitive disadvantage relative to their competitors, however, which continued to produce the less costly leaded-petrol cars. The regulation forced all the manufacturers to produce only unleaded-petrol cars. In this market, a win–win situation would emerge if, after the regulation, firms' profit increased because all the firms could benefit from consumers' higher willingness to pay for unleaded-petrol cars, without putting themselves at a cost disadvantage with respect to competing firms. The regulation of CFCs in the Montreal Protocol may represent a similar situation.