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Trade, economic geography and the choice of product quality☆

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ABSTRACT

The present paper studies the effect of the choice of product quality on trade and location of firms. We discuss a model where consumers have preferences for the quality of a set of differentiated varieties. Firms do not only develop and sell manufacturing varieties in a monopolistic competitive market but also determine the quality level of their varieties by investing in research and development. We explore the price and quality equilibrium properties when firms are immobile. We then consider a footloose capital model where capital is allocated to the manufacturing firms in the region offering the highest return. We show that the larger region produces varieties of higher quality and that the quality gap increases with larger asymmetries in region sizes and with larger trade costs. Finally, the home market effect is mitigated when firms choose their product quality.

1. Introduction

The present paper studies the effect of the choice of product quality on trade and location of firms. In particular, this paper discusses the role of the size of regions in firms' choice of location and product quality. It is well-known that firms' mobility fosters spatial polarization of economic activity (Krugman, 1991). It is however less clear how differences in region sizes affect the quality produced in each region. Recently, Picard and Okubo (2012) highlight that firms endowed with higher qualities choose to locate in the larger region. Yet, product quality is not an exogenous factor. Firms invest in research and development to improve their product quality and this investment is likely to affect their decisions about plant locations. Such a relationship between quality and location is a topic that has lacked attention.

In this paper we build a quality-augmented version of Ottaviano et al.'s (2002) model where consumers have preferences for the quality of manufacturing varieties. Each firm produces a distinct variety and competes under monopolistic competition. We first consider a trade framework where firms are immobile and choose their product quality. This allows us to discuss the effect of region sizes and trade cost on the choice of product quality and trade patterns. We then consider an economic geography framework in which firms choose both their product quality and location, which highlights the role of investment in product quality in the dispersion of economic activities.

We obtain the following results. In the first framework, we show that the larger region hosts the firms that produce varieties of higher quality and that the quality gap between regions increases with larger regional asymmetries and larger trade costs. Hence, the size of the local market is an important determinant of the average product quality and the added value of the goods that are produced in a particular region. In this paper, such a result does not hinge on income effects but rather on a market size and competition effect. On the one hand, firms get higher returns from their investment when they locate in the region where demand is larger. On the other hand, investments in product quality foster competition and make the larger region more competitive. Hence, incentives to invest in quality are mitigated by a harsher competition in larger regions. Quite interestingly, we show that the co-agglomeration of firms and consumers in the same locale is good for average quality and good for cost of living. Although firms agglomerating in the larger region face a harsher competition, they benefit from a larger market, which increases their incentives to invest in quality. Therefore, global quality rises. Finally, the model highlights the existence of complementarity effects between trade costs and returns to investments in quality improvements. Quality investments reinforce the impact of trade costs on prices and consumptions.

In the second framework, we consider the location choice of firms that simultaneously choose their product quality. We show that the location equilibrium exists and is unique. In this location and quality equilibrium, the firms that choose to produce high quality varieties are the ones that locate in the larger market. As standard in the economic geography literature, a fall in trade cost entices a larger number of firms to locate in the larger region. More interestingly, we show that firms invest more in quality on average and the quality gap decreases as trade costs fall. Removing trade barriers is always good for quality because firms have access to larger markets and more easily recoup their investment costs. This market access effect always dominates the negative effect that quality investments have on competition. We also show

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that market integration reduces regional disparities in terms of product quality. Better access to consumers increases the economic returns on quality investment. Finally we provide ambiguous results about the effect of investments in product quality on the spatial distribution of firms and the home market effect.

The paper is structured as it follows. Section 2 discusses the literature on the topic. Section 3 exposes the model while Section 4 presents the short run equilibrium. Section 5 discusses the long run choice of quality in a trade model where the spatial structure of capital is fixed. Section 6 discusses the simultaneous choice of quality and capital location and highlights the relationships between quality on the economic geography. Section 7 concludes. The Appendix A contains all mathematical proofs.

2. Related literature

This paper is closely related to several literature strands. First, quality and location is the focus of a well-known business literature about "sophistication" and "clustering". Porter (1990, p. 188) reports some qualitative evidence that investment in product quality turns out to be more important and more successful in regions with larger demand sizes. A typical example lies in the story of the two German designers of the rotary press, Koenig and Bauer, who returned from London (U.K.) to Bavaria (Germany) in 1818 to set up their first plant because this region was one amongst the world's largest market for printing press. German competitors in the press industry responded with differentiation strategies based on quality and reliability, which made Germany the country with the highest quality and highest price premium in this market. Similarly, the emergence of a US cluster in patient monitoring equipment after World War II is mainly explained by the fact that the US wealthy private hospitals had higher demands for sophisticated monitoring than any European country with socialized medicine. Finally, the emergence of the Japanese cluster in the robotic industry is also explained by the higher demand for robotics by the Japanese management who had significantly stronger engineering background.

Second, these examples show that large markets are attractive not only to more firms but also to the most sophisticated and successful ones. This statement has already been approached in the factual and empirical literature in economics. In a seminal work, Griliches (1957) suggested that technology adoption of the spread hybrid seed corn in U.S. agriculture was closely linked to profitability and therefore to the size of farmers' markets. Schmookler (1966) argued that larger markets give more incentives for product innovation. Sutton (1991) presented cross-country case studies to document the concentration of industries in larger markets. Since then, a significant body of empirical literature gives evidence about the role of market size in the incentives to invest in R&D, with a particular focus on the pharmaceutical industry (e.g., Acemoglu and Linn, 2004). Berry and Waldfogel (2010) offer evidence that larger markets include producers with higher-quality goods in the news and restaurant industries. Such evidence is supported by the results of the present model.

Furthermore, the quality channel is also important in trade patterns. According to Ferreira et al. (2012), the opening of international trade in the movie industry is responsible about 75% of increase in US movie investment budgets. Our results also confirm many empirical results from studies on trade data. In particular, it is aligned with Hummels and Klenow's (2005) finding that larger countries export goods with higher quality margins and extensive margins. Although this paper does not discuss product heterogeneity within countries or firms, it indirectly relates to recent studies about the quality dispersion across importers and exporters.[1] In particular, it is consistent with the finding that prices are correlated with sales and revenues. Finally, many trade studies suggest that trade is better explained by demand or quality heterogeneity than by cost heterogeneity.[2] This fact motivates our analysis of the role of investment in product quality rather than cost innovation in trade patterns and firms' location.

Academic research has also produced a theoretical literature about product quality and trade based on vertical differentiation to explain why higher quality products are more likely to be consumed and produced in high wage countries.[3] Murphy and Shleifer (1997) develop a model where high quality products end up being produced in high human capital countries. Feenstra and Romalis (2006) extend the Heckscher Ohlin model to product qualities. Recently, Kugler and Verhoogen (2012) theoretically study the issue of endogenous quality in a trade context but focus on the impact of exchange rate devaluations. Eckel et al. (2011) discuss the impact of quality choice of multi-product monopolies and oligopolies serving consumers with linear demands that are similar to ours. The relationship between product quality and location choice is recently studied in Picard and Okubo (2012) who show that larger regions attract better quality firms.[4] None of those papers studies how the firms' product quality relates to region sizes and trade costs and to the firms' location choice.

This paper extends this idea in a model where product quality is a variable chosen by firms.[5] This paper differs by its focus and approach from two closely related contributions. First, using a discrete choice model, Fajgelbaum et al. (2011) study the patterns of specialization in a trade framework where firms are immobile. Because they give results on the case where firms choose one out of two quality levels, they find that countries may host firms with different quality levels. However, this outcome stems from the dichotomous property of quality[6] and cannot be found in this present paper where firms have access to a continuum of quality levels. Second, using Melitz and Ottaviano's (2008) framework, Antoniades (2015) discusses the impact of firms' cost and quality heterogeneity and country sizes. However, his focus is on quality ladder, product prices and entry and export decisions in a trade framework where firms are immobile. By contrast, this paper discusses the sorting of firms and the impact of capital allocation in the context of homogenous firms and non-destination-specific investment. This seems more appropriate to the study of regional issues where capital is free to move (Ottaviano and Thisse, 2004). Because the two papers share the same preferences, production functions and monopolistic competitive setting, it shares common properties with respect to the impact of country size and intensity of competition. This paper however focuses on the markup structure, the impact of co-agglomeration of firms and consumers, and the effect of quality investment on the existence of bilateral trade. It further discusses an analytical solution for firms' endogenous location and the home market effect.

Finally, this paper considers investments in product quality as fixed and destination-independent costs. It follows the economic literature on innovation that mostly considers R&D investments as fixed inputs that lower cost or improve demand (Spence, 1975; Dasgupta and Stiglitz, 1980; Shaked and Sutton, 1987; etc.). This literature has highlighted the positive role of larger market size on product quality as investment costs and quality improvements spread over a larger pool of consumers. Such a property applies if quality improvements are not specific to different consumer groups. This paper extends this view to regional economics where investments are less likely to be specific to destinations because language, culture and income can fairly be assumed to be homogenous across regions (e.g., within the same country or continent). This view also applies to many industries that mostly

[1] See Khandelwal (2010), Baldwin and Harrigan (2011), Crozet et al. (2012), and Manova and Zhang (2012), Di Comite et al. (2014).

[2] See e.g. Baldwin (2005), Greenaway (1995) and Greenaway et al. (1995), Fukao et al. (2003), and Foster et al. (2008).

[3] See Linder (1961), Falvey (1981), Falvey and Kierzkowski (1987) and Flam and Helpman (1987) and Stockey (1991).

[4] Okubo et al. (2010a) study a similar two-type heterogeneity model.

[5] The paper relates to the various studies of the relationship between vertical and horizontal differentiation (See Gabszewicz and Wauthy, 2012; Di Comite et al., 2014).

[6] In the same way, Okubo et al.'s (2010a) get similar patterns by using the assumption of two levels of marginal cost.