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A simple model of quality heterogeneity and international trade

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ABSTRACT

This paper develops a trade model with firm-specific quality heterogeneity in markets where firms face the threat of imitation and engage in limit-pricing strategies. Firms producing high-quality (high-price) products export, whereas firms producing lower-quality (lower-price) products serve the domestic market. Trade liberalization raises the average domestic markup and increases the number of products consumed in each country. However, the impact of trade liberalization on the average export markup depends on the nature of liberalization. Although the presence of markups renders the laissez-faire equilibrium suboptimal, trade liberalization increases national and global welfare.

1. Introduction

Several empirical studies have documented the presence of substantial firm heterogeneity in narrowly defined product categories.[1] According to these studies, firm heterogeneity takes the form of productivity or product-quality differences among establishments. More productive firms are larger, charge lower prices, and are more likely to engage in exporting. Firms producing higher-quality products charge higher prices and are more likely to engage in exporting.

The starting point of this paper is based on three observations. First, it is well known that firms in many R&D-intensive markets often face inelastic demand curves (especially during the early stages in the life of new products) coupled with threat of imitation. This situation arises in many R&D-intensive markets where the low sensitivity of demand can be traced to advertising, high switching costs, and high consumer-search costs. For example, Simon (1979, Table 4) reports that the demand for 17 out of 22 pharmaceutical brands analyzed is inelastic, with the average price elasticity during their life cycle period ranging from -0.05 to -0.87.[2] Firms in these imperfectly competitive markets do not maximize profits by charging the unconstrained monopoly price, but usually resort to entry-preventing strategies to minimize the threat of

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[1] Important contributions are Clerides et al. (1998), Bernard and Jensen (1999), Aw et al. (2000), Schott (2004), and Hallak (2006) among many others.

[2] In addition, Feenstra and Weinstein (2010) combine translog preferences and unconstrained monopoly pricing to estimate the welfare effects on imported varieties. They find that about 140 out of 1000 varieties generate inelastic demands. Thus many products face inelastic demand curves.

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imitation. Indeed, the combination of inelastic demand curves with threat of imitation has been the building blocks of Schumpeterian growth theory.

Second, several studies have documented the existence of significant fixed exporting costs (see, e.g., Roberts and Tybout, 1997). Third, a growing empirical literature has established that the effects of trade on firm profit margins measured by domestic and export markups are in general ambiguous.[3] These observations raise several novel research questions. What are the effects of trade liberalization in markets where firms face inelastic demands and engage in Bertrand price competition with potential imitators? Does trade liberalization in these markets operate through the same channels as the ones proposed by the existing literature on firm heterogeneity and trade (Melitz, 2003; Melitz and Ottaviano, 2008)? What are the general-equilibrium effects of trade liberalization on domestic and export markups in the presence of significant fixed domestic costs and fixed exporting costs?

This paper develops a model of trade with firm-specific quality heterogeneity in which firms face potential imitators and positive fixed costs when entering the domestic and exporting markets. Following the insights of Schumpeterian growth theory, we introduce Bertrand price competition between a firm that discovers a new variety and a competitive fringe of imitators that results in entry-deterring limit prices.[4] We also assume that each firm faces a unitary-elastic demand curve, which is derived from a Cobb–Douglas utility function.[5]

In the model, firms producing higher-quality products charge higher prices and markups, enjoy higher profits, and export their products. In contrast, firms producing lower-quality products charge lower prices, earn lower profits, and serve only the domestic market. Trade liberalization increases the number of varieties available for consumption; reallocates resources from low-quality to high-quality products that generates exit of inefficient firms; and improves national and global welfare. Trade liberalization increases the average domestic markup. However, the effects of trade liberalization on the average *export* markup depend on the nature of that liberalization: a move from autarky to restricted trade or an increase in the number of trading countries increases the average export markup; a decline in foreign-market entry costs reduces the average export markup; and a reduction in per-unit trade costs has an ambiguous effect on the average export markup. We also present a modified version of our model where firms face spatial marginal costs of production. In the modified version of our model, firms with higher-quality products charge higher prices in more distant markets; and enjoy higher markups, larger revenues and larger market shares. More firms export to more proximate markets, and sufficiently high foreign-market-entry costs eliminate bilateral trade flows between distant markets. Finally, we find that the laissez-faire equilibrium is inefficient. This inefficiency can be traced to the difference between the socially optimal and market-based average markups.

Our model offers several predictions that are consistent with empirical findings. For instance, the prediction that each surviving firm charges a price that is positively correlated to its product quality level is consistent with empirical studies that routinely use unit values to measure product quality (Schott, 2004; Hummels and Skiba, 2004; Hallak, 2006). Furthermore, the prediction that the average quality (and price) of exports is higher than the average quality (and price) of products sold only in the domestic market provides a novel general-equilibrium explanation based on quality sorting of Alchian and Allen (1964, pp. 74–75) conjecture of *shipping the good apples out*. This prediction is also supported by several empirical studies (Hummels and Skiba, 2004; Baldwin and Harrigan, 2011; Verhoogen, 2008).[6] The model's prediction that productivity (and in our case quality) differences account for higher export markups is consistent with the findings of De Loecker and Warzynski (forthcoming).

Our paper is related to a growing theoretical literature on firm heterogeneity, trade and markups. Bernard et al. (2003) (BEJK, henceforth) develop a model in which firm heterogeneity arises from firm-specific *Ricardian* comparative advantage. Their model assumes that firms engage in limit-pricing strategies resulting in an endogenous distribution of markups. However, their model assumes that the number of varieties produced/consumed in the world is exogenously fixed.[7]

Our model is more closely related to Melitz (2003) and Melitz and Ottaviano (2008) who address formally the effects of trade liberalization in markets characterized by productivity-based firm heterogeneity. Melitz (2003) focuses on the effects of trade liberalization on aggregate productivity and welfare in markets where firms face positive production and exporting costs and charge the unconstrained monopoly price. Melitz and Ottaviano (2008) focus on the effects of trade on markups, aggregate productivity, and welfare in the case where firms face zero fixed production and fixed exporting costs and charge the unconstrained monopoly price.

[3] Levinsohn (1993) argued that import competition reduced the average domestic markups in Turkish manufacturing firms. Chen et al. (2009) find that trade openness reduces average domestic markups in the short-run but has no long run effects. Using plant-level data from Cote d'Ivoire, Harrison (1994) analyzed changes in markups following a 1985 trade liberalization episode which reduced trade costs. She found that markups increased in five out of nine sectors and declined in others following the reforms.

[4] Segerstrom et al. (1990) and Grossman and Helpman (1991), among many others, provide more details on this type of market structure.

[5] Under Dixit and Stiglitz (1977) preferences and the threat of imitation, each firm faces a kinked demand curve. In this case, the profit-maximizing entry deterring strategy can be either a constant monopoly markup or a limit price depending on the quality level.

[6] Feenstra (2004) reports that the average price and quality of Japanese exported cars to the US was higher than the corresponding average price and quality of domestic US cars. For instance, according to Table 8.3 on page 274, in 1979 (two years before the auto VER was imposed on Japanese cars) the unit value of Japanese cars imported into the US was $4949 compared to $4186 of small US cars. The corresponding unit-quality values for imported Japanese and domestic US cars were $4361 and $4197, respectively.

[7] de Blas and Russ (2010) generalize the BEJK model by introducing a discrete number of potential entrants (team of rivals) competing in a Betrand fashion with each incumbent firm. Their model delivers an endogenous distribution of markups but inherits several features from the BEJK model. These features include an exogenously given number of varieties, absence of foreign-market entry fixed costs, and a specific distribution of productivity levels among firms.