



## Firms' locations under demand heterogeneity<sup>☆</sup>

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### ABSTRACT

In this paper, we develop an economic geography model in which firms sell product varieties with heterogeneous demands. We show that firms that sell products with higher demand choose to establish their plants in larger countries, which provide better access to the most frequently demanded and valuable varieties. The impact of spatial sorting depends on the skewness of the distribution of demand intensity across varieties. In a model in which only capital moves across regions, demand heterogeneity diminishes the amount of capital invested in larger countries. In a model in which the work force moves across regions, demand heterogeneity is found to eliminate dramatic changes in the location patterns and to result in the asymmetric dispersion of workers rather than their symmetric dispersion or complete agglomeration in a specific region.

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### 1. Introduction

The present paper studies the impact of demand heterogeneity on trade and firm location. Firms sell product varieties with characteristics and uses that consumers value differently. Some firms sell product varieties that are highly demanded, whereas others produce varieties with low demand. Firms are therefore heterogeneous with respect to the intensity of demand for their products and consumers' taste and preference for their products. The role of demand heterogeneity in trade has recently been examined by Baldwin and Harrigan (2011) and Foster et al. (2008), who show that exporting firms quote higher prices than non-exporters. The impact of taste heterogeneity on trade has also been presented by Crozet et al., (2012), who show that Champagne and Burgundy wines are exported in larger quantities, to more numerous regions and at higher prices if they receive better quality

ratings by reputed wine tasters (e.g., Robert Parker). However, heterogeneity in taste and demand is also likely to have an impact on firms' location decisions and therefore on the regional composition of industries. The present paper discusses this issue in more detail.

The causal relationship between firms' location and their product characteristics is well documented in the business literature. Porter (1990) discusses this relationship as the link between industrial clustering and product sophistication. This author offers many examples of sets of firms that sell higher added value products and choose to cluster in regions with larger markets. For instance, in 1818, Koenig and Bauer are known to have returned from London (U.K.) to Bavaria (Germany) to set up the production plant of their novel "rotary press" because Bavaria was one of the world's largest markets for printing presses. Other German producers of high-quality presses followed this path and moved their plants to Bavaria, establishing this region as the world's leader in the press industry in terms of sales and sophistication. Similarly, after World War II, the patient monitoring equipment industry clustered in the U.S. because wealthy private hospitals in the U.S. had higher demands for sophisticated monitoring than many European countries with socialized medicine. In the 1970s, the robotic industry clustered in Japan because Japanese management teams had stronger engineering backgrounds and, consequently, higher demand for robotics (Porter, 1990, pp. 188–204). These examples show that large markets are attractive not only to more firms but also to the most successful ones. A recent strand of literature in industrial economics confirms this view. For

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instance, [Berry and Waldfogel \(2010\)](#) offer evidence that larger markets attract producers with higher-quality goods in the news and restaurant industries. To our knowledge, this causal relationship between firms' location decisions and the demand for their product characteristics has not been fully explored in the economic literature.

The international trade literature has highlighted the role of firms' mobility on spatial economic discrepancies and the role of trade costs and country sizes on the spatial distribution of firms ([Krugman, 1991](#)). However, this literature has not studied whether and how firms' mobility fosters discrepancies in the value of goods supplied by regions. Do larger regions (or cities) attract firms that produce high-value, high-demand goods, giving an endogenous return premium to the industries located in those regions? Are peripheral regions (or cities) left with the firms that produce low-value, low-demand goods? In this context, we ask two additional questions: Does such demand heterogeneity exacerbate or reduce the home market effect, according to which larger regions host a more than proportional share of industrial activity? What kind of demand heterogeneity has a stronger impact on the spatial distribution of firms?

In this paper, we extend [Ottaviano et al.'s \(2002\)](#) model by assuming that consumers share the same heterogeneous preferences over a set of product varieties. More specifically, we assume that the intensity of the preference for each variety is distributed according to a taste distribution that, for a given set of prices, maps into a demand distribution. As a result, product values and product demands differ across varieties but not across consumers. Each firm produces a distinct variety, competes under monopolistic competition and chooses its plant location in one of two regions. We sequentially envisage the situations in which capital and workers are mobile. In a first footloose capital model, all consumers are immobile, and capitalists allocate their capital to regions offering the highest return to capital ([Martin and Rogers, 1995](#)). In a second core periphery model, firms are run by mobile skilled workers who choose the residence and work location that offers the best outcome in terms of earnings and consumer surplus. Because skilled workers move with their firms, the demand for manufacturing varieties follows the firms' moves and creates a demand linkage. In each situation, we derive the price equilibrium conditions and the firms' location equilibrium conditions. We then discuss the impact of the demand distributions on the location equilibrium.

We obtain the following results. In both models, we first show that firms that sell goods with higher demand and value locate to larger regions. As a result, larger regions obtain better access not only to more varieties, as is usually emphasized in the new economic geography literature, but also to products with higher consumer value. Second, we discuss the impact of the taste and demand distribution functions on trade and firms' location choices. To our knowledge, this issue has been neglected in previous works, in which Pareto distribution functions are used because of their convenient analytical properties. We show that the skewness of the demand distribution has an important effect on firms' location and on the home market effect. The introduction of demand heterogeneity reduces the home market effect only if the demand distribution is unskewed or skewed toward high-demand varieties, if high-demand varieties are not overly abundant. This conclusion applies to uniform and Pareto demand distribution functions. We further show how the impact of changes in demand distributions can be broken down between shifts in average demand and changes in the spread of those distributions. The demand distributions are non-negligible determinants of firms' location patterns.<sup>1</sup>

Third, we discuss the core-periphery model and show how the number of equilibria, the possibility of catastrophic changes and the effect of trade costs are related to demand distributions. Accordingly, we establish a condition under which those distributions yield a unique location equilibrium. We also show that the introduction of

demand heterogeneity eliminates the possibility of catastrophic changes that exist in the same model with homogenous demands. Hence, demand heterogeneity is likely to explain the empirical difficulty of verifying catastrophic changes (e.g., [Davis and Weinstein, 2002](#)). Finally, we show that demand heterogeneity should not be considered a dispersion force or an agglomeration force. Indeed, compared to the homogenous demand model, the introduction of heterogeneity has ambiguous effects on the dispersion and agglomeration of firms. In particular, the introduction of demand heterogeneity makes an initially dispersed economy less dispersed and an initially agglomerated economy less agglomerated. This is a force that entices skilled workers to agglomerate partially.

The remaining part of this introduction presents a deeper review of the literature.

## 2. Related literature

This paper relates to several strands of literature. Beyond the business literature mentioned above, the microeconomic literature has proposed several models for product sophistication and quality. One strand of models presents pure vertical differentiation, in which individuals purchase a single good at various quality levels ([Gabszewicz and Thisse, 1979](#); [Shaked and Sutton, 1983](#)). The other strand follows the seminal work by [Spence \(1975, 1976\)](#), who models demand as a function of purchased volumes and product quality. In such models, quality is a simple “demand shifter” that alters consumers' willingness to pay for a product. The trade literature has sequentially built on each strand.

Early trade literature developed the first view of vertical differentiation with a single good. This literature assumes that countries produce the same variety with a different quality, which entices richer countries to specialize in high-quality varieties ([Linder, 1961](#); [Falvey, 1981](#); [Falvey and Kierzkowski, 1987](#); [Flam and Helpman, 1987](#); [Stockey, 1991](#)). Although this link between quality and income is supported by the data ([Schott, 2004](#); [Hummels and Klenow, 2005](#); [Hallak, 2006](#)), this view is not in accordance with empirical studies showing significant product diversity.

More recent contributions in trade economics emphasize the role of product diversity by presenting hybrid models with horizontally differentiated varieties and demand shifters in each variety, as in this paper ([Foster et al., 2008](#); [Baldwin and Harrigan, 2011](#); [Fajgelbaum et al., 2011](#)). As in [Schott \(2004\)](#), this literature suggests that one product has higher quality than another if the former product has a higher demand for the same price. A critical feature in the discussion of product quality is the impact of income on the composition of an individual's basket of goods. In [Baldwin and Harrigan \(2011\)](#) and in our paper, income has no effect on the composition of the basket of goods. To our knowledge, only [Fajgelbaum et al. \(2011\)](#) present a model in which higher-income consumers have an increasing consumption bias toward higher-quality varieties. These contributions impose strong assumptions on the distribution of demand shifters and offer no discussion of firms' location choices, as we do in this paper.

The paper also relates to the literature on cost heterogeneity.<sup>2</sup> This literature responds to the empirical research on trade at the firm level and explains the impact of trade liberalization on the export decisions of firms that are immobile and endowed with heterogeneous productivity.<sup>3</sup> However, this literature has recently been qualified by a research agenda concerned with the empirical identification of a positive correlation between firms' export prices and export status. [Foster et al. \(2008\)](#), [Manova and Zhang \(2009\)](#) and [Baldwin and Harrigan \(2011\)](#) suggest that trade is better explained by demand heterogeneity than by cost

<sup>2</sup> See [Melitz \(2003\)](#), [Helpman, et al. \(2004\)](#), [Falvey et al. \(2004\)](#), [Melitz and Ottaviano \(2008\)](#), [Baldwin and Robert-Nicoud \(2008\)](#).

<sup>3</sup> See for instance, [Tybout and Westbrook \(1995\)](#), [Bernard et al. \(2003a,b\)](#).

<sup>1</sup> [Cabral and Mata \(2001\)](#) study the distribution of firm size in more depth.

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