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Trade and industrial structure with large firms and heterogeneity

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ABSTRACT

We develop a model of trade and firm heterogeneity in an oligopolistic setting. This setting generates key differences in terms of modelling setup, modelling predictions and welfare implications with respect to the existing literature on trade and firm heterogeneity. In terms of modelling setup our approach allows us to explore interaction between potentially large heterogeneous firms, in contrast to recent trade literature with heterogeneity and atomistic firms. As a result variables like market price and total sales vary endogenously as different firms enter the market. We offer a solution for the integer problem inherent in small group models, based on stochastic dominance. The model generates testable predictions deviating from the benchmark firm heterogeneity model of Melitz (2003) in terms of the effect of trade liberalisation on markups, market shares, the market price. We also derive predictions on the effect of distance and market size on the probability of zero trade flows and export prices. Our model features the possibility that welfare declines as a result of trade liberalisation. The result in Brander and Krugman (1983), the benchmark model for trade under oligopoly, that welfare unambiguously rises with free entry and might decline without free entry due to increased cross-hauling is reversed. In a setting with heterogeneous instead of homogeneous firms, welfare might decline with free entry. A negative welfare effect without free entry can be ruled out if the firm size distribution is sufficiently dispersed.

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1. Introduction

The reallocation effects of trade are an important mechanism linking openness to productivity. Bernard and Jensen (2004) attribute almost half of the rise of manufacturing total factor productivity in the USA between 1983 and 1992 to reallocation effects linked to resources being shifted towards more productive and trade oriented firms. Episodes of liberalisation in developing countries also show the importance of changes in firm composition effects. Given the strong message from the empirical literature on composition effects, a number of models of heterogeneous productivity have been put forward in the recent theoretical trade literature to help us better understand composition effects linked to trade. Melitz (2003) and Melitz and Ottaviano (2008) introduce heterogeneous productivity in a monopolistic competition framework with, respectively, CES-preferences and linear demand preferences, whereas Bernard et al. (2003) include heterogeneous productivity in a model with Bertrand competition. However, firm heterogeneity has not been examined under oligopoly with free entry. We do so here, demonstrating that such an approach has several advantages, in particular the possibility to model large firms.

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Table 1
Examples of industrial concentration.

NAICS 31-34: all manufacturing	Top 50 firms have 24.5% of U.S. revenue
NAICS 334: computers and electronics	Top 4 firms have 61.2% of U.S. revenue sector represents 25% of world merchandise trade
NAICS 336: transportation equipment manufacturing	Top 4 firms have 42.1% of U.S. revenue sector represents 20% of world merchandise trade
NAICS 336311: carburetors, pistons, etc.	Top 4 firms have 65.7% of U.S. revenue
NAICS 51113: book publishers	Top 4 firms have 41.7% of U.S. revenue
NAICS 52211: commercial banking	Top 4 firms have 29.5% of U.S. revenue
NAICS 522210: credit card issuing	Top 4 firms have 75.8% of U.S. revenue
NAICS 4461101: pharmacies and drug stores	Top 4 firms have 53% of revenue
Global motor vehicle production	Top 4 firms have 42% of global vehicle sales

Note: U.S. data are from U.S. Census Bureau (2006), and are for 2002.
Trade data are for 2004, from COMTRADE.
Global motor vehicle production is for 2007, from industry sources.

Production and trade at industry level are typically dominated by a small number of very large firms. For example, from Table 1, the top four motor vehicle producers account for approximately 40% of global production, while at the detailed (5-digit NAICS) industry level, the top four firms in the U.S. often represent 40–60% of sales. In addition to high concentration, industrial structure and markups are sensitive to the degree of openness and market size (Hoekman and Kee, 2007; Hoekman et al., 2004). Yet, while markets are dominated by large firms, and markups are varying, an important feature of the recent workhorse monopolistic competition models with heterogeneity of both Melitz (2003) and Melitz and Ottaviano (2008) is that firms are atomistic, while with Melitz-type models, markups are fixed. Indeed, though individual, atomistic firms exit in equilibrium and are replaced by new entering firms, this has no implications for the properties of the market equilibrium at an aggregate or industry level. This theoretical feature offers the analytical advantage of enabling the definition of a smooth entry and exit process following policy shocks that can be characterised entirely in terms of firm population aggregates. However, it hinges on the assumption that even large firms are actually small, relative to the market as a whole and in terms of their individual relevance for the decisions of other firms.

In this paper we depart from the approach followed in the recent literature. Instead of relying on large group assumptions under monopolistic competition, we combine oligopoly and firm heterogeneity with free entry. Basic aspects of market structure – markups, industrial concentration, relative firm positions, and prices for domestic and export markets – are endogenous under this approach. Preferences are assumed to be CES across different sectors and within each sector firms produce a homogeneous good.[1,2] Modelling large non-atomistic firms requires us to work with firms living only for one period to keep the model tractable. Also others who have modelled the role of large firms in international trade like Di Giovanni and Levchenko (forthcoming) work with this assumption. Firms living for a single period is a limitation of our approach in comparison to Melitz (2003) where firms live for multiple periods, subject to an exogenous death probability in each period. Unlike Bernard et al. (2003) and Melitz and Ottaviano (2008), we do not actually need to assume a specific distribution of firms' cost structures (productivity) to generate our core results. We focus on market structure and the role of large firms, guiding us in the choice of modelling setup. There is only one factor of production and when studying trade between two countries, we assume like Melitz (2003) that the two countries are equal. This implies that wages are equal. Also, we follow Neary (2009) in working with a continuum of sectors. This implies that deviations of sectoral profit from the paid sunk entry costs implied by the discrete number of firms are subject to the law of large numbers at the level of the economy. Whereas Neary (2009) focuses heterogeneity across sectors, we focus on heterogeneity within sectors and remain agnostic about differences between sectors. Exploring the effect of market size, we will work with equal sectors.

Our model differs in three important ways from the benchmark model of firm heterogeneity, Melitz (2003): in terms of modelling setup, in terms of modelling predictions and in terms of welfare effects of trade liberalisation. First, in terms of modelling setup our model allows for large firms, whereas in Melitz (2003) all firms are atomistic. Modelling large firms requires a solution of the integer problem. With small group competition, we cannot expect entry to lead to zero expected profits, and the actual number of firms matters. We use stochastic dominance to solve the integer problem and this allows us to pinpoint the unique number of entrants that satisfy free entry. The integer problem has been a sticking point in the modelling of oligopoly with heterogeneous costs.[3] Our solution method also enables comparative statics on changes in market size and trade costs. Such solution methods may also prove useful for other models of trade with small group

[1] We emphasise large non-atomistic firms, abstracting from product differentiation, so that we can isolate model properties linked to discrete numbers of firms. This is the standard approach in models of trade and oligopoly, as pointed out by Leahy and Neary (2011).

[2] The recent oligopoly and trade literature has avoided CES preferences. However, as most of world trade actually involves imports by firms of raw materials, semi-processed goods, and industrial inputs, we view CES-type preferences as better justified for representing derived demand given standard representations of CES-type production and cost functions. In addition, as Feenstra (2010) points out, the recent use of quadratic utility functions and an additively separable numeraire is best suited for partial equilibrium analysis.

[3] Neary (2010) also addresses the integer problem in models of oligopoly with free entry, but proposes a different way to solve it. Using aggregative games, the discrete number of firms free entry condition can be approximated by the continuous number of firms equivalent conditional upon the existence of a so called lean outsider.

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