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Firm Heterogeneity and International Trade Liberalisation: A Generalized Cournot Oligopoly Approach

Abstract
The main goal of this article is to contribute to the theoretical analysis of international trade under imperfect competition using the Cournot oligopoly model with heterogeneous firms. In particular, our objective is to provide some insights into the role of cost asymmetry in studying the effects of trade liberalisation in the Cournot oligopoly framework. In order to introduce firm heterogeneity into the oligopoly model we use the generalised Cournot framework with asymmetric firms that differ in terms of their productivity, levels of output and market shares. We show that trade liberalisation leads to the elimination of less productive firms and results in lower equilibrium prices, higher sales per firm and lower markups in the industry.

Keywords
Cournot oligopoly model | firm heterogeneity | imperfect competition | international trade liberalisation | market structure

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1. Introduction

The last two decades have seen a renewed interest in studying the effects of international trade. For many years, the key concepts of comparative advantage and comparative disadvantage and simple two-country models were employed to identify industries in which one country was relatively stronger than the other and to study the resulting patterns of international specialisation and the gains from trade. In the open economy setting, industries having comparative advantages were expected to expand, while industries with comparative disadvantages were expected to contract. However, during the last decades, this view has been challenged by the analysis of extensive firm-level datasets that revealed large differences among firms within the same industry in terms of their productivity and export performance.

Contemporary research in the field of international trade increasingly focuses on individual firms, plants and products rather than on countries and industries. The firm-level evidence shows several new trade facts that were not previously observable at the aggregate level. In particular, the evolution of aggregate trade is driven by two 'margins': the 'intensive margin' refers to average exports per firm and the 'extensive margin' refers to the number of exporting firms, the number of exported products and the number of export destinations. The empirical evidence shows that the variation in aggregate trade between countries is mostly driven by the 'extensive margin'.

It is well-documented that exporting firms differ from non-exporters in a number of ways. They are bigger, generate higher value-added, pay higher wages, employ relatively more skilled workers, generate more capital per worker, and their productivity levels are higher compared to non-exporters (Bernard and Jensen, 1995; Bernard and Wagner, 1997; Clerides *et al.*, 1998; Castellani, 2002; Delgado *et al.*, 2002; Wagner, 2002; Girma *et al.*, 2003, 2004; Baldwin and Gu, 2003; Hansson and Nan Nan, 2004; and Mayer and Ottaviano, 2007).

These findings also have several important trade policy implications. Trade liberalisation leads to market share reallocations towards more productive

firms and raises average industry productivity as low-productivity firms exit and high-productivity firms expand their operations. The evidence shows that the opening of distant markets gives an additional opportunity to only the most productive firms within each industry, allowing them to enlarge their market shares to the detriment of less productive competitors, some of which might be forced to exit the market or shut down. These facts are explained by recent theoretical studies based on multi-country models. However, these models differ in terms of their features that cause only the most productive firms to export, and many issues still remain unresolved.

One of the key issues concerns the modelling of imperfectly competitive market structures. It is well known that big firms have always played an important role in the models of imperfectly competitive market structures. However, the recent developments in the theory of international trade stressing the role of firm heterogeneity kept imperfect competition but jettisoned oligopoly for the most part. Instead, as the heterogeneous-firm-literature burgeoned in the 2000s, monopolistic competition quickly became established as the workhorse model of the imperfectly competitive market structures.

Therefore, the main objective of this article is to contribute to the study of imperfectly competitive markets by introducing firm heterogeneity into the Cournot oligopoly model and extending it to an open economy setting. In particular, we aim to provide some insights into the issue of cost asymmetry in an oligopolistic market. In order to introduce firm heterogeneity into the oligopoly model, we use the generalised Cournot framework with asymmetric firms that differ in terms of their productivity, levels of output and market shares. Then, using this framework, we study the effects of opening to international trade. The contribution of our study to the literature is purely theoretical, but it allows deriving a number of predictions that can be tested empirically in future studies.

The structure of this article is as follows. In the next section, we provide the literature review in which we discuss the major approaches to modelling firm heterogeneity in the formalized international trade theory literature. Subsequently, we describe the properties of the theoretical framework we use. Then, we extend this framework to an open economy setting. Finally, we report and discuss our main findings. The article ends with final conclusions, limitations of our approach and directions for future studies.

2. Literature review

The contemporary world is dominated by imperfect competition and oligopolistic firms. These firms have substantial influence over a certain industry or market, and at the same time, they have visible rivals with whom strategic interaction is a fact of life. Each firm is aware that its actions affect others and, therefore, prompt reactions of other firms in the industry. Each firm then takes these reactions into account when making a decision about prices, output or other business actions. Many examples of oligopolies can be found across all the major industries, such as oil and gas, pharmaceuticals, airlines, mass media, steel manufacturing, automobiles, and telecoms (Belleflamme & Peitz, 2015).

Although oligopoly is pervasive in our daily lives, it is relatively rarely found in the theoretical models that are used in the contemporary international trade literature. This was true prior to the 1980s, when simple models of comparative advantage based on the assumption of perfect competition, such as Ricardian and Heckscher-Ohlin models, dominated the field, and it has also been true in the last three decades, when monopolistic competition models have been enjoying the near monopoly position in the field. The formal analysis of international intra-industry trade under oligopoly was initiated in the early 1980s by Brander (1981) and Brander and Krugman (1983) and continued by several other authors. The recent extensions of the seminal articles by Brander (1981) and Brander and Krugman (1983) include, *inter alia*, Cieślik and Ryan (2012), Cieślik (2015), Brander and Spencer (2015), Cieślik (2018) and Cieślik and Wincenciak (2018).

Throughout the 1980s, oligopoly played an important role in the international trade policy analysis, partly because it seemed that oligopoly models provided solid theoretical foundations for the so-called strategic trade policy (STP). Examples of early studies on STP include Brander and Spencer (1981, 1983, 1984, 1985) and Eaton and Grossman (1986). Whereas early authors initially got excited by learning that countries have a lot to gain when imposing barriers to trade or allowing subsidisation of industries competing in internationally oligopolistic markets, later writers managed to calm down the new wave of protectionism by demonstrating that any trade policy recommended under a particular market structure might not be recommended under a different market structure (Shy, 1995; p. 7). These later writers mitigated the strong policy actions recommended by

the early STP literature (Brainard & Mortimort, 1997). While this line of research is still cited and provides inspiration for related work, Head and Spencer (2017) showed that the share of articles mentioning oligopoly in the top field journal - the Journal of International Economics - has steadily declined since the early 1990s.

At the same time, the growing body of empirical firm heterogeneity literature made the role of large firms in international trade increasingly hard to ignore. In a series of early empirical studies, Bernard and Jensen (1995), Wagner (1996) and Bernard and Wagner (1997) documented very uneven export performance of individual firms. In the subsequent studies, Bernard et al. (2007) and Mayer and Ottaviano (2007) demonstrated that a relatively small number of multi-product and multi-market firms account for large shares in the total exports of the US and France, respectively. For example, they found that, in the US in 2000, only 12% of firms exported five or more products to five or more destinations, but they collectively accounted for 92% of the US total exports. Similarly, French exports in 2003 were also highly concentrated, with 11% of French firms that exported five or more products to five or more countries accounting for 87% of the total exports.

Subsequently, Freund and Periola (2015), based on cross-country evidence, found that the top five firms accounted for on average 30% of total exports, while Sutton and Trefler (2016) reported that the richest significant exporter was at least 55 times richer than the poorest significant exporter. More recently, Gaubert and Itskhoki (2021) documented that the largest firm in a typical French manufacturing industry had a market share of 20%. Moreover, there is also some empirical evidence showing that markets have become more concentrated over time (Autor et al., 2017; 2020).

The early empirical studies on firm heterogeneity in international trade, such as Bernard and Jensen (1995, 1999), did not refer to any theoretical frameworks, as the formal trade theoretical literature that focused on the issue of firm heterogeneity simply did not exist at that time (Wagner, 2007, 2012). Therefore, the highest priority of trade economists at the turn of the century was to integrate heterogeneous firms into a general equilibrium model of international trade. This led to the development of the frequently cited Melitz (2003) model that introduced the role of firm heterogeneity into the well-known monopolistic competition framework that was proposed initially by Spence (1976) and Dixit and Stiglitz (1977) and later employed by Krugman (1979, 1980, 1981) in the context of international trade with perfectly symmetric firms.

However, in contrast to Krugman (1979, 1980, 1981), Melitz (2003) placed the relationship between the differences in the level of labour productivity and exporting at the centre of analysis. His model assumed that productivity differences were exogenously given, and each firm had to pay exogenously given fixed costs of entry into domestic and foreign markets. Firm heterogeneity resulted in the self-selection of firms into domestic and foreign markets, i.e. highly productive firms exported while low productivity firms operated only in domestic markets. Since then, the international trade literature focusing on firm heterogeneity has been dominated by various monopolistic competition models (Redding & Melitz, 2014).

At about the same time, Neary (2003) called for the renewed use of oligopoly models in the study of international trade at his presidential address to the European Economic Association. Since then, his call has been repeated several times in a series of his articles. For example, Neary (2010) stated that the international trade theory developed models of trade under both perfect and monopolistic competition well but contained only very few elements of oligopoly, and he sketched out an agenda for models that would remove the assumption of massless firms. According to him, endogenising entry and exit decisions of firms while retaining a role for large firms that would compete strategically is the key to developing more realistic models that can shed light on the nature of competition in the contemporary global economy.

Subsequently, according to Leahy and Neary (2013, p. 221): "A consistent approach to modelling oligopoly in general equilibrium requires that firms are 'large in the small but small in the large': playing strategically against a small number of competitors in their own sectors, (…) while at the same time too small in the economy as a whole to influence aggregate variables such as national income or the price level." The potential solution to the above dilemma would need to involve models in which firms are "large in the small and small in the large". This could be achieved elegantly via a continuum of sectors inside which operate granular firms.

A key step in operationalizing the concept of the "large in the small and small in the large" was a tractable specification of preferences that could be additively separable. This was partially done by Neary (2016), who developed a full general equilibrium

model of international trade under oligopoly assuming continuum-quadratic preferences and allowed him to aggregate a continuum of sectors in which a small number of firms operated under Cournot competition. In particular, he demonstrated how competitive advantage interacted with comparative advantage to determine resource allocation and studied the gains from trade, the distribution of income between wages and profits, and production and trade patterns.

The alternative line of research on modelling oligopoly in general equilibrium was pioneered by Bertrand et al. (2003). They proposed a theoretical framework with a continuum of industries within each of which there was Bertrand competition between firms producing homogenous goods. According to their framework, a low-cost firm captured the whole market for each product and set the price equal to the cost of the second most efficient producer. However, Costinot and Rodriguez-Clare (2013) argued that the Bertrand et al. (2003) initial form of Bertrand competition did not change any of the main predictions obtained from the models that assumed monopolistic competition. In the Bernard et al. (2003) model, domestic markups remained constant after trade liberalisation despite increased competition. Therefore, several subsequent articles attempted to modify the approach initially proposed by Bertrand et al. (2003).

In particular, Atkeson and Burstein (2008) relaxed the assumption that firms in each industry produce identical goods and allowed for product differentiation. Their framework inputs were produced by a limited number of domestic and foreign entities in a continuum of industries. Each firm was aware that it could affect aggregate industry prices and output, but no firm could affect the final product price or wages due to the continuum of industries. Moreover, markups increased with the market share as long as the elasticity of demand across industries was lower than the elasticity within industries. In addition, their framework was able to explain both imperfect pass-through and pricing to market, which has been very well documented in the prior empirical literature but inconsistent with the earlier theoretical approaches based on the assumption of monopolistic competition.

Eaton et al. (2013) employed Bertrand pricing, following Atkeson and Burstein (2008), and studied the effects of dropping the continuum of firms assumption. They showed that the markup charged by the largest firm had a 5 to 95 percentile range of 25% to 29% under parameter settings in which the monopolistic competition markup would be 22%. The lower-ranked firms charged only 'negligibly higher' markups than 22%. At the same time, their results showed that the choice of Bertrand versus Cournot competition assumption might matter a lot for their quantitative results. With Cournot competition, the markups of the top firm could increase up to 45%, and the second firm could charge a markup of 30%.

Edmond et al. (2015) also employed the Atkeson-Burstein approach to study the gains from trade in their theoretical model. They found that international trade liberalisation significantly reduced markups. However, in their framework the choice of Bertrand versus Cournot made significantly less difference to average markups and gains from trade compared to the prior study by Eaton et al. (2013). They demonstrated that the pro-competitive effects of trade liberalisation were not significantly larger under Bertrand oligopoly compared to the baseline Cournot framework.

Holmes et al. (2014) abandoned the assumption of a Pareto distribution for firm productivities and assumed instead that productivity distribution is log-normal. They developed an allocative efficiency index related to variation in markups. They demonstrated that, holding prices fixed, trade liberalisation increased allocative efficiency in similar countries due to the convergence of average markups across countries. Subsequently, De Blas and Russ (2015) also relaxed the assumption of a Pareto distribution and demonstrated that when the Pareto distribution is replaced with a Frechet distribution, then average markups decline with increased foreign competition.

Whether the firm distribution is Pareto or not, there is certainly no doubt that it has a thick right tail. The biggest firms are indeed big, which is an important fact of real life that is not compatible with the assumption that firms are massless. Hottman et al. (2016) argued that when thinking about large oligopolistic enterprises, it was crucial to model them as suppliers of multiple imperfectly substitutable products. In order to maintain their theoretical model tractable, they deviated from the original Atkeson and Burstein (2008) model by assuming the upper tier continuum of industries display an elasticity of substitution equal unity. This assumption made pricing in each industry independent from other industries. Then, they estimated an elasticity of substitution using scanner data (i.e. barcodes).

According to their calculations, over two thirds of firms supplied multiple barcodes, and such firms

accounted for more than 99% of the production in their respective industries. Their results documented a hybrid model of market structure. A typical industry consisted of a limited number of very large firms with substantial market shares and a competitive fringe of small firms with negligible shares. As a result, the majority of firms set markups close to the monopolistic competition benchmark. They found that the median largest firm set a markup between 25% and 100% higher than the average firm within the same industry. They also demonstrated that moving from Bertrand to monopolistic competition lowered the price index by around 4%, while a move from Cournot reduced the price index by 13%.

Sutton and Trefler (2016) developed an interesting theoretical model that assumed Cournot competition between vertically differentiated firms with different levels of product quality. In their view, the prior monopolistically competitive frameworks did not support the coexistence of goods exhibiting vertical differences in quality. They considered a development process in which firms could exogenously increase their abilities to produce high quality goods. This resulted in an inverted U-shaped relationship between the market shares and per capita incomes. This theoretical relationship was supported by their empirical findings based on the international data on trade and GDP per capita.

More recently, Gaubert and Itskhoki (2021), also following the Atkeson and Burstein (2008) approach, developed a multi-industry granular model of international trade where industries host a limited number of firms. In their model, firms could be large within the industries they operate and significantly affect a country's pattern of comparative advantage. Their model was validated using French microdata on firms' domestic and export sales. They found that granularity accounted for about 20% of the variation in export intensity and was most pronounced in highly export-intensive industries. The extension to a dynamic environment with both idiosyncratic and aggregate shocks revealed that firm dynamics played a central role in shaping comparative advantage reversals observed in the data.

In contrast to the aforementioned models, this article employs the alternative analytical framework that builds on the relatively simple theoretical model developed by Bekkers and Francois (2008), who used it to explore cross-country differences in industry structures. Their model is able to nest popular trade models such as the original Brander and Krugman (1983) reciprocal dumping model and the Ricardian technology-based trade model, as two special cases. Unfortunately, their model cannot not be solved analytically. Therefore, in this article, we propose an alternative approach that allows us to obtain an analytical solution. Then, we use this approach to directly study the effects of trade liberalisation.

3. Model setup

In this section we describe the methodology of the research and the main assumptions of the model. We follow the Bekkers and Francois (2008) approach and use a general equilibrium Cournot oligopoly framework with heterogeneous firms for a single industry for the case of the closed economy. Moreover, we assume that the only factor of production in this model is homogenous labour.

3.1. Demand side

For simplicity, we assume an iso-elastic market demand of the following form that can be directly derived from the standard consumer utility maximization problem:

$$Q = ap^{-\varepsilon} \tag{1}$$

where: a is the parameter to capture the market size, p is the price and ε – the price elasticity of demand. The inverse demand function is then given by:

$$p(Q) = \left(\frac{a}{Q}\right)^{\frac{1}{\varepsilon}}. \tag{2}$$

Similar to the seminal Melitz (2003) model of monopolistic competition, we assume the existence of the cost asymmetry of firms with respect to marginal costs (c_i), but at the same time for simplicity, we neglect the fixed cost of production. Hence, the profit function of i-th firm is written as follows:

$$\pi_i = p(Q)q_i - c_i q_i. \tag{3}$$

where: q_i is the output of i-th firm and Q is the aggregate output: $Q=\Sigma^n_{i=1} q_i$.

The profit maximization yields the following first order condition:

$$\frac{\partial \pi_i}{\partial q_i} = \frac{\partial p(Q)}{\partial Q} \cdot \frac{\partial Q}{\partial q_i} q_i + p(Q) - c_i = 0. \tag{4}$$

Solving for the aggregate industry output we obtain:

$$Q = a\left(\frac{\varepsilon n - 1}{\varepsilon \sum_i c_i}\right)^{\varepsilon}. \tag{5}$$

This allows us to solve for the level of individual output of every firm:

$$q_i = Q\varepsilon - Q\varepsilon c_i \left(\frac{Q}{a}\right)^{\frac{1}{\varepsilon}} \tag{6}$$

Substituting the solution for the aggregate industry output (5) into (6) yields:

$$q_i = a\left[\varepsilon - (\varepsilon n - 1) \cdot \frac{c_i}{\sum_i c_i}\right] \cdot \left[\frac{\varepsilon n - 1}{\varepsilon \sum_i c_i}\right]^{\varepsilon}. \tag{7}$$

We can define the share of i-th firm in industry total costs as:

$$s_i = \frac{c_i}{\sum_i c_i}. \tag{8}$$

Then, we can also define the average (unweighted) unit cost in the industry as:

$$\bar{c} = \frac{1}{n} \sum_{i=1}^{n} c_i. \tag{9}$$

This allows us to express individual sales by:

$$q_i = a[\varepsilon - (\varepsilon n - 1)s_i] \cdot \left[\frac{\varepsilon n}{\varepsilon n - 1} \cdot \bar{c}\right]^{-\varepsilon}. \tag{10}$$

We can also define the market shares in industry total output as:

$$m_i = \frac{q_i}{Q} = \varepsilon - (\varepsilon n - 1)s_i. \tag{11}$$

Then, the expression for the equilibrium price level becomes:

$$p(Q) = \frac{\varepsilon \sum_i c_i}{\varepsilon n - 1}. \tag{12}$$

For the quantity and price to be finite it is required that $\varepsilon n \neq 1$.[1] Using the average unit cost the equilibrium price in the industry can be rewritten as:

$$p(Q) = \frac{\varepsilon n}{\varepsilon n - 1} \cdot \bar{c}. \tag{13}$$

This implies that the equilibrium price level can be expressed as the markup over the average unit cost in the industry. It can be noted that the size of the markup depends on the constant price elasticity of demand and the number of firms that operate in the industry.

The following three equations constitute the set of equilibrium conditions:

$$p(Q) = \frac{\varepsilon \sum_i c_i}{\varepsilon n - 1} = \frac{\varepsilon n}{\varepsilon n - 1} \cdot \bar{c}, \tag{14}$$

$$Q = a\left(\frac{\varepsilon n - 1}{\varepsilon \sum_i c_i}\right)^{\varepsilon}, \tag{15}$$

$$q_i = a[\varepsilon - (\varepsilon n - 1)s_i] \cdot \left[\frac{\varepsilon n}{\varepsilon n - 1} \cdot \bar{c}\right]^{-\varepsilon}. \tag{16}$$

The aforementioned conditions are obtained given the number of firms that operate in the industry. However, the number of firms is not constant and needs to be determined endogenously within the model.

4. Closed Economy Equilibrium

The next step in our theoretical analysis is to determine the equilibrium number of firms that would exist in the case of the closed economy. For this, similar to the seminal Melitz (2003) model, we need to determine first the zero-cut-off-profit (ZCP) and the free entry (FE) conditions. Then, we can study the consequences of trade liberalisation by looking at the effects of the increased country size.

1 The case of ε=1 obviously excludes the possibility of a monopoly.

4.1. Zero-cut-off-profit and free entry conditions

In the absence of fixed costs of production, the participation constraint requires that for every firm to produce the non-negative level of output it must have the marginal cost of production lower than the industry price, i.e. $c_i<p$:

$$c_i < \frac{\varepsilon n}{\varepsilon n-1} \cdot \bar{c}. \tag{17}$$

Let there be such c^* for which p=c^*. For every i, where $c_i<c^*$ firms obtain positive profits, and for every i, where $c_i>c^*$, there are negative profits, and firms cannot produce and exit the market.

$$c^* = \frac{\varepsilon n}{\varepsilon n-1} \cdot \bar{c}. \tag{18}$$

This condition allows us to express the number of firms as follows:

$$n = \frac{c^*}{\varepsilon(c^*-\bar{c})}. \tag{19}$$

Defining the average markup as $\bar{\mu}=p/\bar{c}$, we obtain:

$$n = \frac{1}{\varepsilon} \cdot \frac{\bar{\mu}}{\bar{\mu}-1}. \tag{20}$$

It can be immediately noted that the cost distribution is, therefore, important for finding the equilibrium number of firms that operate in the industry. If costs are homogeneous across firms, then the potential number of firms could be infinite (since $c^*=\bar{c}$). However, the greater the cost differentiation across firms, the smaller the number of firms in the industry.

Now, we need to impose another industry equilibrium condition to determine the number of firms that operate in the closed economy. In particular, we assume firms can freely enter and exit the market. This free entry assumption implies zero expected profits in the industry equilibrium.

Similar to the seminal Melitz (2003) model, we assume that each firm must incur sunk fixed cost f of learning about the marginal cost parameter. Also like in the Melitz (2003) model, we assume that the marginal cost parameter is drawn from a distribution. Let us suppose that $G(c)$ represents the cumulative distribution function of marginal costs. In addition, we assume that producing firms can exit the market with constant fixed probability of death δ in every period.

The entry and exit process leads to a zero–cut-off–profit condition and a free entry condition. The ZCP can be written as:

$$p = c^*. \tag{21}$$

The FE condition is given by equalization of ex-ante expected profits and sunk costs of drawing the marginal cost parameter:

$$G(c^*)\sum_{k=0}^{\infty}(1-\delta)^k\bar{\pi} = f, \tag{22}$$

which simplifies to:

$$\bar{\pi} = \frac{\delta f}{G(c^*)}, \tag{23}$$

where: $\bar{\pi}$ is the expected profit conditional on entry.

Combining the ZCP condition with the FE condition enables us to determine the equilibrium number of firms in the closed economy. However, it has to be noted that the exact cut-off value of cost (c^*) crucially depends on the actual formula for the cost distribution, $G(c)$.

Suppose for simplicity that marginal costs are distributed uniformly on an interval c_l-c_u, then $G(c)$ becomes:

$$G(c) = \frac{c-c_l}{c_u-c_l}. \tag{24}$$

Let us define $h(c)=g(c)/\ G(c^*)$, where $g(c)$ is the probability density function for $G(c)$. Then, we can express profits as follows:

$$\bar{\pi} = \int_{c_l}^{c^*}[pq-cq]h(c)dc. \tag{25}$$

with $m_i=q_i/Q=\varepsilon(p-c_i)/p$ we can rewrite:

$$\bar{\pi} = Q\int_{c_l}^{c^*} m(p-c)h(c)dc = Q\varepsilon\int_{c_l}^{c^*}\frac{(p-c)^2}{p}h(c)dc. \quad (26)$$

Using expression for $h(c)$ and the formula for Q we can write:

$$\bar{\pi} = \frac{a\varepsilon}{(c^*)^{\varepsilon+1}}\int_{c_l}^{c^*}\frac{(c^*-c)^2}{c^*-c_l}dc = \frac{a\varepsilon}{3(c^*)^{\varepsilon+1}}(c^*-c_l)^2. \quad (27)$$

Therefore, using equation (23) the cut-off value for c^* can be determined by the following condition:

$$\frac{a\varepsilon}{3(c^*)^{\varepsilon+1}}(c^*-c_l)^2 = \frac{\delta f(c_u-c_l)}{c^*-c_l}. \quad (28)$$

Knowing the exact value of c^* we can turn back to the equilibrium number of firms.

5. Effects of trade liberalisation

Following the seminal article by Krugman (1979) the consequences of trade liberalisation can be studied by looking at the effects of the increased market size. We can now totally differentiate equation (28) over c^* and a to find the effect of an increased market size on the cut-off value of the marginal cost. Hence, we obtain:

$$\frac{dc^*}{da} = \frac{\varepsilon(c^*-c_l)^3}{3((\varepsilon+1)(c^*)^{\varepsilon}\delta f(c_u-c_l)-a\varepsilon(c^*-c_l)^2)}. \quad (29)$$

The sign of the above expression can be determined using the FE condition. It leads to conclusion that it crucially depends on the value of ε:

$$sign\left(\frac{dc^*}{da}\right) = (\varepsilon+1)(c^*-c_l)-3c^*, \quad (30)$$

which can be either negative or positive.

For the sufficiently low values of ε (i.e. less than 2) the above expression is negative. This means that increasing the market size will lead to a decrease in the cut-off value of the marginal cost and is likely to squeeze out less productive firms out of the market. Hence, similar to the Melitz (2003) model, the average level of productivity in the industry increases as a result of trade liberalisation.

The possibility of free entry combined with the enlarged market and the lower cut-off value of the marginal cost, leads to a decrease in the equilibrium price and increased sales per firm. In addition, we can note that trade liberalisation results in increased competition due to the larger number of operating firms and lower markups in the industry.

6. Conclusions

In this article, we argued that monopolistic competition models that currently dominate the economic literature missed many important aspects of reality, and we outlined the advantages and attempts to bring back the Cournot oligopoly model to the centre of the theoretical analysis in the field of international trade. Large firms have always played an important role in the models of imperfectly competitive market structures. However, recent theoretical developments stressing the role of firm heterogeneity for the most part adopted monopolistic competition models that completely neglected strategic interactions among firms.

Therefore, the main goal of this article was to contribute theoretically to the study of the imperfectly competitive markets by introducing firm heterogeneity into the generalized Cournot oligopoly model. In particular, our objective was to provide some insights on the effects of trade liberalisation under the assumption of cost asymmetry in an oligopolistic market. In order to introduce firm heterogeneity into the oligopoly model, we used the generalized Cournot framework with heterogeneous firms that differed in terms of their productivity, outputs and market shares. In particular, we demonstrated that a decrease in the cut-off value of the marginal cost and elimination of less productive firms out of the market due to trade liberalisation resulted in the lower equilibrium prices, increased sales per firm and lower markups in the industry.

At the same time, however, it must be noted that the obtained theoretical predictions crucially depend on the set of initial assumptions underpinning the employed research framework. In particular, in this article we studied the effects of trade liberalisation by looking at the effects of the increased market size assuming that the distribution of firms is the same both in the home and foreign countries. This

assumption can be treated as the major limitation of our theoretical study. Hence, in future studies, it would be advised to introduce international trade more directly via the entry of foreign firms exporting to the home country market and vice versa. This would allow the more explicit study of the role of differences in marginal cost distributions in both home and foreign countries. Another major limitation of our approach is related to the use of a very simple uniform distribution of marginal costs. Therefore, in future studies, other distributions should also be used to validate the robustness of our theoretical findings. Moreover, future theoretical studies should also address the issue of indivisibility in the generalized Cournot model with heterogenous firms. Finally, the predictions of the theoretical model should become the subject of future empirical tests.

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