



Trade liberalisation and innovation under sector heterogeneity^{☆,☆☆}

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ABSTRACT

Mark-ups and the degree of trade openness vary substantially across sectors. This paper builds a multi-sector endogenous growth model to study the influence of trade liberalisation on innovation and, by extension, on sector and aggregate productivity growth under sectoral heterogeneity. I find that differences in the degree of competition generate substantial differences in firms' innovative responses to trade liberalisation. A movement from autarky to free trade promotes innovation and productivity growth in those sectors which are initially less competitive. This result is robust to an alternative scenario in which the economy is open to trade, but the degree of trade openness is common across sectors. Finally the paper outlines the importance of reallocation effects within sectors and across sectors that are the result of differences in product market competition across sectors. A movement towards zero trade costs has a smaller effect on aggregate innovation when the sectors are heterogeneous in terms of competition.

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1. Introduction

A recent body of theoretical and empirical literature studies the influence of trade openness and trade liberalisation on productivity growth. These studies explore the extent to which a larger degree of trade openness affects the rate of a sector's technological change and ultimately the evolution of TFP. To address this question, some researchers have relied on endogenous growth models with imperfect competition and product or process innovation (Segerstrom et al., 1990; Rivera-Batiz and Romer, 1991a,b; Peretto, 2003; Licandro and Navas, 2011), and more recently, firm heterogeneity and industry dynamics (Ederington and McCalman, 2007; Baldwin and Robert-Nicoud, 2008; Gustafson and Segerstrom, 2010; Atkeson and Burstein, 2010; Navas and Sala, 2007; Long et al., 2011; Impulliti and Licandro, 2011).

These papers focus on the representative sector case, hence differences among sectors and the interactions that could emerge because of these differences are not explored. Empirical evidence suggests that sectors are not homogenous in two dimensions that are relevant to a

firm's investment decision to innovate: the degree of product market competition and the degree of trade openness.¹ The former is a key determinant of innovation both in early endogenous growth models (Romer, 1990; Grossman and Helpman, 1991), and more recent contributions (Aghion et al., 1997, 2001, 2005; Peretto, 1999). In addition, several papers argue that trade may increase innovation efforts precisely through an increase in competition.² The latter clearly affects how firms respond to trade liberalisation. Despite the relevance of these two dimensions, few papers have investigated the consequences of the existence of these two sources of heterogeneity for the effect that trade liberalisation has on innovation.

The fact that sectors differ greatly in the degree of product market competition within a country is a stylized fact well-documented in the data (Eslava et al., 2009; Griffith et al., 2010). Epifani and Gancia (2011) report that in the US manufacturing sector at a four-digit level

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¹ The former is measured using sector average mark-ups as standard in the literature. While the literature on economic growth has been focused on (exports + imports)/GDP as a measure of trade openness, Rodriguez and Rodrik (2000) suggests that this may not be the appropriate measure. Exports and imports are measuring how successful the country is in the international context. However, this could be the result of low trade barriers or other technological advantages. Following this critique we use sectoral trade costs measures provided by Bernard et al. (2006).

² The main mechanism through which trade has an impact on innovation in these papers is the increase in competition. This could come through different channels: an effect through direct changes in the profitability of R&D: (Peretto, 2003; Licandro and Navas, 2011; Rivera-Batiz and Romer, 1991b) etc., and an indirect effect through selection: competition allows only the most productive firms to survive. The reallocation of market shares and productive resources towards the incumbents contribute to increase innovation investments. That is the case of the recent contributions with firm heterogeneity (Atkeson and Burstein, 2010).

of disaggregation, mark-ups vary substantially across industries. The degree of trade openness varies substantially across sectors and this is the case even for developed economies. Using sectoral data obtained from Bernard et al. (2006), we observe that average trade costs faced by different US manufacturing sectors (3-digit NAICS code) during the period 1989–2005 varies considerably from 3% up to 18%. This difference is even larger if we consider a finer level of disaggregation.

The aim of this paper is to introduce sector heterogeneity in the degree of product market competition in a standard multi-sector endogenous growth model with private R&D investments, to see how trade affects innovation and productivity growth at both sectoral and aggregate level. The model is based on the framework developed in Licandro and Navas (2011) that explores the effect of trade liberalisation on innovation and growth in an oligopolistic general equilibrium model (OLGE) that incorporates process innovation by incumbent firms. I have focused on this particular framework because the empirical evidence suggests that this is the most relevant case. Doms and Bartelsman (2000) and Foster et al. (2001) provide empirical support that innovation by incumbents accounts for the largest proportion of sectoral productivity growth. Akcigit and Kerr (2010) using the US Census of Manufacturing firms, find that old and large firms undertake innovations whose main aim is to encourage productivity improvements, while new and small firms perform product innovation. Finally, by assuming oligopolistic competition, I allow firms to interact strategically.³

To analyse the impact of this source of sector heterogeneity, I consider the implementation of a common trade policy in an environment in which sectors differ in the degree of product market competition. This exercise enables us to isolate the contribution of sectoral differences in product market competition to the relationship between trade and innovation. In this exercise, I consider two alternative scenarios (restricted entry vs. free entry) and two alternative trade liberalisation policies: a movement from autarky to free trade and a movement from positive to zero trade costs. In the second policy I consider either an initial situation in which trade costs are common across sectors or an alternative scenario in which the degree of trade openness is common across sectors, as explained below. In the six scenarios, trade liberalisation affects innovation through a joint effect of an increase in market size and an increase in competition. However, the latter is different across sectors due to differences in the initial degree of competition. More precisely, when the countries move from autarky to free trade, the initially less competitive sectors experience a larger increase in innovation and by extension, sector productivity growth. This is the consequence of the fact that the increase in competition coming from foreign markets is tougher in sectors which are initially less competitive. Once the countries are opened to trade, a reduction in trade costs in sectors which start with the same level of trade barriers increases innovation and sector productivity growth in those sectors that are initially more competitive. This is the consequence of the fact that, for the same trade barrier, a sector which is initially more competitive is relatively more closed to foreign trade and a reduction in trade barriers intensifies competition more in those sectors. When I consider instead an alternative scenario in which all sectors start with the same degree of trade openness, I find that innovation increases more in the less competitive sectors. In the six cases, tougher competition increases firm size, promotes innovation and it generates a reallocation of productive resources across sectors. When I allow for free entry, considering that the initial level of trade openness is common across sectors, the same competition effect reduces mark-ups by more in the less

competitive sectors. This generates a reallocation of market shares and productive resources towards incumbents that further contribute to innovation. Consequently, the level of competition that the sector faces initially becomes an important determinant of the final effect that trade liberalisation has on innovation. In Appendix 3, instead, an asymmetric trade liberalisation exercise is explored. I find that asymmetric trade liberalisation has a heterogeneous impact at a sectoral level. More precisely, firms increase innovation efforts in those sectors that are relatively more open to foreign trade, contributing to a rise in sectoral TFP growth.

The introduction of sector heterogeneity in the level of competition in the study of the effects of trade on innovation and productivity growth reveals two important findings that are absent in a representative sector analysis. First, this heterogeneity generates important reallocation effects across sectors and across activities within a sector through general equilibrium effects. This has varied effects on sector productivity growth: in the case of restricted entry, a common trade liberalisation policy may induce a reduction in productivity growth in those sectors which are relatively more competitive or, as shown in Appendix 1, also those ones more open to foreign trade. Second, and most important, the existence of these differences across sectors partially mitigates the benefits of trade. In an environment where sectors face identical trade barriers but differ in terms of competition, a movement towards free trade has a positive effect on aggregate productivity growth, although this effect would be larger if sectors were more homogeneous in terms of competition. Similarly, when sectors differ in trade barriers, a movement towards a common trade barrier has a positive effect on aggregate productivity growth. The existence of diminishing returns to scale associated with labour in R&D activities implies that when industries face different trade barriers there is relatively too much R&D investment in some industries and relatively too little in other industries. The movement towards a common trade barrier generates a reallocation of resources from industries that invest relatively too much (and consequently labour is relatively less productive) to industries that invest relatively too little (and consequently labour is relatively more productive). Therefore, this paper suggests that when industries differ in these trade barriers and competition due to institutional reasons, the removal of these institutional barriers helps the economy to enjoy fully the benefits of trade.

Although this paper is related to an extensive literature that examines the effects of trade openness and trade liberalisation on innovation and growth, to the best of my knowledge, this paper is the first to study the role of this source of heterogeneity across sectors in innovation and sector productivity growth. Two related papers in the area are Impulliti and Licandro (2011) and Ederington and McCalman (2007). The first paper introduces firm heterogeneity into the oligopolistic competition model of Licandro and Navas (2011) to disentangle the effects of trade openness on sector productivity growth that are derived from selection, from the effects that are derived from a pure increase in competition. Though their results could be interpreted in terms of sector heterogeneity, the only source of sector heterogeneity in their model is the initial productivity. The consequences of the presence of asymmetries in certain policy variables, like the degree of product market competition or the degree of trade openness, are not explored. Ederington and McCalman (2007) explore the effect of trade liberalisation on the rate of technology adoption in a small open economy. Their paper finds that unilateral trade liberalisation is likely to delay the adoption date for the median firm. This effect depends on several sectoral characteristics and the effect is stronger in, for example, more competitive sectors (low entry costs, large domestic markets). Their model uses a monopolistic competition model in partial equilibrium. Thus, neither the rich interaction across sectors that emerges in a general equilibrium context, nor the strategic interaction among firms, which are crucial elements in my model, is explored.

³ In this paper firms compete à la Cournot. However, most of the results are robust in qualitative terms to alternative oligopolistic market structures like Bertrand with product differentiation. (These results are available on request).

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