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# FIRM BEHAVIOUR IN INTERNATIONAL MARKETS

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# Firm Behaviour in International Markets

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## Abstract

This thesis consists of three essays on firm behaviour in international markets. Abstracts can be found at the beginning of their respective chapters. The first chapter, titled "Trading Tasks and Quality", presents a tractable trade model that combines vertical product differentiation at the firm-level with international fragmentation of production to explain some recently unearthed stylised facts about exporters in developing countries. In line with the recent empirical evidence, it suggests that there is a close link between exports and imports at the firm-level, and it is quality that establishes the link between the two. The second and third chapters revisit the debate on globalisation and wage inequality. The second chapter, titled "The Trade and Wages Debate Revisited: A new explanation for an old mystery", develops a general equilibrium model where trade liberalisation between two identical countries increases wage inequality in favour of white-collar workers. It shows that country characteristics, such as the relative endowment of white-collar workers and the degree of competition, matter for the equilibrium level of wage inequality after trade liberalisation. The endowment of white-collar labour also affects the level of openness; an increase in the worldwide supply of white-collar labour expands the range of traded goods and increases the volume of trade in already-traded goods. Furthermore, it improves global welfare. The third chapter, titled "Cross-border Mergers and Wage Inequality", focuses on another aspect of globalisation and its effect on wage inequality. It suggests a two-way relationship between cross-border mergers and wage inequality: on the one hand, wage inequality in favour of white-collar workers increases the profitability of cross-border mergers; on the other hand, at any level of openness, wage inequality is lower in the presence of cross-border mergers than in their absence. Therefore, participation of a country in global business raises wage inequality, but its level is lower under trade and investment integration compared to trade integration only.

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## WORD COUNT

The body of the thesis consists of 145 pages with a typical page (page 3) containing 347 words. Therefore, the thesis is 50,315 words long (including pages i to v, it is 52,050 words long).

The thesis was typed using Scientific Workplace. Stata 10 was used for statistical analyses, and Microsoft Excel for generating figures.

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# Introduction

In recent years, production has become more international, and its organisation has considerably changed. This has led researchers in international economics to change their focus from countries to firms. Today, understanding the role that firms play in international trade lies at the heart of the literature. The next question is how changes in their behaviour influence economy-wide variables such as factor prices and welfare.

Since mid-1990s, motivated by the empirical findings of Bernard and Jensen (1995, 1999), the literature has extensively discussed the reasons for and implications of the exceptional performance of exporters, and such attempts have led to the development of a new theoretical framework: heterogeneous firms trade models (Bernard et al. (2003), Melitz (2003)). More recently, with the availability of transaction-level data, the focus of the international trade literature has shifted from studying how different firms behave differently in a market, to studying why a firm behaves differently in different markets. Such data tell us new information about exporters. For instance, they typically export multiple products and use imported inputs.<sup>1</sup>

The first chapter of the thesis is motivated by these empirical findings from developing (Southern) countries. To be specific, there is ample empirical evidence that Southern firms charge higher free-on-board prices for their products in richer and more distant markets,

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<sup>1</sup>For instance, U.S. exporters that export more than one 10-digit Harmonised System product accounted for 99.6 percent of export value in 2000 (Bernard et al., 2007). These findings are not confined to developed countries, transaction-level trade data from a number of developing countries show similar patterns, as reported by Manova and Zhang (2012) using Chinese data, Görg et al. (2010) using Hungarian data, and Kugler and Verhoogen (2009) using Colombian data.



and they pay higher prices for the imported varieties of inputs than for the domestic varieties. I present a tractable trade model that explains these findings based on vertical product differentiation at the firm-level and international fragmentation of production. In the model, there exist differences between the North (developed region) and the South in demand for quality and in quality of task (input) supply. Southern firms adapt their product quality to local market by changing the mix of high-quality imported and low-quality domestic tasks across the product varieties they produce. In particular, Southern firms produce higher-quality products for richer and more distant markets by increasing their use of high-quality imported tasks from the North. I also study the equilibrium of the model at the industry-level with firm heterogeneity in productivity. The model predicts that firms with heterogeneous productivity differ from each other by their set of imported tasks, which I call the extensive margin of intermediate imports, as well as by their export status. To be specific, more productive Southern firms use higher fractions of imported tasks from the North, and they are more likely to export to the Northern market. In line with the recent empirical evidence, the model suggests that there is a close link between exports and imports at the firm-level, and it is quality that establishes the link between the two.

While recently unearthed facts about international trade motivate the first chapter, the last two chapters revisit an old debate: the relationship between globalisation and wage inequality. The rise in globalisation has been considered one of the two potential causes of the recent increase in wage inequality in favour of white-collar workers, the other reason being skill-biased technical change. In 1990s, the globalisation explanation focused primarily on trade and relied heavily on the Heckscher-Ohlin-Samuelson theory which is based on differences in relative factor endowments between countries. The predictions of the theory regarding wage inequality have been challenged by a number of empirical findings. For instance, the theory predicts that trade liberalisation should lower wage inequality in Southern countries, but the empirical evidence shows the opposite. In Chapters

2 and 3, I present a general equilibrium model which predicts that trade and investment integration between two identical countries increases wage inequality. The model builds on the General Oligopolistic Equilibrium (GOLE) framework developed by Neary (2003). The assumption of oligopolistic behaviour is useful for two reasons. First, it implies that trade can arise between two identical countries from strategic interaction between firms. The model does not rely on Ricardian differences in technology or Heckscher-Ohlin differences in relative factor endowments between countries, thus it provides an appropriate tool to study trade between similar countries. Second, the assumption of oligopolistic competition allows us to study another aspect of globalisation: cross-border mergers and acquisitions, the dominant form of foreign direct investment since mid-1980s.

In Chapter 2, I study the effect of trade liberalisation between two identical countries on wage inequality. In the model, there is a continuum of goods, each of which is produced by a small number of firms in each country. Goods differ from each other by the production efficiency of their suppliers. Firms employ blue-collar workers for production tasks, and white-collar workers for non-production tasks such as marketing and customer services. I assume that domestic and export sales have different factor intensities, export sales being relatively more intensive in white-collar labour. The reason is that non-production activities such as shipping goods, marketing them, and customer services are more costly when the goods are supplied to the foreign market. The assumption finds empirical support as reported by, for instance, Bernard and Jensen (1997), Bernard and Wagner (1997), and Maurin et al. (2002). In this setting, the model predicts that only the more efficient firms in production are able to export to the foreign market. So the range of traded goods is endogenously determined in the model. The model also predicts that trade affects the relative factor prices in the country: it induces an increase in the relative demand for white-collar labour since export sales are biased towards this factor. Therefore, compared to autarky, wage inequality is higher in the trade equilibrium. This result does not rely on relative differences in characteristics between the trading partners.

Nevertheless, country characteristics matter for the equilibrium level of wage inequality after trade liberalisation. In particular, for a given level of openness, wage inequality in the trade equilibrium is higher the lower the relative endowment of white-collar workers, or the higher the degree of competition in the country. The endowment of white-collar labour also affects the level of openness; an increase in the worldwide supply of white-collar labour expands the range of traded goods and increases the volume of trade in already-traded goods. Furthermore, it improves global welfare.

In Chapter 3, I study another aspect of globalisation: foreign direct investment, or cross border mergers and acquisitions (CBMAs) in particular. I extend the model developed in Chapter 2 to allow for CBMAs as an alternative mode of foreign market entry. Being the dominant mode of foreign direct investment, studying CBMAs is highly relevant. Nevertheless, there is little theoretical understanding of their effect on factor prices. In the model, profitable CBMAs arise because they reduce the level of competition and allow merger partners to avoid the additional cost of supplying to their respective export markets. The model predicts that CBMAs involve firms that are less efficient than exporters. Compared to countries with low wage inequality, CBMAs involve relatively more efficient firms in high-inequality countries. I also compare wage inequality with and without CBMAs. At any level of trade openness, wage inequality is lower the presence of CBMAs than in their absence. Taken together with the result that trade liberalisation increases wage inequality relative to autarky, this result implies that participation of a country in global business raises wage inequality in favour of white-collar workers. Nevertheless, the resulting level of inequality is lower under trade and investment integration compared to trade integration only.

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# Chapter 1

## Trading Tasks and Quality

### Abstract

I present a trade model featuring North-South differences in demand for quality and in quality of task supply. The model explains a number of stylised facts: Southern firms charge higher factory-gate prices for their products in rich than in poor, and in distant than in near markets. The model predicts that firms vary the quality of their products across markets by changing, between varieties, the fractions of low and high-quality tasks. This mechanism for quality differentiation introduces a new margin to trade: the extensive margin of intermediate imports. Extension of the model to general equilibrium with heterogeneous firms shows that even under low fixed and zero variable trade costs, only the more productive Southern firms export to the rich Northern market. Compared to their domestic market, they charge higher prices in the North, with the most productive ones earning higher revenues.

### 1.1 Introduction

In 2004, Regal, a Turkish brand of consumer durables, launched a successful series of TV commercials. Each commercial advertised a particular product of Regal. The plot was the following. Inside an interrogation room, there is an interrogator and a customer. The interrogator offers the customer two brands of a product –a luxury brand and Regal. Then, he explains to the customer that the Regal product shares the same features as the luxury one, but cheaper. Finally, the interrogator asks her to choose between the two, and she invariably goes for the luxury one. The plot ends with the interrogator insulting the customer because of her *irrational* choice.

The commercials would have attracted even greater public interest, if the interrogator had also explained that the two products were manufactured using the same machinery and workers in the same product line in the same factory located in Manisa, Turkey. Regal is the low-end brand of Vestel Group which is one of the leading manufacturers of consumer durables in Turkey. The Group sells its products under different brands in the domestic, Middle-Eastern and European markets.<sup>1</sup> In each product line, the Group's factory produces multiple brands that differ slightly in their appearance but share the same features. The brands, however, differ significantly from each other in terms of price, with SEG being the lowest-priced one.

In this paper, I develop an international trade model that rationalises Vestel Group's strategy – which, as I will argue below, is quite common for Southern (developing) country exporters. In the model, a firm adapts its product quality to meet local demand – known as quality-to-market. Quality-to-market is possible because the firm can source its inputs from multiple suppliers of differentiated quality – known as multi-sourcing. In short, the model predicts that a firm adapts its product quality to local demand by changing the fractions of low and high-quality inputs across its product varieties. Assuming that Southern firms source high-quality inputs from Northern countries, the mechanism suggested in the paper introduces a new margin of trade adjustment within a firm: the extensive margin of imported inputs. Firms change the set of their imported inputs from the North depending on the characteristics of the markets where they sell their products. The supply-side mechanism presented in this paper can be embedded in various trade models. In the paper, I embed it in the heterogeneous firms trade model developed by Melitz (2003).

Anecdotal evidence for the validity of multi-sourcing as a mechanism for within-firm quality differentiation comes from an interview that I conducted with an advisor to the Customs Administration of Turkey. Based on his extensive experience with Turkish

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<sup>1</sup>For instance, it sells Regal only in the domestic market, and exports its products under a number of high-quality world brands, such as Electrolux and Whirlpool, in the European market.

exporters, he provided various examples of how Turkish manufacturers vary the quality of their inputs to produce different versions of the same product. Such strategies, he argued, are common among firms operating particularly in textiles, consumer durables and electronics. In one example, he described a manufacturer of electric cookers. The manufacturer produces two identical-looking electric cookers, but one is more expensive than the other and sold mostly in the European market. In the production of the more-expensive one, the manufacturer uses higher-quality coating and large-diameter electrical cables, both of which prolong the life of the oven.

It is not only Turkish exporters that engage in quality-to-market. A number of studies provide econometric evidence that supports its validity in other Southern countries as well (see Table 1.A.1). The studies find that firms charge higher factory-gate (fob) prices for their products in rich than in poor markets (F1), and also in distant than in near markets (F2). Both correlations are found to be stronger for differentiated products. These are robust findings as they have been confirmed by studies using data from countries with quite different characteristics: Bastos and Silva (2010) using data from Portugal, Manova and Zhang (2012) using data from China, and Görg et al. (2010) using data from Hungary. Assuming that high quality is associated with high price, F1 suggests that a firm sells high-quality products to its customers located in rich markets.<sup>2</sup> With respect to distance, the finding suggests that a firm-level Alchian-Allen effect is at work: distance raises transport costs; a higher (per unit) transport cost is associated with a lower relative price of high-quality to low-quality products, and thus a higher relative demand for the high-quality one. In other words, the firm "ships the good apples out".<sup>3</sup> These two observations, F1 and F2, point to the quality-to-market hypothesis as a plausible explanation.

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<sup>2</sup>Crozet et al. (2009) report a similar finding for French wine exporters. The paper is very interesting and insightful as the authors rely on objective criteria to distinguish between high-quality and low-quality wine. However, since I focus on export strategy of firms from Southern countries, I am not exploring the paper further.

<sup>3</sup>Hummels and Skiba (2004) build a simple model to show that a country changes the relative share of its high-quality exports owing to per unit transport costs; they also provide empirical support for the Alchian-Allen hypothesis.

There also exists evidence supporting multi-sourcing of inputs as a mechanism for within-firm quality differentiation. Manova and Zhang (2012) use transaction-level data from China, and find that firm-product-level variation in input prices is positively associated with firm-product-level variation in export prices (F3). They also report that firms that export to a large number of destinations import their inputs from a large number of origins. Their findings suggest that Chinese firms that export multiple-quality varieties source their inputs from multiple countries. Although the validity of quality-to-market hypothesis has been tested by a number of studies, Manova and Zhang (2012) is the only study that provides a mechanism for the observed pattern of firm-product level prices across destinations. One may argue that sourcing inputs from multiple countries as a means of product differentiation is specific to China and cannot be generalised to other countries. Nevertheless, Goldberg et al. (2009, 2010) provide evidence that Indian firms also benefited from imported inputs to increase their product diversity in the aftermath of trade liberalisation. Colantone and Crinò (2011) report similar findings for 25 European union countries over the period 1995-2007.

Imported inputs can provide Southern firms access to high-quality inputs. Kugler and Verhoogen (2009) use transaction-level data from a Southern country, Colombia, and present evidence pointing to the existence of quality differences between domestic and imported varieties of inputs. Assuming that high quality commands a high price, quality difference between imported and domestic varieties should be reflected in a price difference between them. Indeed, this is what Kugler and Verhoogen find in the data (F4). After exploring other possible reasons for firm-product-level differences between domestic and imported varieties, they suggest that quality difference appears as the most plausible one.

I argue that firm-level quality-to-market and multi-sourcing of inputs together consistently explain the empirical findings F1-F4. The model predicts both quality-to-market and multi-sourcing at the firm-level by combining two types of heterogeneity – task (input)



quality and taste for quality. On the supply side, to produce a final good, a Southern firm combines a continuum of tasks that vary according to their skill requirements. The firm can source each task from domestic or foreign suppliers. Assuming that skills of foreign workers are of higher quality than those of domestic workers, the quality of tasks produced by foreign suppliers is higher. High quality comes at a high price; sourcing a task from foreign suppliers is more expensive than sourcing it from domestic suppliers. Facing a trade-off between quality and cost, the firm decides which inputs to source domestically and which ones to import. The model predicts that it imports more skill-intensive ones from the North, and sources the rest domestically. Since, compared to Southern consumers, rich Northern consumers demand higher-quality products, the firm adapts its product to each market by changing the fraction of its imported tasks. Also, it uses a higher fraction of imported tasks to sell its product in a distant than in a near market since the relative demand for high quality products is higher in the distant market. Thus, in line with the empirical evidence, the firm engages in quality-to-market strategy by sourcing some tasks from multiple sources.

With its focus on firms' outsourcing decision, this study is inspired by two seminal papers (Feenstra and Hanson (1996), and Grossman and Rossi-Hansberg (2008)). The present work differs mainly in two respects: first, it incorporates quality differences between suppliers into the firm's decision of where to outsource; second, it allows for multi-sourcing of an input at the firm-level. To my knowledge, such extensions, which appear to be useful in understanding Southern firm's importing strategy, have not been explored so far in the literature.

The model suggests a new firm-level trade margin: extensive margin of intermediate imports. Imagine a Southern country that has gone through a substantial trade liberalisation process. Through trade liberalisation, domestic firms gain access to Northern (i.e. OECD) markets. Compared to the domestic market, demand for quality is higher in

rich Northern markets.<sup>4</sup> A Southern firm that desires to sell its product in those markets chooses to add new varieties to its product line, which are of higher-quality than that of the existing ones. To produce the new varieties, the firm needs higher-quality intermediate inputs. If such high-quality intermediates are not available in the domestic inputs market, it imports them from Northern markets.<sup>5</sup> So, at the firm-level, the extensive intermediate imports margin is positively associated with the extensive product margin. Goldberg et al. (2009, 2010) find that better access of Indian firms to high-quality OECD inputs in the aftermath of trade liberalisation led them to increase the number of their product varieties. The resulting increase in the extensive product margin contributed significantly to the growth in manufacturing output during that period.

After studying firm's problem, I solve for the industry equilibrium. I show that, compared to low-productivity firms, high-productivity firms use higher fractions of imported tasks, produce higher quality products, and although they follow a more costly outsourcing strategy, they charge lower quality-adjusted prices. Also, the extension modifies the specifications for quality choice in other quality heterogeneous firms (QHF) models by incorporating consumer preferences into firm's decision. This modification relaxes the restriction on fixed trade costs to obtain the prediction that only the more productive firms select into exporting (Melitz (2003)): even under low fixed and zero variable trade costs, only the more productive Southern firms can export to the Northern market where the intensity of consumer preferences for quality is higher than in the Southern market. I also show that, compared to their domestic market, exporters charge higher prices in the Northern market, with the most productive ones also earning higher revenues. We are more likely to observe a positive correlation between firm-product-level prices and revenues across destinations the less dispersed the productivity distribution is. This result, which has not been studied theoretically so far, is consistent with the empirical finding

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<sup>4</sup>See Bils and Klenow (2001) and Broda and Romalis (2009) for evidence that richer consumers consume higher-quality goods.

<sup>5</sup>There is extensive empirical evidence suggesting a positive correlation between per capita income and quality of exported products (Hummels and Klenow (2005), Schott (2004)).

of Manova and Zhang (2012) (see Table 1.A.1). Finally, I look into the effects of a skill-upgrading in the South – Southern workers upgrade the quality of their skills. As a result of a skill-upgrading, the South moves towards higher-quality and more skill-intensive tasks in the global value chain, leading to the exit of low-productivity final good exporters from the Northern market.

As I mentioned above, this paper is related to the recently growing theoretical literature on quality and firm heterogeneity. Two features distinguish it from others. First, the paper proposes a new mechanism for quality differentiation between firms: changing extensive margin of intermediate imports. All QHF studies, including the current one, tell us that high-productivity firms produce high-quality products. They, however, differ in their explanation for quality-differentiation between firms. Many QHF studies argue that quality is a mere product of firm productivity (e.g. Baldwin and Harrigan (2011), Johnson (2011), Kneller and Yu (2008)). There are only a few studies that try to underline the possible mechanisms that make quality differentiation possible. Among them, Verhoogen (2008) and Kugler and Verhoogen (2011) are closest to this paper. Both studies put forward input quality as the source of quality differentiation between firms – it is labour and capital in Verhoogen (2008) and a single domestic intermediate input in Kugler and Verhoogen (2011).

The second feature that distinguishes the current study from other QHF studies is that its main focus is *within-firm* quality differentiation rather than *between-firms* quality differentiation. Although he does not explore it further, Verhoogen (2008) also highlights the possibility of quality-to-market at the firm-level, but he does not explore it further in the paper.

The present study develops a flexible supply-side mechanism for quality production. I show that this mechanism satisfactorily explains some recent empirical findings about Southern exporters and importers when combined with what are now standard assumptions in the literature: richer consumers demand higher quality goods, and input quality is

an important determinant of output quality. Then, I extend the model to heterogeneous firms to see the consequences of within-firm differentiation at the industry-level. First, I derive a well-founded specification for firm’s quality choice in a market; it combines firm productivity and overall task quality that in turn depends on firm productivity and the intensity of consumer taste for quality. Second, I show that, even when variable trade costs are zero and fixed trade costs are low, Melitz’s productivity sorting prediction arises from North-South differences in quality demand; only the more productive Southern firms can export to the Northern market where quality demand is higher than in the Southern market. These firms set higher prices in the Northern market than in their domestic market. The most productive ones also earn higher revenues in the Northern market where they charge higher prices. Finally, the model predicts that when the South moves – driven by a skill-upgrading in the region – towards the production of more skill-intensive tasks, low-productivity final good exporters drop out of the Northern market.

## 1.2 Model

I assume two regions, North ( $N$ ) and South ( $S$ ). I denote a region by  $c$  where  $c = N, S$ . Both regions are populated by people who inelastically supply their skills. Suppliers employ skills in the production of tasks, and firms use tasks in the production of final goods.

### 1.2.1 Consumers

A two-tier utility function represents consumer preferences in both regions. The upper-tier is a Cobb-Douglas function which determines the allocation of a consumer’s budget between a homogeneous good ( $x_{c0}$ ) and a continuum of horizontally (and vertically) differentiated varieties indexed by  $\phi$ . The lower-tier is a CES aggregate of differentiated goods, where quality ( $q(\phi)$ ) augments quantity ( $x(\phi)$ ). The specification of the utility

function follows Hallak (2006):

$$U_c = x_{c0}^{1-\mu} \left[ \int_{\phi \in \Omega_c} [q_c(\phi)^{\gamma_c} x_c(\phi)]^{\frac{\sigma-1}{\sigma}} d\phi \right]^{\frac{\mu\sigma}{\sigma-1}}; \quad \sigma > 1, \quad \gamma_c > 1, \quad 0 < \mu < 1; \quad (1.2.1)$$

where  $\mu$  denotes budget share of differentiated goods,  $\sigma$  elasticity of substitution between varieties, and  $\gamma_c$  intensity of consumer preferences for quality in region  $c$ . In (1.2.1),  $\Omega_c$  gives the set of available varieties of the differentiated good in region  $c$ .

The specification in (1.2.1) incorporates heterogeneous consumer preferences for quality since the parameter  $\gamma$  is region-specific. Hallak (2006) finds that  $\gamma$  is increasing in consumer income: richer consumers have more intense preferences for quality. Hallak's finding is also consistent with the demand side of the Linder hypothesis (1961). Linder argues that countries with higher per capita income demand relatively higher-quality goods.

## 1.2.2 Suppliers

A supplier is a task producer. Following the approach developed by Feenstra and Hanson (1996), I assume a continuum of intermediate goods industries. I depart from their approach by calling the product of an industry a Task rather than an Input.<sup>6</sup> Grossman and Rossi-Hansberg (2008) suggest the term Task to describe the 21<sup>st</sup> century trade in intermediate goods. Rapid improvements in information and communication technologies have eased the coordination of activities across different geographic areas, and have broken down production into smaller tasks. As a result, trading tasks that used to be non-tradable, such as accounting, can now be traded.

Production of a final good consists of a continuum of tasks indexed by  $j$ ,  $j \in [0, 1]$ . Northern and Southern suppliers produce vertically (quality) differentiated varieties of a

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<sup>6</sup>I may use two terms interchangeably in the paper.

task. Depending on its choice of product quality, a final good producer decides from which supplier to source each task. Using this tractable supply side model, we can study within-firm product differentiation by quality.

Tasks lie on the unit interval such that their skill requirements are increasing; let  $a(j)$  denote the skill requirement of task  $j$ , then  $a(j)' > 0$ .<sup>7</sup> Northern skill is equally productive as Southern skill in the physical production of tasks. But it is more productive than the Southern in the quality production: one unit of Northern skill produces one unit of quality, and one unit of Southern skill produces  $\lambda$  units of quality,  $\lambda < 1$ .<sup>8</sup>

Suppliers operate in perfectly competitive industries in each region. There is a large number of suppliers in each industry. So, a supplier charges a price that is equal to its marginal cost of production. It implies that a Northern supplier of task  $j$  charges a price equal to

$$p_j^N = a(j)r_N, \tag{1.2.2}$$

and a Southern supplier charges a price equal to

$$p_j^S = a(j)r_S, \tag{1.2.3}$$

where  $r_c$  denotes the price of skill in region  $c$ . Since Northern skills are more productive, their unit price is higher:  $r_N > r_S$ .<sup>9 10</sup>

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<sup>7</sup>Indeed, skill requirement refers to efficiency labour requirement.

<sup>8</sup>See Clark (1987) for a discussion about the possible reasons of differences in labour quality between the North and the South.

<sup>9</sup>It is in line with the empirical evidence reported, for instance, by Easterly (2004) who finds that skilled workers earn more in Northern countries than in Southern ones.

<sup>10</sup>I assumed per unit transport costs and tariffs on tasks in an earlier version of the paper. Since they do not add to the main mechanism in the paper, I assume them away in this version. In general, any cost that increases the relative cost of Northern tasks will not change the results derived from the model. Nevertheless, exploring the role that trade costs play in shaping trade in intermediates is an interesting research area. See Ornelas and Turner (2008, 2012) for two recent contributions.

### 1.2.3 Firms

A firm is a final good producer. There is a large number of firms, and they operate in a monopolistically competitive industry in each region. Throughout the paper, I focus on Southern firms.

A firm pays a fixed entry cost to learn its productivity, and to create a brand. Upon entry, it pays a fixed cost to run the production facilities. Then, the firm combines an equal amount of each task to produce a variety of the final good.<sup>11 12</sup> Production consists of two parts: physical units and quality. For both, I use similar specifications to those used by Kugler and Verhoogen (2011). The following function represents the production of physical units:

$$F(n) = n\phi^\alpha, \quad (1.2.4)$$

where  $n$  denotes number of each task,  $\phi > 0$  firm productivity, and  $0 < \alpha < 1$  sensitivity of unit cost to firm productivity. Thus, a firm with productivity  $\phi$  requires  $\phi^{-\alpha}$  units of each task to produce one unit of final good. Its marginal cost of production is lower the higher the sensitivity of costs to firm productivity (higher  $\alpha$ ).

The quality of final good ( $q$ ) depends on overall task quality ( $\Psi$ ) and firm productivity ( $\phi$ ) in the following way:

$$(i) \frac{\partial q(\phi, \Psi)}{\partial \phi} > 0; (ii) \frac{\partial^2 q(\phi, \Psi)}{\partial \phi^2} < 0; (iii) \frac{\partial^2 q(\phi, \Psi)}{\partial \phi \partial \Psi} > 0. \quad (1.2.5)$$

Assumption (i) in (1.2.5) guarantees that product quality is increasing in both firm productivity and overall task quality used in production. The second assumption implies decreasing returns to both productivity and task quality. Finally, assumption (iii) implies

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<sup>11</sup>As in Bernard et al. (2010), varieties in a market are differentiated from each other by their brand. A firm is allowed to supply only one horizontal variety in a market, although it is allowed to produce different vertically-differentiated varieties in different markets.

<sup>12</sup>The firm can use the same production facilities to manufacture different (vertically differentiated) varieties of a product. So, I assume that the fixed cost of introducing a new variety is negligible.

that marginal gain in quality from productivity is increasing in task quality. In other words, productivity and task quality are complementary in producing quality. For the results derived until Section 1.3.4, only the following assumptions are crucial:  $\frac{\partial q(\phi, \Psi)}{\partial \Psi} > 0$ ,  $\frac{\partial^2 q(\phi, \Psi)}{\partial \Psi^2} < 0$ . The rest of the assumptions in (1.2.5) are required for the extension of the model to heterogeneous firms.

As I mentioned earlier, task quality is proportional to the quality of skills embodied in that task. Thus, if a firm sources tasks in  $[0, I]$  from the South and the rest from the North, the overall quality of its tasks is equal to

$$\Psi(I) = \lambda \int_0^I a(j) dj + \int_I^1 a(j) dj. \quad (1.2.6)$$

In words, the higher the share of tasks sourced from Northern suppliers the higher is the overall task quality:

$$\frac{\partial \Psi(I)}{\partial I} = (\lambda - 1)a(I) < 0.$$

Thus the model assumes both horizontal and vertical task differentiation. It introduces quality considerations into firm's decision where to outsource a continuum of inputs, and this structure is novel to the literature.

To sum up, firms combine a continuum of tasks that they source from the North or the South, and produce differentiated goods. Then, they sell their products to consumers.<sup>13</sup>

### 1.3 Partial Equilibrium

In this section, I focus on the behaviour of a single firm with productivity  $\phi$ . The firm sources tasks in  $[0, I]$  from Southern suppliers and the rest from Northern suppliers. It can sell its product to multiple destinations. So, the firm has to decide the characteristics and price of the product it sells to each market.

All results in this section can be derived without specifying a particular functional form

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<sup>13</sup>Throughout the paper,  $\phi$  is an index for both firms and brands.



for product quality. As I mentioned before, any function that satisfies the assumptions stated in (1.2.5) will generate the results derived in Section 1.3. One particular functional form that is used extensively in the literature to represent complementarity is the following:

$$q(\phi, I) = [\phi^{-b} + \Psi(I)^{-b}]^{\frac{-1}{b}}, \quad (1.3.1)$$

where  $b$  denotes the degree of complementarity. Grossman and Maggi (2000) and Kugler and Verhoogen (2009) use similar functions to model complementarity.

Given the production function in (1.2.4), firm's marginal cost of production is equal to

$$C(\phi, I) = \phi^{-\alpha} \left[ r_S \int_0^I a(j) dj + r_N \int_I^1 a(j) dj \right]. \quad (1.3.2)$$

Demand it faces in region  $c$  is

$$x_c(\phi) = \frac{\mu Y_c}{P_c} (q(\phi, I)^{\gamma_c})^{\sigma-1} \left( \frac{p(\phi, I) + t_c}{P_c} \right)^{-\sigma}, \quad (1.3.3)$$

where  $p$  denotes the price charged by the firm,  $P_c = \left[ \int_{\phi \in \Omega_c} \left( \frac{p_c(\phi) + t_c}{q_c(\phi)^{\gamma_c}} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$  quality-adjusted price index, and  $Y_c$  aggregate income in region  $c$ ;  $t_c$  is per unit cost of transporting the good to region  $c$ . Define the consumer price of variety  $\phi$  as  $p_c^{cif}(\phi, I) = p(\phi, I) + t_c$ .

Given the demand for its product, the firm chooses the price ( $p$ ) and the fraction of tasks to be sourced from Southern suppliers ( $I$ ). Its choice of  $I$ , which is the fraction of domestically-sourced tasks, determines the marginal cost of production by (1.3.2), and the quality of the final good by (1.3.1). Here is the profit maximisation problem of the firm:<sup>14</sup>

$$\max_{p(\phi, I), I \in [0, 1]} \Pi(\phi, I) = x(\phi) [p(\phi, I) - C(\phi, I)] \quad (1.3.4)$$

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<sup>14</sup>Here, I drop region subscripts. Also, in this section, I assume that the firm makes positive profits. In the next section, I discuss a firm's decision of being active in the industry.

$$\text{subject to } x(\phi) = \frac{\mu Y}{P} (q(\phi, I)^\gamma)^{\sigma-1} \left( \frac{p^{cif}(\phi, I)}{P} \right)^{-\sigma}.$$

The firm charges the following price to maximise its profits:

$$p(\phi, I) = \frac{\sigma}{\sigma - 1} C(\phi, I) + \frac{1}{\sigma - 1} t. \quad (1.3.5)$$

The price of a variety equals to a constant mark-up over its marginal cost, plus a fraction of the cost of transporting the variety to the final consumer. So, the firm charges a higher price for the variety that it produces at a higher marginal cost, and that it sells to a more distant consumer.

To maximise its profits, the firm also chooses the fraction of its domestically-sourced tasks, and this fraction solves the following equation:

$$(\sigma - 1)\gamma (p(\phi, I) - C(\phi, I)) \frac{\partial q(\phi, I)}{\partial I} - q(\phi, I) \frac{\partial C(\phi, I)}{\partial I} = 0. \quad (1.3.6)$$

The solution of the equation (1.3.7) defines an implicit function:

$$I^* = I(\Gamma, X),$$

where  $\Gamma$  is a vector of the following parameters  $\gamma, \phi, \lambda, \mu, t$ ; and  $X$  is a vector of aggregate variables and skill prices  $Y, P, r_S, r_N$ . A change in  $I^*$  implies a change in the set of imported inputs at the firm-level. Thus the model introduces a new margin of trade adjustment: the extensive margin of imported inputs. Now, substitute  $p(\phi, I)$  from (1.3.5) into (1.3.6) to obtain:<sup>15</sup>

$$\gamma (C(\phi, I) + t) \frac{\partial q(\phi, I)}{\partial I} - q(\phi, I) \frac{\partial C(\phi, I)}{\partial I} = 0. \quad (1.3.7)$$

In the absence of quality considerations, minimising costs would be the only motive

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<sup>15</sup>Please see Appendix 1.A.1 for the derivation of the corresponding second-order conditions.

that determines the firm-level task trade. It is what we learn from the model developed by Feenstra and Hanson (1996). On the other hand, when deciding on the fraction of its domestically-sourced tasks, a firm in this model faces a trade-off between two opposing effects. A higher  $I$  reduces the firm's marginal cost:

$$\frac{\partial C(\phi, I)}{\partial I} = \phi^{-\alpha} a(I) (r_S - r_N) < 0. \quad (1.3.8)$$

At the same time, a higher  $I$  lowers the quality of its product:

$$\frac{\partial q(\phi, I)}{\partial I} = \frac{\partial q(\phi, I)}{\partial \Psi} \frac{\partial \Psi(I)}{\partial I} < 0,$$

as well as the demand for its product:

$$\frac{\partial x(\phi, I)}{\partial I} = \frac{\partial x(\phi, I)}{\partial q} \frac{\partial q(\phi, I)}{\partial I} < 0.$$

In short, the firm's profit-maximising fraction of domestically-sourced tasks satisfies

$$\frac{\partial}{\partial I} \left( \frac{C(\phi, I) + t}{q(\phi, I)^\gamma} \right)_{I=I^*} = 0.$$

In the rest of this section, I characterise the comparative statics of  $I^*$  – the fraction of domestically-sourced tasks – with respect to the intensity of preferences for quality ( $\gamma$ ), firm productivity ( $\phi$ ), per unit transport costs ( $t$ ), and productivity gap between Northern and Southern skills ( $\lambda$ ).

### 1.3.1 Effect of consumer preferences

What is the effect of the intensity of consumer preferences for quality,  $\gamma$ , on the firm's outsourcing decision – the fraction of its domestically-sourced tasks ( $I^*$ )? To answer this question, totally differentiate the firm's first-order condition in (1.3.7) with respect to the

taste parameter ( $\gamma$ ) and  $I$ , and evaluate this derivative at  $I^*$ :

$$\left\{ \left[ (\sigma - 1) (p(\phi, I) - C(\phi, I)) \frac{\partial q(\phi, I)}{\partial I} \right] d\gamma + D_{II} dI \right\}_{I=I^*} = 0,$$

where  $D_{II}$  denotes the derivative of the combined first-order condition (1.3.7) with respect to  $I$ , and it is negative as long as the second-order conditions for profit-maximisation hold.

Then,

$$\left( \frac{dI}{d\gamma} \right)_{I=I^*} = - \left\{ \frac{\partial q(\phi, I)}{\partial I} \frac{C(\phi, I) + t}{D_{II}} \right\}_{I=I^*}. \quad (1.3.9)$$

Since  $\frac{\partial q(\phi, I)}{\partial I} < 0$  and  $D_{II} < 0$ , both the numerator and denominator of (1.3.9) are negative.

This implies  $\left( \frac{dI}{d\gamma} \right)_{I=I^*} < 0$ . When it faces more intense preferences for quality, the firm sources a higher fraction of tasks from Northern suppliers, and by doing so it improves the overall quality of its inputs. Therefore it produces a higher-quality variety for such consumers:

$$\left( \frac{dq(\phi, I)}{d\gamma} \right)_{I=I^*} = \left\{ \frac{\partial q(\phi, I)}{\partial I} \frac{dI}{d\gamma} \right\}_{I=I^*} > 0,$$

and it charges a higher price for this variety:

$$\left( \frac{dp(\phi, I)}{d\gamma} \right)_{I=I^*} = \frac{\sigma}{\sigma - 1} \left\{ \frac{\partial C(\phi, I)}{\partial I} \frac{dI}{d\gamma} \right\}_{I=I^*} > 0.$$

The following result summarises this finding.

**Result 1.3.1** *A Southern firm facing different demands for quality in different markets differentiates the quality of its product: it sells a higher-quality variety in high-demand than in low-demand markets. When producing the high-quality one, the firm uses an overall higher-quality of tasks by importing more tasks from the North.*

The firm chooses endogenously to become a multi-product firm.<sup>16</sup> This firm produces multiple varieties (versions) of a product in a single product line, and sells them in different markets. Across the varieties, it changes the mix of domestic (Southern) and imported (Northern) tasks. As it pays a higher price for the imported variety of a task, the firm's production cost varies across varieties. As a result, the price it charges also varies across markets.

Result 1.3.1 is in line with the empirical facts F1 and F3 in Table 1.A.1: a Southern firm charges higher factory-gate prices for its product in rich compared to poor markets; and the dispersion of its export prices is positively correlated with the dispersion of its input prices. When consumer demand for quality is high in a market, the firm meets the demand by upgrading the quality of its product. It does so by using higher-quality inputs. Since such inputs are more expensive than low-quality ones the firm charges a higher price in that market.

The result highlights a link between firm's extensive intermediate imports margin and its product margin. As Southern firms gain access to new markets where quality demand is higher than in their domestic market, they add new product varieties to their product lines. Since they sell the new varieties in the rich markets, they should be of higher quality than the existing ones. To produce them, firms need high-quality input varieties that may not be available in the domestic market. They can source such inputs from the North as Northern workers are able to produce higher-quality inputs than their Southern counterparts. In other words, Southern firms gain access to high-productivity Northern workers through intermediate imports. Thus, an expansion on Southern firms' extensive product margin towards higher-quality varieties is associated with an expansion on their extensive intermediate imports margin towards higher-quality inputs.

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<sup>16</sup>I use the term here in a different sense from the existing trade literature that studies firms that produce horizontally-differentiated products (e.g. Bernard et al. (2010), Eckel and Neary (2010)), and from the industrial organisation literature that studies firms that produce vertically differentiated products for a single market (e.g. Johnson and Myatt (2003) and the studies cited in that paper). Here, I study firms that produce vertically differentiated products for segmented markets.

As I mentioned in the introduction, its focus distinguishes the current study from other studies. Here the focus is within-firm quality differentiation between markets rather than between-firms differentiation within a market. Although it is not their primary aim, there are a few theoretical studies that mention the possibility of within-firm quality differentiation. Eckel et al. (2010) show that a multi-product firm invests differently in quality between its horizontally differentiated products that it sells in a market, but not in the quality of a single product between markets.<sup>17</sup> Verhoogen (2008), on the other hand, notes that varying demand for quality across markets leads to within-firm quality differentiation. He does not, however, elaborate on this argument since the firm-level dataset he uses does not allow for testing such prediction. So, he focuses on firm-level average prices, wages and quality in the rest of the paper. In another paper, Crinò and Epifani (2010) observe among Italian manufacturing firms that the correlation between firm productivity and export intensity is increasing in per capita income of the export market. They build a partial equilibrium QHF model to rationalise this observation. Their model correctly predicts that a firm sells a higher-quality product in rich compared to poor markets. However, since the price charged by the firm does not vary with its product quality, the model does not explain the positive correlation between firm-product level prices and per capita income of the destination markets. The primary focus of Crinò and Epifani is the relationship between firm productivity and its export intensity, and their model successfully explains the observed relationship between the two. The current paper, on the other hand, explicitly focuses on within-firm quality and price differentiation. Furthermore, I also suggest a mechanism for such differentiation, which is supported by empirical evidence.

In summary, Result 1.3.1 gives an explanation for the stylised facts F1 and F3 in Table 1.A.1. To my knowledge, this study is the only one that tries to consistently explain them within a single model.

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<sup>17</sup>But their empirical results show that firms upgrade the quality of their core-competence products and sell them at higher prices on average in their export markets.

### 1.3.2 Effect of transport costs

Firms may incur both specific and ad valorem costs when exporting their products. So, a general specification for the consumer price of a good is

$$p_c^{cif}(\phi, I) = \tau p(\phi, I) + t,$$

where  $\tau$  denotes the ad valorem part of the trade cost and  $t$  denotes the specific part. Assume that there are two varieties of a good: one is high-quality and the other low-quality, and the high-quality variety is more expensive, i.e.  $p^h > p^l$ . If both  $\tau$  and  $t$  are non-zero, then the relative consumer price of the high-quality variety,  $(\tau p^h + t)/(\tau p^l + t)$ , increases as  $t$  increases and  $\tau$  decreases. Existing literature on quality and trade focuses on specific trade costs, which are assumed to depend positively on the bilateral distance between the source and the destination market. Since the presence of a specific trade cost reduces the relative price of high-quality goods, exporters should be willing to ship high-quality products longer distances. This is called the Alchian-Allen effect. On the other hand, the presence of an ad valorem trade cost, assuming  $t$  is non-zero, will encourage exporters to ship low-quality goods to markets where they incur high ad valorem trade costs. Therefore, specific and ad valorem trade costs have opposite effects on the relative demand for high-quality products.

Until recently, a lack of detailed data at the product level has hindered researchers from testing the Alchian-Allen hypothesis empirically. Now the availability of firm-product level data makes it possible to test this hypothesis at the firm-level. Two recent empirical papers, Görg et al. (2010) and Manova and Zhang (2012), find that firm-product prices are positively correlated with the firm's distance to the destination market, and the correlation is stronger for differentiated products. Görg et al. (2010) report that there is about 25-30 per cent price difference between a Hungarian exporter's product shipped to Germany and to the US. As I discussed above, this empirical finding, F2 in Table 1.A.1, is closely related

to Alchian-Allen's "shipping the good apples out" hypothesis (1964). As I discussed above, Alchian and Allen provide a demand-side explanation. We need to complement it with a supply-side mechanism of within-firm quality differentiation to fully explain F2. It is where our model comes in.

It is hard to find such mechanism in existing QHF studies. In a model with linear demand, a firm reduces its mark-up in a more distant market – implying a negative correlation between a firm's prices in different markets and its distance from them. In a model with logit demand, as in Verhoogen (2008), a firm lowers both the price and quality of its product in more distant markets (Martin (2009)). So, models with linear and logit demand imply the opposite of what F2 suggests. In a model with CES preferences, a firm adds to its fob price a fraction of the specific cost it bears to transport its product to a market (see (1.3.5)). Assuming that it bears a higher specific cost to transport its product to a more distant market, the firm charges a higher price in such market. Although this explanation is consistent with the observed positive correlation between a firm's fob prices in different markets and its distance from them, it does not explain the second part of F2, which says that the correlation is stronger for differentiated products.

Since existing literature focuses on specific trade costs, I assume that  $\tau$  is zero in the text. I provide a discussion on the effect of ad valorem trade costs on firm's product quality in Appendix 1.A.2. To see the model's implications for the effect of specific trade costs on a firm's product quality, totally differentiate (1.3.7) with respect to  $t$  and  $I$ , and evaluate the derivative at  $I^*$ :

$$\left(\frac{dI}{dt}\right)_{I=I^*} = -\left\{\frac{\gamma \frac{\partial q(\phi, I)}{\partial I}}{D_{II}}\right\}_{I=I^*} < 0.$$

Assuming that specific trade costs increase in distance between home and destination markets, a Southern firm uses a higher fraction of imported tasks from the North, and thus produces a higher-quality variety to sell in a distant than in a near market. It also charges a higher fob price in such market since it bears higher production and transportation costs.



As suggested by Alchian and Allen, adding a per unit transport cost to prices reduces the relative price of high-quality products, and thus increases their relative demand. Knowing it, a firm produces a higher-quality variety to sell in a more distant market. Since producing a higher-quality variety is more costly, it charges a higher price for this variety. So, a Southern firm charges a higher (fob) price for its product in a distant than in a near market for two reasons: first, it adds a fraction of unit transport cost to the price; second, it uses a higher fraction of imported tasks, which are of higher-quality and more expensive, to produce a higher-quality variety for such market. Although the first reason is common in models with CES preferences, the second one is unique to the current model.

**Result 1.3.2** *In the presence of specific trade costs that depend positively on bilateral distance, a Southern firm sells a higher quality product in a distant than in a near market. When producing the high-quality one, the firm uses a higher fraction of imported tasks from the North. Since the imported variety of a task is more expensive than the domestic variety, the firm bears a higher production cost, and thus charges a higher price for the variety it sells in the distant market.*

Result 1.3.2 is consistent with the stylised fact F2.<sup>18</sup> To fully explain it, a model has to feature within-firm quality differentiation across markets. It is what this model does: a firm uses an overall higher-quality of tasks to produce a higher-quality variety for a distant market, and it charges a higher price for this variety. This model explains F2 in a comprehensive way to include other elements that are also missing in existing QHF studies – F1, F2 and F3 in Table 1.A.1. So, the current model provides a useful tool to

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<sup>18</sup>There is an analogy between Result 1.3.2 and the response of a firm to voluntary export restraints (VERs). An exporting country sets VERs to limit the quantity of its exports to a specific country. We know from other studies that a VER may also create an incentive for exporters to upgrade the quality of their products. In 1981, the Japanese government imposed a restriction on the number of its car exports to the U.S. This led to an increase in the price of Japanese cars imported by the U.S. Feenstra (1984) empirically illustrates that the two-thirds of this price increase resulted from quality improvement by the Japanese car exporters. Although the underlying mechanisms are different in two cases, this is an interesting analogy to note. I would like to thank Richard Baldwin for bringing this analogy to my attention.

study comprehensively the recently unearthed stylised facts that existing QHF models do not accommodate.

### 1.3.3 Effect of productivity gap

Here, I discuss an implication of the model that is not yet tested: what is the effect of a change in the relative productivity of Southern skill ( $\lambda$ ) on the firm's profit-maximising fraction of domestically-sourced tasks? To be specific, what happens if Southern workers upgrade the quality of their skills –  $\lambda$  rises. To find the answer, totally differentiate the first-order condition in (1.3.7) with respect to  $\lambda$  and  $I$ , and evaluate it at  $I^*$ :

$$\left\{ \left[ \gamma(C(\phi, I) + t) \frac{\partial^2 q(\phi, I)}{\partial I \partial \lambda} - \frac{\partial q(\phi, I)}{\partial \lambda} \frac{\partial C(\phi, I)}{\partial I} \right] d\lambda + D_{II} dI \right\}_{I=I^*} = 0. \quad (1.3.10)$$

In Appendix 1.A.3, I prove that the term in the square brackets in (1.3.10) is positive.

Since  $D_{II} < 0$ , we obtain

$$\left( \frac{dI}{d\lambda} \right)_{I=I^*} > 0.$$

**Result 1.3.3** *Assume that Southern workers upgrade their skills –  $\lambda$  rises. At constant skill prices, it leads a Southern firm to increase the fraction of its domestically-sourced tasks. The resulting impact on the product quality is ambiguous.*

This is an intuitive result. At constant skill prices, an improvement in the productivity of Southern skill reduces its productivity-adjusted price. This would lead firms substitute away from Northern suppliers, and to increase the fraction of their domestically-sourced tasks. This reasoning, however, ignores another effect that is at work here. As a result of a skill-upgrading in the South, even keeping  $I$  unchanged, the quality of a firm's product improves. The quality gain arises from quality improvement in the firm's initially domestically-sourced tasks. Thus the demand for its product increases, and so does its

profits. So, the initial  $I$  is not optimal at the new level of  $\lambda$ . The firm can now afford to source a higher fraction of tasks from the North:  $I$  falls. Here the substitution effect dominates the quality-upgrading effect. As a result, when there is a skill-upgrading in the South, a Southern firm increases the fraction of its domestically-sourced tasks.

The resulting effect of an increase in  $\lambda$  on a firm's product quality is ambiguous. On the one hand, the quality of tasks that the firm used to source, and is still sourcing from Southern suppliers increases. On the other hand, the quality of tasks that the firm used to source from the North, but is now sourcing from the South reduces. Thus the overall effect of a higher  $\lambda$  on the firm's product quality remains ambiguous.

A skill-upgrading in the South unambiguously reduces the firm's marginal cost and price. The reason is that the firm switches from high-price Northern suppliers to low-price Southern suppliers for a range tasks. Consumers benefit from lower product prices. Without determining the resulting effect of a higher  $\lambda$  on the firm's product quality, however, we cannot tell the direction of change in the quality-adjusted price that consumers face in a market.

This simple exercise shows that a skill-upgrading in the South can result in the region moving up in the global value chain towards higher skill-intensive tasks. The result in part hinges on its partial equilibrium nature: it ignores the indirect effect working through changes in relative skill prices. We should expect the indirect effect to weaken the substitution effect. It is, however, ambiguous whether the indirect effect will be strong enough to turn the result around. In Section 1.4, where I embed the model in a general equilibrium framework, I will examine the other extreme: what happens if relative skill prices adjust one-to-one to a change in relative productivities?

### 1.3.4 Effect of firm productivity

Another interesting relationship is the one between the firm's productivity ( $\phi$ ), and its profit maximising fraction of domestically-sourced tasks ( $I^*$ ). To find the nature of the

relationship, totally differentiate the first-order condition in (1.3.7) with respect to  $\phi$  and  $I$ , and then evaluate it at  $I^*$ :

$$\left\{ \frac{\partial}{\partial \phi} \left[ \gamma (C(\phi, I) + t) \frac{\partial q(\phi, I)}{\partial I} - q(\phi, I) \frac{\partial C(\phi, I)}{\partial I} \right] d\phi + D_{II} dI \right\}_{I=I^*} = 0.$$

Simplify the expression using (1.3.7):

$$\left( \frac{dI}{d\phi} \right)_{I=I^*} = - \left\{ \gamma \frac{\partial q(\phi, I)}{\partial I} \underbrace{\frac{b \frac{C(\phi, I) + t}{q(\phi, I)} \frac{\partial q(\phi, I)}{\partial \phi} + \frac{\alpha}{\phi} t}_{<0}}{D_{II}} \right\}_{I=I^*}.$$

Given the signs above, we obtain

$$\left( \frac{dI}{d\phi} \right)_{I=I^*} < 0. \quad (1.3.11)$$

In words, a high-productivity firm, compared to a low-productivity one, sources a higher fraction of tasks from Northern suppliers. The result directly follows from the complementarity between firm productivity and overall task quality in the production of final good quality. Using the same fraction of imported tasks as a low-productivity firm, a high-productivity one is able to produce a higher-quality product  $\left( \frac{\partial q(\phi, I)}{\partial \phi} > 0 \right)$  at a lower cost  $\left( \frac{\partial C(\phi, I)}{\partial \phi} < 0 \right)$  – implying a higher demand for its product. This creates an incentive for the firm to upgrade the quality of its product by using a higher fraction of imported tasks from the North. From a consumer's point of view, the quality-adjusted price charged by a more productive firm is lower:

$$\begin{aligned} \left( \frac{d [p^{cif}(\phi, I)/q(\phi, I)^\gamma]}{d\phi} \right)_{I=I^*} &= \left\{ \frac{\partial [p^{cif}(\phi, I)/q(\phi, I)^\gamma]}{\partial \phi} + \frac{\partial [p^{cif}(\phi, I)/q(\phi, I)^\gamma]}{\partial I} \frac{dI}{d\phi} \right\}_{I=I^*} \\ &= \left\{ \frac{\partial [p^{cif}(\phi, I)/q(\phi, I)^\gamma]}{\partial \phi} \right\}_{I=I^*} < 0, \end{aligned}$$

since  $\left\{ \frac{\partial [p^{cif}(\phi, I)/q(\phi, I)^\gamma]}{\partial I} \right\}_{I=I^*} = 0$  by the Envelope Theorem. The following result summarises these findings.

**Result 1.3.4** *A high-productivity Southern firm, compared to a low-productivity one, uses a higher fraction of imported tasks from the North and produces a higher-quality variety. Also, it charges a lower quality-adjusted price, and thus earns larger revenues.*

The result that more productive firms produce higher-quality varieties is not new. Indeed, there is a growing pile of studies in the international trade literature focusing on between-firm quality differentiation. They find that firm productivity is positively associated with product quality, and negatively with the product's quality-adjusted price (Baldwin and Harrigan (2011), Johnson (2011), Kneller and Yu (2008), Kugler and Verhoogen (2011), and Verhoogen (2008)). What Result 1.3.4 adds to their findings is that it offers a new mechanism by which productivity differentials between firms generate quality differentials between their products: different firms use different mixes of domestic and imported tasks. In line with the empirical evidence (F4), for a Southern firm, the imported variety of a task is of higher-quality than the domestic variety of the same task. So, a more productive Southern firm produces a higher-quality product by using a higher fraction of imported tasks.

So far, I have set up the model, and derived some results from a single firm's perspective, which are in line with the empirical facts in Table 1.A.1. In the next section, I embed the model in a Melitz-type heterogeneous-firm framework. Before jumping to the next section, I summarise the results derived up to here. First, a Southern firm engages in quality-to-market by selling a higher-quality variety in rich than in poor, as well as in distant than in near markets. Second, a high-productivity Southern firm, compared to a low-productivity one, produces a higher-quality variety since it uses a higher fraction of imported tasks. Also, it charges a lower quality-adjusted price and earns larger revenues in a market. Finally, when Southern workers upgrade their skills, a Southern firm

increases the fraction of its domestically-sourced tasks, resulting in an ambiguous change in the product quality.

## 1.4 Industry Equilibrium

I start with describing the setup of the general equilibrium extension. Consumer preferences in each region are given by (1.2.1). Let  $L_c$  denote the population of region  $c$ , then the relative size of the Southern market satisfies  $L_S/L_N = \varepsilon > 1$ . In both regions, an individual inelastically supplies one unit of skill.

I explain the setup of intermediate goods and the differentiated final good industries in Section 1.2. In the homogenous good industry, which is perfectly competitive, a large number of firms produce  $x_0$ . They produce the good under constant returns to scale technology. The good is freely traded between the two regions. Northern skills are more productive than Southern ones in the production of  $x_0$ : one unit of Northern skill produces one unit, and one unit of Southern skill produces  $\lambda < 1$  units of  $x_0$ . In each region the industry is large enough so that each produces a strictly positive output of  $x_0$ . It requires that productivity-adjusted skill abundances in the two regions are almost identical. Thus the homogenous good industry equalises the productivity-adjusted skill prices between them:  $r_S = \lambda r_N$ .

In the differentiated goods industry, there is a continuum of firms, indexed by their productivity  $\phi$ . There is Melitz-type uncertainty in the industry: all firms are ex-ante identical; they have to pay a fixed entry cost ( $f_e > 0$  in terms of Northern skills, and  $f_e/\lambda$  in Southern skills) to learn their productivity. Firms draw their productivities from a Pareto distribution ( $G(\phi)$ ) with shape parameter  $\nu$ :

$$G(\phi) = 1 - \phi^{-\nu}, \text{ where } \phi \in [1, \infty) \text{ and } \nu > \eta_N > \eta_S > 2,$$

where  $\eta_c = (\alpha + \gamma_c - 1)(\sigma - 1)$ ,  $c = S, N$ . The density function corresponding to  $G(\phi)$  is

$g(\phi)$ .

A firm enters the industry only if its expected profits in that market are higher than the cost of entry. Upon entry, a firm pays a fixed production cost ( $f > 0$  in terms of Northern skills, and  $f/\lambda$  in terms of Southern skills) to run the production facilities. Only those firms that can cover the fixed production cost can produce. Thus, as in Melitz (2003), some firms are not active in the industry.

The active ones decide where to locate in the next stage. Locating in the North produces a lump-sum benefit which increases with firm productivity. For instance, assuming that infrastructure quality is higher in the North, a firm can benefit from lower fixed costs if it locates in this region. Owing to the complementary nature of public infrastructure, a more productive firm benefits more from locating in the North. The following function represents the lump-sum benefits from locating in the North:

$$\beta(\phi) = \beta\phi,$$

where  $\beta > 0$ . Nevertheless, it is more costly to locate in the North since, for instance, land prices are higher. The additional fixed cost of locating in the North is  $\ell > 0$ . So, a firm locates in the North if and only if its productivity is greater than  $\phi_l = \ell/\beta$ . In the rest of the paper, I assume this value is extremely large –  $\phi_l \rightarrow \infty$ . Two implications arise from such an approach: first, a firm's location decision is independent of its output and exporting decisions; and second, only the most productive firms are able to locate in the North. Others locate in the South, and, as it has been so far, their behaviour is what I focus here.<sup>19</sup>

After deciding where to locate, a firm decides which markets to sell its products. To export its product, it has to pay a fixed cost that I express in terms of fixed production

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<sup>19</sup>I keep firm's location problem as simple as possible since it is not the focus of this paper. Under these assumptions, the distribution of firms across regions does not affect the key results derived from the model. As  $\phi_l \rightarrow \infty$ , expected profits of Northern firms have negligible effect on the entry decision of a potential entrant, and thus I ignore them. The question of firm location can also be studied within this model by allowing a firm's output decision to depend on its location.

cost as  $f_X = \theta f$ ,  $\theta > 0$ .<sup>20</sup> Also, the firm has to determine the varieties to be produced in its product line. From then on, it earns the same per period profit unless hit by a bad shock that induces a forced exit from the industry. The probability of being hit by a bad shock is  $\delta$ , which is exogenous, and identical across firms and time.

As I mentioned in Section 1.2.1, Hallak (2006) finds that the taste parameter  $\gamma$  is increasing in consumer income. So, since  $r_N > r_S$ , I assume  $\gamma_N > \gamma_S$ : Northern consumers have more intense preferences for quality than Southern ones.

For the sake of mathematical tractability, I assume that the elasticity of complementarity between productivity and task quality is unity ( $b = 1$ ), and that transport costs are zero ( $t = 0$ ).

Next, using (1.3.7), I need to derive the key firm-level expressions: price, task quality, and product quality. Setting  $t = 0$  in (1.3.7) gives

$$\gamma C(\phi, I) \frac{\partial q(\phi, I)}{\partial I} - q(\phi, I) \frac{\partial C(\phi, I)}{\partial I} = 0.$$

We can write each term explicitly. When the degree of complementarity between productivity and task quality is unity, we have

$$\frac{\partial q(\phi, I)}{\partial I} = q(\phi, I)^2 \Psi(I)^{-2} (\lambda - 1) a(I).$$

Using this together with (1.3.2) and (1.3.8), we obtain

$$\gamma \phi^{-\alpha} \left[ r_S \int_0^I a(j) dj + r_N \int_I^1 a(j) dj \right] q(\phi, I)^2 \Psi(I)^{-2} (\lambda - 1) a(I) - q(\phi, I) \phi^{-\alpha} (r_S - r_N) a(I) = 0.$$

By conditional factor price equalisation, we have  $r_S = \lambda r_N$ :

$$\gamma \phi^{-\alpha} r_N \left[ \lambda \int_0^I a(j) dj + \int_I^1 a(j) dj \right] q(\phi, I)^2 \Psi(I)^{-2} (\lambda - 1) a(I) - q(\phi, I) \phi^{-\alpha} r_N (\lambda - 1) a(I) = 0.$$

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<sup>20</sup>A firm pays  $f_x$  in terms of Northern skills, and  $f_x/\lambda$  in Southern skills.



Note that  $\Psi(I) = \lambda \int_0^I a(j) dj + \int_I^1 a(j) dj$ . Simplifying and re-arranging gives

$$\gamma \frac{q(\phi, I)}{\Psi(I)} - 1 = 0. \quad (1.4.1)$$

Without imposing a functional form on the unit skill requirement function  $a(j)$ , identifying a firm's profit maximising fraction of domestically-sourced tasks ( $I^*$ ) is not possible. We can, however, express  $I^*$  as a function of firm productivity, and consumer taste parameter  $\gamma_c$ . In (1.4.1), add region subscripts and use (1.3.1) with  $b = 1$  to obtain

$$\Psi(I^*) = \tilde{\Psi}_c(\phi) = \phi(\gamma_c - 1). \quad (1.4.2)$$

Remember that  $\Psi(I)$  is a decreasing function of  $I$ . So, this expression confirms previous findings in the paper: more productive Southern firms use higher fractions of imported tasks from the North (Result 1.3.4); a firm which sells in both markets uses a higher fraction of imported tasks to produce a higher-quality variety for the Northern market since  $\gamma_N > \gamma_S$  (Result 1.3.1).

Another implication of (1.4.2) is that a firm's absolute mark-up ( $p(\phi) - C(\phi)$ ) varies across markets, with its mark-up being higher in the Northern market. This results from the interaction between demand and supply-driven quality differentiation in the model. This feature will prove to be important to explain the fifth stylised fact in Table 1.A.1, about which I have remained silent so far: a firm's prices and revenues correlate positively across markets (F5). According to Manova and Zhang (2012), existing heterogeneous firm trade models do not explain F5. The models with standard CES preferences imply zero correlation as a firm's costs and prices do not vary across markets; those with quadratic preferences imply ambiguous results. According to them, a consistent explanation for F5 requires within-firm quality differentiation and varying mark-ups across markets.

Let us take the unit skill prices in the North  $r_N$  as the numéraire. So, set  $r_N = 1$ ,

and use (1.4.2) to derive the marginal cost, price, quality and quality-adjusted price of the variety that a firm with productivity  $\phi$  sells in region  $c$ :

$$C_c(\phi) = (\gamma_c - 1)\phi^{1-\alpha}, \quad (1.4.3a)$$

$$p_c(\phi) = \frac{\sigma}{\sigma - 1}(\gamma_c - 1)\phi^{1-\alpha}, \quad (1.4.3b)$$

$$q_c(\phi) = \frac{\phi(\gamma_c - 1)}{\gamma_c}, \quad (1.4.3c)$$

$$\frac{p_c(\phi)}{q_c(\phi)^{\gamma_c}} = \frac{\sigma}{\sigma - 1}(\gamma_c - 1)^{1-\gamma_c}\gamma_c^{\gamma_c}\phi^{1-\alpha-\gamma_c}. \quad (1.4.3d)$$

The expression in (1.4.3c) gives the firm's product quality choice in a market. With the extension to heterogeneous firms, the model predicts that a firm's quality choice depends on its own productivity  $\phi$ , and its overall task quality  $\Psi(I^*)$  which, in turn, depends on firm productivity and consumer taste for quality from (1.4.2). Thus the study contributes to the QHF literature by suggesting a well-founded and simple specification for a firm's optimal quality choice, which features quality-to-market strategy. As the imported variety of a task is more expensive than the domestic variety, the firm charges a higher price for the variety that it sells in the Northern market (1.4.3b). Within a market, compared to a low-productivity firm, a high-productivity firm charges a lower quality-adjusted price (1.4.3d).

A firm, first, decides whether to enter the industry. Second, it decides which markets to serve. Finally, it decides on its task composition (domestically-sourced and imported), product quality, and price for each variety it produces. I started from the firm's final decision. So, the next step is to study the firm's market participation decision. A firm with productivity  $\phi$  produces if and only if it makes positive profits; the firm's variable profits should, at least, cover its fixed costs. Otherwise, it remains inactive. It is easy to see that if a Southern firm exports to the Northern market then it should also sell in the domestic market. The reason is the following: if a firm is profitable in the Northern market, then its variable profits in this market should cover the sum of fixed production

cost  $f$  and fixed trade cost  $f_X$ . Since it does not have to pay any additional fixed costs to sell its product in the domestic market, the firm should also sell its product there. But the reverse is not true: a Southern firm that is profitable in the domestic market may not profitably export to the Northern market as it has to pay an additional fixed cost  $f_X$  to sell its product there. In other words, only a fraction of active firms in the Southern market export to the Northern market.

Formally, we can derive a condition that determines the least productive active firm in the industry. The productivity of this firm provides a cutoff level such that a firm with productivity  $\phi$  is active in the industry iff its productivity is above the cutoff level. Here is the condition:

$$\Pi_S(\phi_{SS}^*) = \Pi_S^{var}(\phi_{SS}^*) - fr_N = 0 \iff x_S(\phi_{SS}^*) [p_S(\phi_{SS}^*) - C_S(\phi_{SS}^*)] - (f/\lambda)r_S = 0, \quad (1.4.4)$$

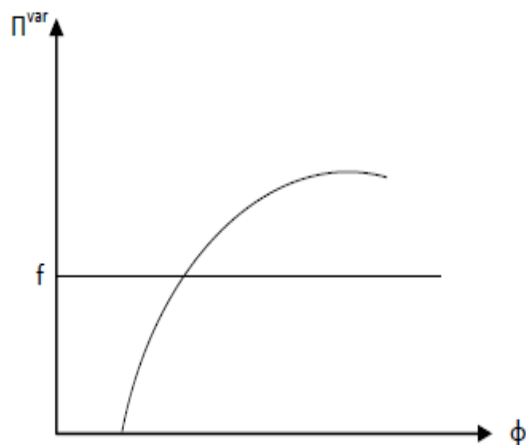
where  $\phi_{SS}^*$  denotes the cutoff productivity of the least active firm in the industry, and  $\Pi_S^{var}(\phi_{SS}^*)$  denotes its variable profits. Appendix 1.A.4 shows, and Figure 1.4.1 illustrates that profits are increasing in productivity. In a market, a high-productivity firm, compared to a low-productivity one, produces a higher-quality variety at a lower cost. So, it charges a lower quality-adjusted price, and makes larger profits. Therefore, any firm with productivity above  $\phi_{SS}^*$  makes positive profits in the industry.

Next, we need to determine which Southern firms serve the domestic market only, and which ones also export to the Northern market. Appendix 1.A.5 shows that the model predicts a sorting of Southern firms by export status: only the more productive Southern firms export to the rich Northern market. The prediction requires the following condition to hold:

$$\theta > \frac{\nu - \eta_N}{\nu - \eta_S}. \quad (1.4.5)$$

As  $\eta_N > \eta_S$ , we have  $(\nu - \eta_N)/(\nu - \eta_S) < 1$ . In Melitz's original model, under zero variable trade costs, sorting of firms into exporting arises only if fixed export cost is larger

Figure 1.4.1: Cut-off productivity condition



than fixed production cost –  $\theta > 1$ . In this paper, on the other hand, sorting of Southern firms into exporting to the Northern market can arise even when fixed cost of exporting is smaller than the fixed production cost –  $(\nu - \eta_N)/(\nu - \eta_S) < \theta < 1$ . So, difference in quality demand between the regions relaxes the condition on fixed trade costs for partitioning of firms by export status; the condition in (1.4.5) is less restrictive than the corresponding condition in Melitz (2003) under zero variable trade costs. Alternatively, we can interpret this as follows: demand difference between the regions plays the role that iceberg trade cost plays in Melitz (2003). It implies that the productivity sorting prediction of Melitz is robust to zero variable trade costs if, for instance, demand heterogeneity across regions is introduced.

Given that the condition in (1.4.5) holds, Appendix 1.A.5 derives the cutoff productivity for exporting relative to that of being active in the industry:

$$\frac{\phi_{SN}^*}{\phi_{SS}^*} = \left( \theta \varepsilon \lambda \frac{\nu - \eta_S}{\nu - \eta_N} \right)^{1/\nu}.$$

The difference between two cutoff productivities depends on two factors: aggregate income and consumer preferences. The ratio  $(1/\varepsilon\lambda)$  captures the Northern aggregate income relative to the Southern. If this ratio rises, then the cutoff productivity for exporting to

the Northern market, relative to serving the domestic market, falls. This prediction is in line with the findings of Chaney (2008); it is easier to sell in a larger than in a smaller market. The second factor that affects the difference between two cutoff productivities is the relative intensity of consumer preferences for quality. The term  $\frac{\nu - \eta_S}{\nu - \eta_N}$  captures this effect. The parameter  $\eta_c$  directly depends on the ratio of consumer taste parameter  $\gamma_c$ . Since  $r_N > r_S$ , in line with the empirical evidence, I assume  $\gamma_N > \gamma_S$ , which implies  $\nu - \eta_S > \nu - \eta_N$ . Therefore  $\phi_{SN}^*$  increases relative to  $\phi_{SS}^*$  when the demand for quality in the Northern market increases relative to the Southern market. This prediction is novel to the QHF literature.

**Result 1.4.1** *Assume that the intensity of consumer preferences for quality differs between the two regions such that  $\gamma_N > \gamma_S$ . It implies that, for Southern firms, the cutoff productivity for exporting to the Northern market is higher than that of serving the domestic market:  $\phi_{SN}^* > \phi_{SS}^*$ .*

Result 1.4.1 modifies the productivity-sorting prediction of Melitz, which says that the productivity cutoff for exporting is higher than for selling in the domestic market. In Melitz's paper (2003), the prediction arises from a combination of fixed and variable trade costs. Here, it arises from a combination of fixed trade costs and differences in consumer tastes for quality between the regions. In the current model, productivity differences between firms are reflected in differences in their costs and differences in their product quality. A firm's product quality depends on its productivity and the overall task quality used in the production, which, in turn, depends positively on the firm's productivity. So, as (1.4.3c) and (1.4.3d) show, compared to a low-productivity firm, a high-productivity firm produces a higher quality variety and charges a lower quality-adjusted price in a market. In other words, low-productivity firms have comparative disadvantage in producing high-quality goods. Such disadvantage is magnified by consumer's greater taste for quality in the Northern market. Thus, even when the fixed export cost is acceptably low, only

the more productive Southern firms are able to export to the Northern market where the taste for quality is more intense than in their domestic market.

The prediction is open to testing. When testing it, one should find a proxy for consumer preferences for quality, and control for aggregate income. Controlling for aggregate income is necessary since, as I argued above, the threshold productivity for selling to a higher-income market is lower. Here, the appropriate measure is gross domestic product (GDP). On the other hand, finding a proxy for consumer preferences for quality is difficult. In doing so, one can benefit from the demand side of the Linder hypothesis (1961). It argues that, in a market, per capita income is the most important determinant of consumer preferences. To be specific, richer consumers demand higher-quality products. So, when testing Result 1.4.1, one can use per capita GDP as a proxy for the intensity of consumer preferences for quality. According to this result, controlling for aggregate income, the productivity threshold for selling to a higher-per-capita-income market is higher.

Now, I will examine the general equilibrium implications of a skill-upgrading in the South.<sup>21</sup> In partial equilibrium, assuming that skill prices remain unchanged, a skill-upgrading in the South leads all firms to substitute away from Northern suppliers. As a result, product prices, unadjusted for quality, fall. Here, I examine the other extreme: relative skill prices adjust to match a change in relative skill productivities.

From expression (1.4.2), we see that, for a firm, the profit-maximising overall task quality depends only on its productivity and the intensity of consumer preferences for quality, implying that its overall task quality will not change with  $\lambda$ . For this result to hold, the firm should be switching from Northern suppliers to Southern ones for a range of tasks;  $I^*$  increases.

$$\frac{dI^*}{d\lambda} = \frac{\int_0^{I^*} a(j) dj}{(1 - \lambda)a(I^*)} > 0.$$

But unlike the partial equilibrium case, here the increase in  $I^*$  does not arise from a substitution effect. Because after a skill-upgrading in the South, relative skill price adjust

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<sup>21</sup>In Appendix 1.A.6, I solve the model in general equilibrium.

such that quality-adjusted relative skill prices remain unchanged. Then, why would a firm move part of its outsourcing from the North to the South? At the initial composition of tasks ( $I_0^*$  vs  $1 - I_0^*$ ), a skill upgrading in the South raises the firm's overall task quality, and thus the quality of and demand for its product:

$$\lambda \uparrow \Rightarrow \Psi(I_0^*) \left( = \lambda \int_0^{I_0^*} a(j) dj + \int_{I_0^*}^1 a(j) dj \right) \uparrow \Rightarrow q(\phi, I_0^*) \uparrow \Rightarrow x_c(\phi) \uparrow .$$

And the associated increase in the relative skill prices in the South raises the firm's marginal cost and price:

$$r_S \uparrow \Rightarrow C(\phi, I_0^*) \left( = \phi^{-\alpha} \left[ r_S \int_0^{I_c^*} a(j) dj + r_N \int_{I_c^*}^1 a(j) dj \right] \right) \uparrow \Rightarrow p_c(\phi, I_0^*) \uparrow .$$

The resulting change in the firm's profits is, however, negative.<sup>22</sup> So, the firm offsets the negative change in its profits by reducing its costs; it lowers the fraction of its imported tasks:  $I_c^*$  increases. As a result, the firm's marginal cost, price, and quality-adjusted price will remain unchanged.

On the extensive margin, we only observe the income-raising effect of higher  $\lambda$ : aggregate income in the South increases, cutoff productivity for being active in the industry falls, and more firms enter the market. The mass of firms selling in the Southern market increases. On the other hand, the mass of those selling in the Northern market remains unchanged. In other words, the Southern market can accommodate a larger mass of firms, but the same is not true for the Northern market. It implies that competition to sell in the Northern market becomes tougher; the upward pressure on skill prices drives low-productivity (and low-quality) firms out of the market –  $\phi_{SN}^*$  rises.

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<sup>22</sup>Firm's profits are negatively related to its quality-adjusted price:  $\frac{p_c(\phi)}{q_c(\phi)^{\gamma_c}}$ . As a result of an equal increase in  $\lambda$  and  $r_S$ , the resulting change in the firm's quality-adjusted price is proportional to

$$1 - \phi^{-(\alpha+1)} > 0.$$

Thus the firm's profits fall.

**Result 1.4.2** *Assume that Southern workers upgrade their skills and become more productive –  $\lambda$  rises. The presence of the homogeneous good causes a matching increase in the relative skill prices,  $r_S/r_N$ . At the firm-level, a firm increases the fraction of its domestically-sourced tasks, keeping its product quality, marginal cost, and price unchanged. At the aggregate-level, income in the South increases. So, the cutoff productivity for selling in the Southern market falls, and the mass of firms increases. In the Northern market, intense competition raises the cutoff productivity, leaving the mass of firms unchanged.*

Now, let us go back to Table 1.A.1. Only one stylised fact, F5, remains unexplained. The extension of the model to heterogeneous firms allows us to explain it in a consistent way with the other stylised facts. F5 says that a firm earns higher revenues in a market where it charges a higher fob price. Manova and Zhang (2012) report this empirical finding using Chinese transaction-level data. They highlight that it is robust to controlling for firm’s country-product specific market share. The QHF studies that use standard CES preferences do not explain F5 because a firm’s fob price does not vary across markets, implying zero correlation. The studies that use quadratic preferences generate ambiguous results.

Can this model accommodate the empirical finding that a firm earns higher revenues in a market where it charges a higher fob price? First, let us check how a firm’s price varies across markets. From (1.4.3b), we see that a firm selling to both markets charges a higher price in the Northern market:

$$\frac{p_N(\phi)}{p_S(\phi)} = \frac{\gamma_N - 1}{\gamma_S - 1} > 1.$$

What about its revenues? The corresponding ratio for the firm’s revenues is equal to:

$$\frac{r_N(\phi)}{r_S(\phi)} = \left( \frac{\phi}{\phi_N^*} \right)^{\eta_N - \eta_S} \left( \frac{1}{\theta \varepsilon \lambda} \frac{\nu - \eta_N}{\nu - \eta_S} \right)^{\eta_S / \nu}.$$



So, we have  $r_N(\phi) > r_S(\phi)$  if and only if the following holds:

$$\phi > \phi_N^* \left( \theta \varepsilon \lambda \frac{\nu - \eta_S}{\nu - \eta_N} \right)^{\frac{\eta_S/\nu}{\eta_N - \eta_S}} = \bar{\phi} > \phi_N^*.$$

Therefore, we can state the following result.<sup>23</sup>

**Result 1.4.3** *There exists a productivity threshold ( $\bar{\phi}$ ) above which a firm's job prices and revenues are positively correlated across markets. Observing such correlation is more likely when firm productivities are less dispersed ( $\nu$  is higher).*

Northern consumers demand higher-quality varieties than Southern consumers. Observing this, a Southern firm uses a higher fraction of imported tasks to produce a higher-quality variety for the Northern market. Since imported tasks are more expensive, producing such variety is more costly. Thus the firm charges a higher price for the variety it sells in the Northern market. If the firm's productivity is high enough, between markets, its cost increases by less than the quality of its product does. Therefore the firm earns higher revenues in the Northern market where it charges a higher fob price.

This prediction does not, however, hold for any Southern firm selling to the Northern market. Whether we observe it for an average productivity firm depends on the productivity distribution. To be specific, if firm productivities concentrate around the mean—their dispersion is low—the chance of observing a positive correlation between firm's (fob) prices and revenues across markets is higher.

## 1.5 Conclusion

Recent transaction-level datasets from Southern countries have unearthed new findings that are either missing in, or conflicting with the predictions of existing international trade models. First, I discuss that they all come together nicely into a consistent story about

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<sup>23</sup>See Appendix 1.A.7 for the proof of the second part of the following result.

a firm's integration into global markets, which can be titled *within-firm differentiation* – a strategy that consists of two elements: quality-to-market and multi-sourcing of inputs. Then, I present a tractable trade model to study the sources and consequences of within-firm differentiation.

The model predicts both quality-to-market and multi-sourcing at the firm-level. On the supply side, to produce a final good, a firm combines a continuum of tasks that vary according to their skill requirements. The firm can source each task from domestic or foreign suppliers. Assuming that skills of Northern workers are of higher quality than those of Southern workers, tasks produced by Northern suppliers are of higher quality. Higher quality commands higher price; for a Southern firm, sourcing a task from Northern suppliers is more expensive than sourcing it from domestic suppliers. Facing a trade-off between quality and cost, the firm decides which inputs to source domestically and which ones to import. The model predicts that it imports more skill-intensive ones from the North, and sources the rest domestically. As consumers located in different regions value quality at varying degrees, the firm adapts its product to local market by changing the fraction of its imported tasks. Also, since the relative demand for high-quality products is higher in distant than in near market, the firm produces a higher-quality variety for the distant market by using a higher fraction of imported tasks. Thus, in line with the empirical evidence, the firm engages in quality-to-market strategy by sourcing tasks from multiple sources.

Next, I extend the model to heterogeneous firms. The extension provides a simple specification for a firm's quality choice, which depends on the firm's productivity and its overall task quality which, in turn, depends positively on the firm's productivity and the intensity of consumer taste for quality. Thus the extension contributes to the QHF literature by deriving a well-founded and simple expression for the quality choice of a firm that engages in quality-to-market strategy. I also solve the model in general equilibrium and show that taste differences between markets relax the restriction on fixed trade costs

to obtain Melitz's prediction that only the more productive firms select into exporting. Under zero variable trade costs, even when the fixed cost of exporting is acceptably low compared to Melitz's threshold, only the more productive Southern firms can export to the Northern market where quality demand is higher than in their domestic market. These firms charge higher prices in the Northern market than in the domestic market. Also, among them, the most productive ones earn higher revenues in the Northern market – implying a positive relationship between firm-product-level prices and revenues across markets.

I propose another prediction that is open to testing. Regardless of what happens to skill prices, a skill upgrading in the South leads firms to substitute away from imported tasks. At one extreme, skill prices remain unchanged – corresponding to partial equilibrium. In that case, the firm's marginal cost and price fall, but the direction of change in its product quality and quality-adjusted price is ambiguous. At the other extreme, skill prices adjust one-to-one to the change in relative productivities. In that case, the firm's product quality, marginal cost, and price remain unchanged. The general equilibrium effect is twofold. First, the South moves up towards more skill-intensive tasks in the global value chain. Second, the resulting increase in Southern aggregate income raises the mass of successful entrants into the domestic differentiated goods industry, and competition for exporting to the Northern market becomes tougher. So, the cutoff productivity for exporting increases. In short, an overall improvement in the quality of tasks produced in the South weeds out low-productivity final good exporters from the Northern market.

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# 1.A Appendix

## 1.A.1 Second-order conditions for profit maximisation

To check the second-order conditions for a unique solution for  $I \in (0, 1)$ , define the corresponding Hessian matrix:

$$H = \begin{bmatrix} \partial^2 \Pi / \partial p^2 & \partial^2 \Pi / \partial p \partial I \\ \partial^2 \Pi / \partial I \partial p & \partial^2 \Pi / \partial I^2 \end{bmatrix}.$$

The second-order conditions for a maximum are:

$$\begin{aligned} \partial^2 \Pi / \partial p^2 &< 0, \\ |H| &> 0. \end{aligned}$$

The signs of the individual terms, evaluated at  $(p^*, I^*)$ , are<sup>24</sup>

$$\begin{aligned} \partial^2 \Pi / \partial p^2 &= \mu Y P^{\sigma-1} (1 - \sigma) (p + t)^{-\sigma-1} q^{\gamma(\sigma-1)} < 0, \\ \partial^2 \Pi / \partial I^2 &= -\mu Y P^{\sigma-1} (p + t)^{-\sigma} q^{\gamma(\sigma-1)-1} \left\{ \underbrace{\frac{\partial q}{\partial I} \frac{\partial C}{\partial I}}_{<0} ((\sigma - 1)\gamma + 1) \right. \\ &\quad \left. + \underbrace{\frac{\partial q}{\partial I}}_{<0} (\sigma - 1)\gamma (b + 1) \frac{p - C}{\Psi} \frac{\partial \Psi}{\partial I} \left( 1 - \frac{q^b}{\Psi^b} \right) \right\} < 0, \\ \partial^2 \Pi / \partial I \partial p &= \partial^2 \Pi / \partial p \partial I = \mu Y P^{\sigma-1} \sigma (p + t)^{-\sigma-1} q^{\gamma(\sigma-1)} \frac{\partial C}{\partial I} < 0. \end{aligned}$$

As  $\partial^2 \Pi / \partial p^2 < 0$ , the first condition is satisfied. To check the second one, we need to determine the sign of  $|H|$  at  $(p^*, I^*)$ :

$$|H| = (\partial^2 \Pi / \partial p^2)(\partial^2 \Pi / \partial I^2) - (\partial^2 \Pi / \partial p \partial I)^2$$

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<sup>24</sup>I abuse the notation by dropping the arguments.

$$\begin{aligned}
&= -\frac{\sigma}{(1-\sigma)^2} \left( \frac{\partial^2 \Pi}{\partial p^2} \right)^2 \frac{\partial C}{\partial I} \left[ (1-1/\gamma) \frac{\partial C}{\partial I} - (\sigma-1)(b+1) \frac{p-C}{\Psi} \frac{\partial \Psi}{\partial I} \left( 1 - \frac{q^b}{\Psi^b} \right) \right] \\
&= \underbrace{\frac{\sigma}{1-\sigma} \left( \frac{\partial^2 \Pi}{\partial p^2} \right)^2 \frac{\partial C}{\partial I}}_{>0} \left[ \frac{p-C}{q} \frac{\partial q}{\partial I} (\gamma-1 - \Psi^b \phi^{-b}) - \underbrace{b \frac{p-C}{\Psi} \frac{\partial \Psi}{\partial I} \left( 1 - \frac{q^b}{\Psi^b} \right)}_{>0} \right].
\end{aligned}$$

The second term in the square brackets is positive.  $|H|$  is positive as long as the second term dominates the first. A sufficient condition for  $|H| > 0$  is

$$\gamma < 1 + \Psi^b \phi^{-b}.$$

In words, the intensity of consumer preference for quality should not exceed unity significantly. Throughout the paper, I focus on the values of  $\gamma$  that satisfy this condition. So,  $I^*$  satisfies  $0 < I^* < 1$ .

### 1.A.2 Effect of ad valorem trade costs on product quality

In the presence of specific and ad valorem trade costs, consumer price of a good is given by

$$p^{cif}(\phi, I) = \tau p(\phi, I) + t.$$

Then the first-order condition with respect to price becomes:

$$p(\phi, I) = \frac{\sigma}{\sigma-1} C(\phi, I) + \frac{1}{\tau(\sigma-1)} t.$$

Using this we can modify (1.3.7) as follows

$$\gamma \left( C(\phi, I) + \frac{t}{\tau} \right) \frac{\partial q(\phi, I)}{\partial I} - q(\phi, I) \frac{\partial C(\phi, I)}{\partial I} = 0. \quad (1.A.1)$$



To see the effect of specific trade costs on a firm's product quality, totally differentiate (1.A.1) with respect to  $t$  and  $I$ , and evaluate the derivative at  $I^*$ :

$$\left(\frac{dI}{dt}\right)_{I=I^*} = -\left\{\frac{\gamma}{\tau} \frac{\frac{\partial q(\phi, I)}{\partial I}}{D_{II}}\right\}_{I=I^*} < 0.$$

So, Result 1.3.2 is robust to the presence of ad valorem trade costs as  $\frac{\partial q(\phi, I)}{\partial I} < 0$ . Now, let us totally differentiate (1.A.1) with respect to  $\tau$  and  $I$  at  $I^*$  to derive

$$\left(\frac{dI}{d\tau}\right)_{I=I^*} = \left\{\frac{\gamma t}{\tau^2} \frac{\frac{\partial q(\phi, I)}{\partial I}}{D_{II}}\right\}_{I=I^*} > 0.$$

In the presence of both specific and ad valorem trade costs, a firm produces lower-quality product varieties for markets where it incurs high ad valorem trade costs. If both specific and ad valorem trade costs depend positively on distance, then the relationship between bilateral distance and the quality of a firm's product will depend on the relative importance of specific and ad valorem costs. In particular, if specific trade costs are more important, then a firm will use higher-quality inputs to produce higher-quality varieties for more distant markets.

### 1.A.3 Proof of Result 1.3.3

To determine the sign of  $(dI/d\lambda)_{I=I^*}$ , we need to know the sign of the following partial derivative:

$$\Upsilon = \left\{ \left[ \gamma(C(\phi, I) + t) \frac{\partial^2 q(\phi, I)}{\partial I \partial \lambda} - \frac{\partial q(\phi, I)}{\partial \lambda} \frac{\partial C(\phi, I)}{\partial I} \right] \right\}_{I=I^*}. \quad (1.A.2)$$

First, let us consider the terms in the expression individually:

$$\begin{aligned} \frac{\partial^2 q(\phi, I)}{\partial I \partial \lambda} &= \frac{\partial^2 q(\phi, I)}{\partial \Psi \partial \lambda} \frac{\partial \Psi}{\partial I} + \frac{\partial q(\phi, I)}{\partial \Psi} \frac{\partial^2 \Psi(I)}{\partial I \partial \lambda}, \\ \frac{\partial q(\phi, I)}{\partial \lambda} &= \frac{\partial q(\phi, I)}{\partial \Psi} \frac{\partial \Psi(I)}{\partial \lambda}, \end{aligned}$$

where

$$\begin{aligned}\frac{\partial q(\phi, I)}{\partial \Psi} &= q(\phi, I)^{1+b} \Psi(I)^{-1-b}, \\ \frac{\partial^2 q(\phi, I)}{\partial \Psi \partial \lambda} &= (1+b) \left( \frac{q(\phi, I)}{\Psi(I)} \right)^{1+b} \frac{\partial \Psi(I)}{\partial \lambda} \left[ \frac{1}{q(\phi, I)} \frac{\partial q(\phi, I)}{\partial \Psi} - \frac{1}{\Psi(I)} \right].\end{aligned}$$

We can use these to expand (1.A.2). Below, for simplicity, I drop the arguments of the functions:

$$\gamma(C+t) \frac{\partial q}{\partial \Psi} \left[ \frac{1+b}{q} \frac{\partial q}{\partial \Psi} \frac{\partial \Psi}{\partial I} \frac{\partial \Psi}{\partial \lambda} - \frac{1+b}{\Psi} \frac{\partial \Psi}{\partial I} \frac{\partial \Psi}{\partial \lambda} + a(I) \right] - \frac{\partial q}{\partial \Psi} \frac{\partial \Psi}{\partial \lambda} \frac{\partial C}{\partial I}.$$

Remember that we are calculating this partial derivative at  $I = I^*$ . So, use the combined first-order condition in (1.3.7) to simplify the expression above, and obtain:

$$\begin{aligned}\Upsilon &= \left\{ \gamma(C+t) \frac{\partial q}{\partial \Psi} \left[ \underbrace{\frac{\partial \Psi}{\partial I} \frac{\partial \Psi}{\partial \lambda}}_{<0} \underbrace{\left( \frac{b}{q} \frac{\partial q}{\partial \Psi} - \frac{1+b}{\Psi} \right)}_{<0} + a(I) \right] \right\}_{I=I^*} \\ &> 0.\end{aligned}$$

This completes the proof.

#### 1.A.4 Derivative of firm profits with respect to productivity

To prove that a more productive firm makes higher profits, differentiate the variable profits of a firm with respect to its productivity  $\phi$ :

$$\begin{aligned}\frac{d\Pi(\phi)}{d\phi} &= \frac{d}{d\phi} [x(\phi) (p(\phi, I) - C(\phi, I))] \\ &= \frac{\partial \Pi(\phi)}{\partial x(\phi)} \left( \frac{\partial x(\phi)}{\partial \phi} + \frac{\partial x(\phi)}{\partial I} \frac{dI}{d\phi} \right) + \frac{\partial \Pi(\phi)}{\partial p(\phi, I)} \left( \frac{\partial p(\phi, I)}{\partial \phi} + \frac{\partial p(\phi, I)}{\partial I} \frac{dI}{d\phi} \right) \\ &\quad + \frac{\partial \Pi(\phi)}{\partial C(\phi, I)} \left( \frac{\partial C(\phi, I)}{\partial \phi} + \frac{\partial C(\phi, I)}{\partial I} \frac{dI}{d\phi} \right).\end{aligned}$$



where  $\tilde{\phi}_c$  is the aggregate (or average) productivity of the firms selling to region  $c$ :

$$\tilde{\phi}_c = \left[ \int_{\phi_c^*} (\phi^{1-\alpha-\gamma_c})^{1-\sigma} \mu_c(\phi) \right]^{\frac{1}{(1-\sigma)(1-\alpha-\gamma_c)}}. \quad (1.A.5)$$

In Melitz's model, the aggregate productivity depends only on elasticity of substitution between varieties ( $\sigma$ ). Here, it also depends on the technology parameter  $\alpha$ , and the intensity of consumer preferences for quality  $\gamma_c$ . As in the original model, we can derive the other aggregate variables in terms of aggregate productivity.

Take  $r_N$  as the numéraire. The following zero-profit condition pins down the cutoff productivity for selling in the Southern market:

$$\mu Y_S \Lambda_S^{1-\sigma} P_S^{\sigma-1} \phi_{SS}^{*(1-\alpha-\gamma_S)(1-\sigma)} = \sigma f.$$

Use (1.A.3d) and (1.A.4) to re-write this condition:

$$\sigma f M_S [k(\phi_{SS}^*) + 1] = \mu Y_S, \quad (1.A.6)$$

where

$$k(\phi_c^*) = \left( \tilde{\phi}_c / \phi_{Sc}^* \right)^{(1-\alpha-\gamma_c)(1-\sigma)} - 1; \quad c = S, N. \quad (1.A.7)$$

So, a firm with productivity  $\phi < \phi_{SS}^*$  remains inactive in the domestic market. The distribution of the active firms becomes:

$$\mu(\phi) = \frac{g(\phi)}{1 - G(\phi_S^*)}.$$

Assume that the distribution of firm productivities is Pareto with a shape parameter  $\nu > \eta_N > \eta_S > 2$ . So, we can write the cutoff productivity condition as:

$$\sigma f M_S \frac{\nu}{\nu - \eta_S} = \mu Y_S.$$

Similarly, we can write the cutoff for exporting to the Northern market by setting  $f_X = \theta f$ ,  $\theta > 0$

$$\sigma \theta f M_N \frac{\nu}{\nu - \eta_N} = \mu Y_N.$$

Use the Pareto distribution assumption, and combine the two cutoff productivity conditions to obtain

$$\frac{Y_S}{Y_N} = \frac{1}{\theta} \frac{\nu - \eta_N}{\nu - \eta_S} \frac{M_S}{M_N}. \quad (1.A.8)$$

Based on conditional factor price equalisation, two regions have almost the same aggregate income. Since I am interested in the effect of the difference in consumer tastes on the cutoff productivities, I ignore the minor differences between the aggregate incomes and, thus, equate the left-hand side of (1.A.8) to unity. On the right-hand side, as  $\eta_N > \eta_S$ ,  $(\nu - \eta_N)/(\nu - \eta_S)$  is less than unity. Now, consider the following case. First, let  $\theta < (\nu - \eta_N)/(\nu - \eta_S)$ , fixed cost of exporting is very small. For the conditional factor price equalisation to hold, we must then have  $M_S < M_N$ : there are some Southern firms whose variable profits in the Northern market cover both the fixed cost of production ( $f$ ) and the cost of exporting ( $f_X$ ), and they are not profitable in their domestic market. But, under monopolistic competition and CES preferences, such a case cannot arise because there are no additional fixed costs that those firms have to incur to sell their products in the domestic market. So, they should be profitable and thus active in their domestic market as well, implying  $M_S > M_N$ . For this inequality to hold, we must have

$$\theta > \frac{\nu - \eta_N}{\nu - \eta_S}. \quad (1.A.9)$$

Thus the model applies when the fixed cost of exporting is not too small. Under this assumption, the cutoff productivity for exporting satisfies

$$\implies \phi_{SN}^* = \phi_{SS}^* \left( \theta \varepsilon \lambda \frac{\nu - \eta_S}{\nu - \eta_N} \right)^{1/\nu}.$$

Given (1.A.9), we have  $\phi_{SN}^* > \phi_{SS}^*$ . This completes the proof.

## 1.A.6 Characterisation of the heterogeneous-firm extension of the model

Appendix A.4 derives the cutoff productivities in North and South. There is also a free-entry condition: a firm enters the market if and only if it expects to cover the fixed entry cost. A firm's expected value is equal to

$$v(\phi) = \max \left\{ 0, \frac{1}{\delta} E [\pi(\phi)] \right\}.$$

Owing to the free-entry condition, its expected per period profits are equal to

$$E [\pi(\phi)] = \delta f_e \tag{1.A.10}$$

$$\implies \Pi(\tilde{\phi}_S)(1 - G(\phi_{SS}^*)) + \Pi(\tilde{\phi}_N)(1 - G(\phi_{SN}^*)) = \delta f_e. \tag{1.A.11}$$

One of its implications is that aggregate profits do not contribute to aggregate income. Because, by (1.A.10), aggregate profits net of entry costs is equal to zero.<sup>25</sup> Thus, income of a region is simply equal to the total payments to workers – value of the stock of skills – in the region:

$$Y_S = \varepsilon \lambda L_N,$$

$$Y_N = L_N.$$

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<sup>25</sup>The aggregate profits of firms that are located in a region may not equal to zero. I propose two different mechanisms so that the argument in the text holds. First, as Chaney (2008) proposes, profits of all firms are collected by a global fund, which then re-distributes them. Second, one can solve for the integrated world equilibrium to pin down the world income. Then, distribute the world income to each region in proportion to their stock of skills. Under both mechanisms, since aggregate profits net of entry costs are zero, they do not contribute to regional income.

Use the Pareto assumption, and the equality  $\frac{r_c(\phi)}{r_c(\phi')} = \left(\frac{\phi}{\phi'}\right)^{\eta_c}$  to express the free-entry condition as;

$$\frac{\eta_S}{\nu - \eta_S} \phi_{SS}^{*- \nu} + \theta \frac{\eta_N}{\nu - \eta_N} \phi_{SN}^{*- \nu} = \frac{\delta f_e}{f}. \quad (1.A.12)$$

I am interested in stable equilibria: the mass of firms entering the market should be equal to the mass of firms exiting so that the distribution of firms in the industry remains unchanged. Let  $M_e$  denote the mass of firms entering the market, then we can write the stability condition as;

$$(1 - G(\phi_{SS}^*))M_e = \delta M, \quad (1.A.13)$$

where  $M = M_S$ . Also, the mass of firms selling to the Northern market satisfies

$$M_N = M \frac{1 - G(\phi_{SN}^*)}{1 - G(\phi_{SS}^*)}. \quad (1.A.14)$$

As a result, we have five equations: two cut-off productivity conditions (1.A.6), one free-entry condition (1.A.12), one stability condition (1.A.13), and the equation that pins down the mass of firms selling to the Northern market (1.A.14). We can solve them to determine the five endogenous variables:  $\phi_{SS}^*$ ,  $\phi_{SN}^*$ ,  $M$ ,  $M_e$ ,  $M_N$ . Here is the solution:

$$\begin{aligned} \phi_{SS}^* &= \left( \frac{f}{\delta f_e} \frac{\eta_S + \eta_N / (\varepsilon \lambda)}{\nu - \eta_S} \right)^{1/\nu}; \\ \phi_{SN}^* &= \left( \theta \varepsilon \lambda \frac{f}{\delta f_e} \frac{\eta_S + \eta_N / (\varepsilon \lambda)}{\nu - \eta_N} \right)^{1/\nu}; \\ M &= \frac{\mu (\varepsilon \lambda L) (\nu - \eta_S)}{\sigma f \nu} = M_S; \\ M_N &= \frac{\mu L (\nu - \eta_N)}{\theta \sigma f \nu}; \\ M_e &= \frac{\mu L (\varepsilon \lambda \eta_S + \eta_N)}{f_e \nu}, \end{aligned}$$

where  $L = L_N$ . Any surplus of skills is absorbed by the homogenous good industry in both regions.

### 1.A.7 Proof of Result 1.4.3

Here, I prove that observing a positive correlation between a firm's fob prices and its revenues across markets is more likely, the closer  $\bar{\phi}$  is to the cutoff productivity in the Northern market ( $\phi_N^*$ ). Differentiate the expression for  $\bar{\phi}$  with respect to  $\nu$ :

$$\frac{d(\bar{\phi}/\phi_{SN}^*)}{d\nu} = \frac{\bar{\phi}}{\phi_{SN}^*} \frac{\eta_S}{\nu} \left[ -\frac{1}{\nu(\eta_N - \eta_S)} \ln \left( \theta \varepsilon \lambda \frac{\nu - \eta_S}{\nu - \eta_N} \right) - \frac{1}{(\nu - \eta_N)(\nu - \eta_S)} \right].$$

If  $\phi_{SN}^* > \phi_{SS}^*$ , we must have  $\ln \left( \frac{\varepsilon}{\lambda} \frac{\nu - \eta_S}{\nu - \eta_N} \right) > 0$ . So, we obtain  $\frac{d(\bar{\phi}/\phi_{SN}^*)}{d\nu} < 0$ . This completes the proof.

Table 1.A.1: Some unexplained observations in recent empirical studies

Stylised Fact	Source
F1: A firm charges a high fob price for a product in rich markets.	Bastos and Silva (2010), Görg et al., (2010), Manova and Zhang (2012)
F2: A firm charges a high price for a product in distant markets. The correlation is stronger for differentiated products.	Bastos and Silva (2010), Görg et al. (2010), Manova and Zhang (2012)
F3: A firm that pays a wide range of input prices also offers a wide range of export prices across markets.	Manova and Zhang (2012)
F4: A firm pays a higher price for imported input than for domestic input in the same product category.	Kugler and Verhoogen (2009)
F5: A firm earns higher revenues in a market where it charges a higher fob price.	Manova and Zhang (2012)



# Chapter 2

## The Trade and Wages Debate Revisited: A new explanation for an old mystery

### Abstract

This paper presents a general equilibrium model where trade liberalisation between identical countries leads to an increase in wage inequality in favour of white-collar workers. Trade arises between the countries from strategic interaction between firms, and it induces an increase in wage inequality because export sales are relatively more intensive in white-collar labour and less intensive in blue-collar labour. Trade liberalisation leads to an increase in wage inequality regardless of country characteristics. Yet the equilibrium level of wage inequality depends on two country characteristics: relative supply of white-collar workers and degree of competition. Wage inequality is lower in the trade equilibrium the greater the relative supply of white-collar workers, or the more competitive the economy. An increase in the worldwide supply of white-collar workers (increase in human capital) leads to endogenous globalisation, expanding the range of traded goods and increasing the volume of trade in already-traded goods. Furthermore, it improves global welfare.

## 2.1 Introduction

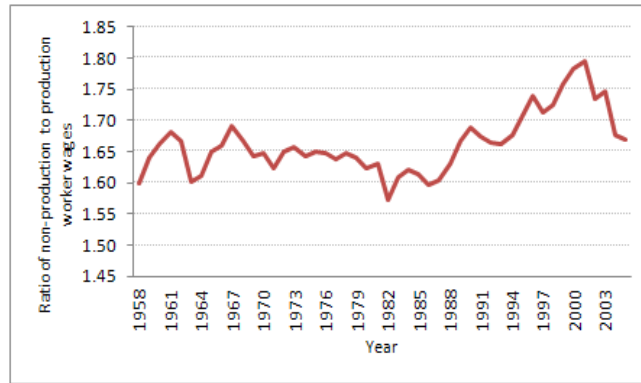
Many countries, regardless of their level of development, have experienced a rise in within-country inequality over the past 30 years. As this trend has been accompanied by a substantial increase in international trade, it has been proposed as a potential explanation. Therefore the relationship between trade and inequality has been studied extensively in the literature.

In this paper, I present a trade model to explain rising wage inequality between occupations – white-collar versus blue-collar.<sup>1</sup> In the model, there is a continuum of goods, each of which is sold by a small number of firms in two identical countries. The countries are initially in autarky, then open themselves to international trade. Trade arises between them from strategic interactions between firms. Domestic and export sales have different factor intensities; export sales are more white-collar labour intensive than domestic sales. It implies that supplying to the export market is more costly than supplying domestically. Therefore, although all goods are tradable, some of them are not traded in equilibrium; only those goods produced at relatively low costs are traded. Firstly, I compare autarky and trade equilibria. I show that, as export sales are relatively white-collar labour intensive, its relative wage (inequality) is higher in the trade equilibrium compared to autarky. Furthermore, for a given level of openness, wage inequality is higher the lower the relative supply of white-collar labour, or the less competitive the economy. Next, I consider the effect of an increase in the relative supply of white-collar labour in a trade equilibrium. I show that it leads to endogenous globalisation – expanding the range of traded goods and increasing the volume of trade in already-traded goods – and improves

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<sup>1</sup>In the literature, the term blue-collar refers to occupations that involve manual labour, and white-collar refers to those that involve managerial or professional work, such as technical, sales, and administrative support. Blue-collar workers are usually classified as unskilled, and white-collar workers as skilled. Berman et al. (1994) show that white-collar workers consistently have more years of education than blue-collar workers in the US, and thus the classification by occupation matches the classification by the level of education very closely. Therefore, as in the existing literature, I will use the two classifications interchangeably in the paper.

Figure 2.1.1: Relative wages in the US (1958-2005)



Source: NBER-CES Manufacturing Industry Database (2005)

welfare unambiguously.

Here, I focus on one dimension of inequality: between-groups wage inequality, in particular between white and blue-collar workers. Figure 2.1.1 presents the evolution of the relative wage of white-collar to that of blue-collar workers in the US during 1958-2005. The upward trend in wage inequality observed during 1980s and 1990s was not confined to the US. Several studies document evidence that other developed countries also experienced a rise in wage inequality (Davis (1992), Katz and Freeman (1994), Machin (1996)), and so did a number of developing countries (Goldberg and Pavcnik (2007), Harrison and Hanson (1999)).

There are two leading explanations for the observed trend in wage inequality: skill-biased technical change and the rise in globalisation. The former suggests that the rapid adoption of new technologies, which favour skilled-labour over unskilled-labour, has increased the relative demand for skilled-labour and thus wage inequality. The empirical evidence regarding the validity of this explanation is mixed. For instance, Berman et al. (1998) find supporting evidence based on a sample of developed countries, while Card and DiNardo (2002) find evidence against this explanation based on US data. The latter explanation suggests that the rise in globalisation has led to an increase in wage inequality. In 1990s, supporters of this view focused on trade integration between the

North and the South (developed and developing countries). Based on the Heckscher-Ohlin-Samuelson model, they concluded that trade liberalisation would raise the relative wage of skilled workers in the North as it has a comparative advantage in producing skill-intensive goods (Wood (1995, 1998)).<sup>2</sup> The model predicts the opposite in the South: trade liberalisation leads to a fall in wage inequality. The trade explanation based on the Heckscher-Ohlin-Samuelson theory has been challenged on account of it contradicting the empirical evidence. For instance, contrary to the model's prediction, wage inequality also increased in Southern countries.<sup>3</sup>

Recently, researchers have proposed alternative trade-related explanations such as intra-industry reallocations induced by trade liberalisation and offshoring of tasks. Two recent papers, Harrison et al. (2011) and Goldberg and Pavcnik (2007), review their relevance. These explanations introduce new channels through which globalisation can affect wage inequality. They are promising and reinforce the link between globalisation and inequality, but their relevance depends on country characteristics.<sup>4</sup>

I will discuss three recent theoretical contributions to the debate on trade and wage inequality, which rely non-Heckscher-Ohlin elements. Neary (2002) develops an oligopolistic model and shows that trade liberalisation encourages domestic firms to undertake investment that uses skilled-labour intensively. Therefore, even the threat of foreign competition, without imposing an increase in actual imports, can raise wage inequality between skilled and unskilled-labour in his framework.<sup>5</sup> In another paper, Matsuyama (2007) develops a continuum Ricardian trade model with multiple factors of production. In the

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<sup>2</sup>In a recent paper, Wood (2012) presents a Heckscher-Ohlin model with generalised trade costs and highlights that it can provide more realistic predictions about factor prices.

<sup>3</sup>Krugman (2000), Feenstra and Hanson (2001), and Goldin and Katz (2010) provide extensive evidence on the relative importance of trade and technology explanation for the recent increase in wage inequality.

<sup>4</sup>Recent theoretical contributions that provide new mechanisms through which trade affects wage inequality can be grouped into two categories: theories aiming to explain the link between trade and wage inequality within occupations (or skill groups), which is referred to as "residual wage inequality" (e.g. Helpman et al. (2010), Egger and Kreickemeier (2009)); those aiming to explain the link between globalisation and wage inequality between groups (e.g. Feenstra and Hanson (1996), Grossman and Rossi-Hansberg (2008)).

<sup>5</sup>This approach is referred to as "trade-induced skilled biased technological change" in Goldberg and Pavcnik (2007). They cite a number of papers that use a similar approach.

model, the technology of supplying goods depends on the destination of the product. In particular, the activities related to shipping the goods, marketing them, and customer services may be more costly when the goods are supplied to the export market than to the domestic market.<sup>6</sup> If such activities and production are performed by different factors of production, then the factor intensity of domestic and export sales will be different. Matsuyama shows that a Hicks-neutral technical improvement in the export sectors expands the range of traded goods and increases the relative prices of the factors that are used intensively in supplying to the export market. Finally, Epifani and Gancia (2008) present a trade model with two goods: one is produced by unskilled-labour, and the other by skilled-labour only. The skill-intensive industry exhibits stronger returns to scale. On the consumption side, the elasticity of substitution between the two goods is greater than unity. They show that increased market size, driven by trade liberalisation, increases the relative output of the skill-intensive good and reduces its relative price. Since the elasticity of substitution in consumption is assumed to be greater than unity, the relative demand for the skill-intensive good increases, so does its share in total expenditures. As a result, the relative wage of skilled-labour also increases.

The current study extends the General Oligopolistic Equilibrium model (GOLE) developed by Neary (2003) by introducing two factors of production and exporting costs. To model trade costs, it employs the same assumption as in Matsuyama (2007): supplying to the foreign market requires additional services which are paid in terms of white-collar labour. Unlike Matsuyama's reliance on Ricardian differences in technology between the trading partners as a reason for trade, the current study relies on oligopolistic behaviour. Thus, it focuses on trade between similar countries.

This study contributes to the literature in three ways. First, it provides a supply-side reason why trade between similar countries, which accounts for more than 65 percent of

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<sup>6</sup>Such activities can also include product customisation as in Maurin et al. (2002). In that case, convergence of consumer preferences can reduce the white-collar labour intensity of exports relative to domestic production.

the world's merchandise trade, can raise wage inequality.<sup>7</sup> Epifani and Gancia (2008) also show that trade between similar countries can raise wage inequality. In their framework, trade arises from consumer love of variety, and strong consumer demand for skill-intensive goods brings about the resulting increase in wage inequality. The current study, on the other hand, places almost no emphasis on the demand side. Trade is generated by oligopolistic behaviour, and differences in factor intensity between domestic and export sales cause the resulting increase in wage inequality. By showing the importance of trade between similar countries for wage inequality, we can address two empirical challenges levelled against the trade explanation for rising wage inequality: in contrast with the predictions of Heckscher-Ohlin-Samuelson model, wage inequality increased in a number of Southern countries during the period of trade liberalisation; the volume of North-South trade was not sufficient to exert such a large effect on wage inequality.

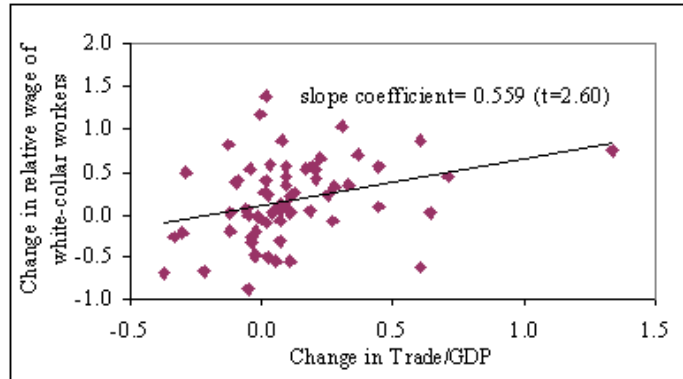
The second contribution of the study to the debate on trade and wages is that it highlights the importance of relative factor endowments within trading partners, rather than between them, for the link between trade and wage inequality. The model predicts that a country's movement from autarky to trade is always associated with a higher wage inequality. Yet the equilibrium level of wage inequality for a given level of openness depends on the relative endowment of white-collar labour in the country; it is higher the lower the relative supply of white-collar labour. Another country characteristic that matters for wage inequality is the degree of competition; wage inequality after trade liberalisation is higher the higher the degree of competition. These results confirm the conclusion of Goldberg and Pavcnik (2007) that country characteristics matter for the effect of globalisation on inequality.

Finally, the study suggests a trade channel through which a worldwide increase in human capital stock improves welfare. In particular, an increase in the relative supply of white-collar labour, which is employed more intensively in export sales, expands the range

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<sup>7</sup>UNCTAD data show that North-North trade accounts for more than 70 percent of North trade, and South-South trade accounts for more than 50 percent of South trade.

Figure 2.2.1: Wage inequality and openness (1985-2003)



*Source: NBER-OWW Database, WDI-World Bank*

of traded goods and increases the volume of already-traded goods. Foreign competition increases the sales and lowers the prices of traded goods. As a result, welfare improves in both countries.

The paper is organised as follows. Section 2.2 reports some stylised facts on wage inequality and international trade, and motivates the predictions of the model presented in Section 2.3. Section 2.4 compares the equilibrium wage inequality before and after trade liberalisation and shows the importance of the relative endowment of white-collar labour and the degree of competition within the countries for the equilibrium level of wage inequality after trade liberalisation. The effects of an increase in the endowment of white-collar labour on wage inequality, trade, and welfare are discussed in Section 2.5. Section 2.6 concludes.

## 2.2 Empirical Motivation

In this section, I provide some stylised facts regarding the relationship between wage inequality and trade.<sup>8</sup> I define wage inequality as the ratio of the average hourly wage of white-collar workers in manufacturing to that of blue-collar workers. The ratio is cal-

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<sup>8</sup>Appendix 2.A.5 describes the data used in this section. It also lists the countries included in the figures.

culated using data from the Occupational Wages around the World (OWW) Database published by National Bureau of Economic Research (NBER). The dataset covers the period 1985-2003. The figures I discuss below illustrate the period change in wage inequality against the period change in the openness ratio, defined as the ratio of the sum of exports and imports to GDP.

Figure 2.2.1 presents the period change in the relative wage of white-collar workers on the vertical axis, and the period change in the openness ratio on the horizontal axis. Spearman's rank correlation between the two is 0.37 ( $p=0.003$ ). Countries such as Estonia and Hong Kong experienced a significant increase both in their openness to international trade and in wage inequality during the period.<sup>9</sup> In short, data show a positive association between openness and wage inequality.

An interesting feature of the data is that there is considerable variation across countries in how closely trade openness and wage inequality move. Figure 2.2.1 shows that countries that experienced similar changes in the openness ratio observed quite different changes in wage inequality. For instance, from mid-1980s to late 1990s, the period change in the openness ratio is around 10 percentage points for both Finland and India, while the respective changes in wage inequality are 8 and 43 percent. This can be explained in various ways. One possible reason for this observation is that the two countries have different factor endowments. In particular, if the relative endowment of white-collar labour differs between the countries, then we would expect their factor prices to respond differently to a demand shock (in this case, trade) of the same size. Data show striking differences in factor endowments between Finland and India. In 1985, the average years of secondary schooling – which is taken in the literature as one of the proxies for skilled labour endowment – was 2.32 years in Finland and only 0.71 years in India.<sup>10</sup> In other words,

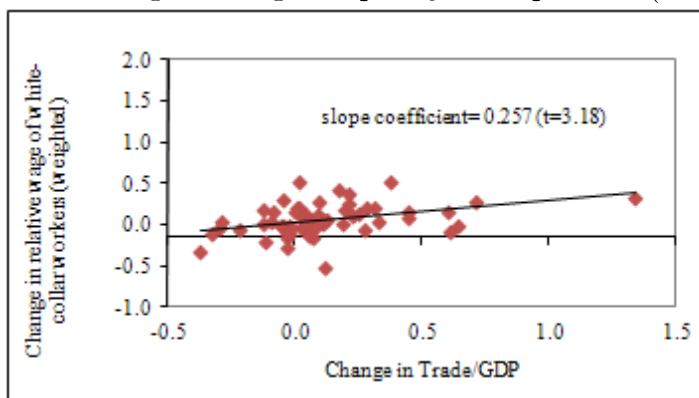
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<sup>9</sup>These two countries are outliers in the sample. When they are excluded, the t-value of the slope coefficient in Figure 2.2.1 falls to 2.15, but it is still statistically significant with a p-value of 0.035.

<sup>10</sup>The source of data is Barro and Lee (2010), retrieved from <http://www.barrolee.com/data/dataexp.htm>. The variable is defined as the average years of secondary schooling attained for population aged 25 and over.



Figure 2.2.2: Weighted-wage inequality and openness (1985-2003)



Source: NBER-OWW Database, WDI-World Bank, Barro and Lee (2010)

at the start of the period, Finland was significantly more abundant in skilled-labour.

How can we explore the validity of the argument that differences in factor endowments can explain the variation across countries in the size of the correlation between trade openness and wage inequality? Given the example of Finland and India, one would expect the size of the effect of openness on wage inequality to be lower for skilled-labour abundant compared to skilled-labour scarce countries. In Figure 2.2.2, I plot the period change in the openness ratio against the period change in wage inequality, weighted by the country's endowment of skilled-labour at the start of the period.<sup>11</sup> Although it retains its size and significance, the slope of the trend line drops to 0.26 from 0.56 in Figure 2.2.1.<sup>12</sup> So, unlike in Figure 2.2.1, for a given change in the openness ratio, wage inequality weighted by skilled-labour endowment exhibits smaller variation across countries.

Figures 2.2.1 and 2.2.2 show us some interesting features of the data, but it would be useful to confirm these findings using more formal econometric tools. I report the

<sup>11</sup>Following the empirical literature, I use the share of population with secondary education as a proxy for skilled-labour endowment. Weights are such that the country with the highest secondary schooling ratio (Slovenia) has the weight one.

<sup>12</sup>In Figure 2.2.2, Spearman's rho between the period change in the openness ratio and weighted change in wage inequality is 0.42 with a corresponding p-value of 0.0005. The null hypothesis that the two correlations are the same is rejected (p-value: 0.0083). We reject the null when the alternative hypothesis is that the correlation between openness and unweighted wage inequality is higher than the one between openness and weighted wage inequality (p-value: 0.0041). We cannot reject the null when the alternative is that the correlation between openness and unweighted wage inequality is smaller than the one between openness and weighted wage inequality (p-value: 0.495).

Table 2.2.1: Trade and wage inequality

Dependent variable: relative wage of white-collar workers				
	(1)	(2)	(3)	(4)
	Epifani and Gancia		Own	
	(2008)		estimations	
Openness	0.568 <sup>a</sup>	0.568 <sup>a</sup>	0.379 <sup>b</sup>	0.376 <sup>b</sup>
	[0.186]	[0.189]	[0.149]	[0.146]
ln(Country size)	0.309 <sup>a</sup>	0.308 <sup>c</sup>	0.543 <sup>c</sup>	0.639 <sup>b</sup>
	[0.130]	[0.169]	[0.326]	[0.319]
Schooling	...	0.004	-0.068	-0.037
	...	[0.333]	[0.090]	[0.090]
Openness*Schooling	...	...	...	-0.159 <sup>a</sup>
	...	...	...	[0.059]
Number of obs.	70	70	590	590
Number of groups	35	35	63	63
R-squared	0.34	0.34	0.60	0.61

*Robust standard errors in brackets.<sup>a</sup> $p < 0.01$ ,<sup>b</sup> $p < 0.05$ ,<sup>c</sup> $p < 0.1$ . Specifications (3) and (4) include a full set of country and year fixed effects. Openness is the ratio of the sum of merchandise exports and imports to GDP. Country size is measured by total labour force. Schooling denotes the average years of secondary schooling. In columns (3) and (4), schooling variable is lagged one-year. In column (4), all covariates are mean-centred.*

empirical results from a recent paper by Epifani and Gancia (2008) to assess the effect of openness on wage inequality. They use data for 35 countries over the period from early 1980s to early 1990s. Their results are reported in columns (1) and (2) in Table 2.2.1. In both specifications, openness is positively and significantly associated with wage inequality. In column (3), I expand their sample to cover 63 countries and use one-year lagged values for schooling to control for possible endogeneity. The coefficient on openness remains positive and significant at the 5 percent level. In column (4), I add the interaction between openness and schooling as an additional regressor. In this specification, all regressors are mean-centred to make the interpretation of the coefficient on the interaction term easier.<sup>13</sup> Results suggest that the association between openness and wage inequality is smaller for countries with an average years of secondary schooling above the sample mean. In particular, when the average years of schooling is at the mean,

<sup>13</sup>See Jaccard et al. (1990) and Aiken and West (1991)).

one unit increase in openness above the mean is associated with 0.38 unit increase in wage inequality. But, when the average years of schooling is at one standard deviation above the mean, one unit increase in openness above the mean is associated with only 0.088 unit increase in wage inequality.<sup>14</sup> Furthermore, the difference is statistically significant at the one percent level.

To summarise, the empirical results presented in Table 2.2.1 suggest that trade openness is positively associated with wage inequality between white-collar and blue-collar workers. Following the empirical strategy of Epifani and Gancia (2008), I use the entire volume of exports and imports, instead of the volume of North-South trade in the empirical analysis. Firstly, I replicate their results qualitatively by using data for a larger set of countries and controlling for possible endogeneity of the schooling variable that is used as a proxy for skilled-labour endowment. Next, I add the interaction between openness and skilled-labour endowment and extend their results by showing that there is a smaller association between openness and wage inequality when the endowment of skilled-labour is relatively high. In the next section, I will present a model that rationalises these empirical findings.

## 2.3 Model Setup

### 2.3.1 Partial Equilibrium

I start with a single good,  $z$ , in partial equilibrium. The good is produced in two identical countries – "home" and "foreign". Countries are closed to international investment. They are, however, open to international trade. There are no tariff barriers. In each country, a small number of identical firms,  $n \geq 2$ , sell the good  $z$ . Firms compete strategically in quantities and sell identical products in segmented markets. Exit from the industry is free, but entry is restricted due to cost advantages of incumbent firms arising from, for

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<sup>14</sup>The standard deviation of the schooling variable in the data is 1.809.

instance, their accumulated experience in the industry. Alternatively, one can consider the current setup as describing the short-run equilibrium of the model.

Production cost of a firm producing good  $z$  stays unchanged across destinations, but its per unit non-production cost  $m$  is higher by  $\delta > 0$  when the firm exports the good. So, the cost of supplying one unit of good  $z$  is;<sup>15</sup>

$$c(z) = \begin{cases} \alpha(z) + m, & \text{for domestic sales} \\ \alpha(z) + (m + \delta), & \text{for export sales} \end{cases}.$$

The parameter  $\delta$  is a key parameter; it captures the firm's inefficiency in supplying its product to the export market. Export sales are more intensive in white-collar workers compared to domestic sales. A number of empirical studies that use firm-level data report that exporters employ relatively more white-collar labour than non-exporters (e.g. Bernard and Jensen (1997), Bernard and Wagner (1997), Maurin et al. (2002)). So, the cost structure assumed here is in line with the empirical evidence. It is worth noting that a higher  $\delta$  makes exporting less profitable and acts as a natural barrier to trade, so it protects domestic firms from foreign competition.

On the demand side, consumers in either country have identical quadratic preferences that result in linear inverse-demand of the following form;

$$p = a' - b'q = p^*, \tag{2.3.1}$$

where  $q$  and  $q^*$  denote aggregate supplies in the home and foreign markets.<sup>16</sup>

$$q = q^* = n [y(n, n; z) + y_X^*(n, n; z)].$$

In the expression,  $y(\cdot)$  denotes a firm's domestic sales, and  $y_X(\cdot)$  ( $y_X^*(\cdot) = y_X(\cdot)$ ) its export sales. They are expressed in terms of the number of domestic firms and exporters. For

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<sup>15</sup>I normalise the factor prices to unity in the partial equilibrium analysis.

<sup>16</sup>I denote foreign variables with an asterisk.

instance,  $y(n, n; z)$  denotes domestic sales of a firm when there are  $n$  domestic firms and  $n$  exporters. One can define export sales accordingly. As two countries are symmetric in all respects, we can focus on the home country.

This setting gives us a standard Cournot oligopoly model with heterogeneous firms and linear demand.<sup>17</sup> A firm maximises its profits, taking the sales of other firms in a market fixed. The resulting profits of a firm supplying good  $z$  in both markets are

$$\pi(n, n; z) = b'(y(n, n; z)^2 + y_X(n, n; z)^2).$$

The following first-order conditions must be satisfied at an interior Nash equilibrium:

$$\begin{aligned} y(n, n; z) \frac{\partial p(y, y_X)}{\partial y} + p(y, y_X) - \alpha(z) - m &= 0, \\ y_X(n, n; z) \frac{\partial p(y, y_X)}{\partial y_X^*} + p(y, y_X) - \alpha(z) - (m + \delta) &= 0, \end{aligned} \quad (2.3.2)$$

We can solve the equations in (2.3.2) to obtain the equilibrium sales, and then substitute them in (2.3.1) to derive the equilibrium market price:

$$\begin{aligned} y(n, n; z) &= \frac{a' - \alpha(z) + (\delta n - m)}{(2n + 1)b'}, \\ y_X(n, n; z) &= \frac{a' - \alpha(z) - [m + \delta(n + 1)]}{(2n + 1)b'}, \\ p(n, n; z) &= \frac{a' + 2n\alpha(z) + n(2m + \delta)}{2n + 1}. \end{aligned} \quad (2.3.3)$$

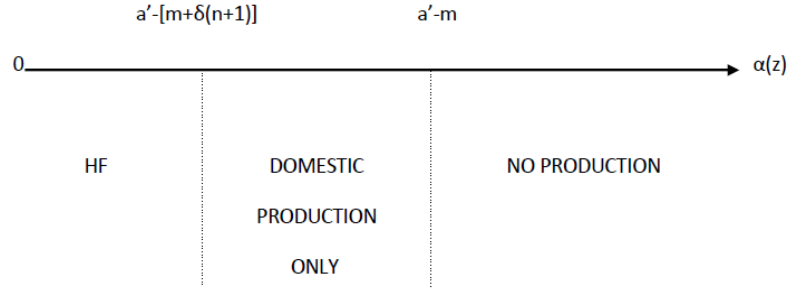
Using the equilibrium sales and price in (2.3.3), we can study the possible specialisation patterns. The condition for a domestic firm to be profitable in both markets is given by;

$$y(n, n; z) \geq 0 \text{ and } y_X(n, n; z) \geq 0 \text{ iff } \alpha(z) \leq a' - [m + \delta(n + 1)].$$

---

<sup>17</sup>Based on the conditions for the existence of a Cournot equilibrium provided by Novshek (1985), it is trivial to see that equilibrium exists in this Cournot model which is characterised by linear demand and constant marginal costs.

Figure 2.3.1: Production patterns



A firm is profitable only in its domestic market iff

$$a' - [m + \delta(n + 1)] < \alpha(z) \leq a' - m.$$

So, a firm is active either in both markets, corresponding to HF region in Figure 2.3.1, or in its domestic market only. Throughout the paper, I assume  $\alpha(z) + m \leq a'$ : domestic sales are always profitable. If exporting is not profitable, then a firm's domestic sales are equal to

$$y(n, 0; z) = \frac{a' - \alpha(z) - m}{(n + 1)b'},$$

and the resulting price is

$$p(n, 0; z) = \frac{a' + n(\alpha(z) + m)}{n + 1}. \quad (2.3.4)$$

## 2.3.2 General Equilibrium Analysis with Heterogeneous Goods

I use General Oligopolistic Equilibrium model (GOLE) developed by Neary (2003). In the model, trade arises, even in the absence of comparative advantage and consumer's love for variety, from strategic interactions between firms. Thus, it provides an appropriate tool to model trade between similar countries. In the model, firms are large in their respective industries but small in the economy. In other words, they influence the price of their

products, but cannot influence economy-wide variables such as factor prices and income.

Since countries are identical in all respects, as I mentioned before, I focus on the home country. In each country, there are  $L$  individuals who have identical preferences represented by the following utility function:

$$U[\{x(z)\}] = \int_0^1 \left[ ax(z) - \frac{1}{2}bx(z)^2 \right] dz, \quad (2.3.5)$$

where  $x(z)$  denotes the consumption of good  $z$ ,  $z \in [0, 1]$ . Continuum-quadratic preferences allow for aggregation if the parameter  $b$  in (2.3.5) is the same across individuals. Since individuals are assumed to have identical preferences, it would be sufficient to solve for the utility maximisation problem of an average individual – a hypothetical individual who is endowed with the per capita income. The average individual maximises (2.3.5) subject to the budget constraint

$$\int_0^1 p(z)x(z)dz \leq I,$$

where  $I$  denotes income per individual. The maximisation problem yields inverse demand functions that are linear in own price, given marginal utility of income  $\lambda$  which is the Lagrange multiplier attached to the budget constraint. The inverse demand function is given by

$$x(z) = \frac{1}{b} [a - \lambda p(z)] \quad \text{and} \quad \lambda[\{p(z)\}, I] = \frac{a\mu_1^p - bI}{\mu_2^p}, \quad (2.3.6)$$

where  $\mu_1^p$  denotes the first moment of the distribution of prices, and  $\mu_2^p$  denotes the second moment:

$$\mu_1^p = \int_0^1 p(z)dz \quad \text{and} \quad \mu_2^p = \int_0^1 p(z)^2 dz.$$

The goods market equilibrium requires;

$$Lx(z) = q(z); \forall z \in [0, 1]$$

where  $q(z)$  is the aggregate supply of good  $z$ . So, the market-clearing price of good  $z$  is given by;

$$p(z) = \frac{1}{\lambda}[a - (b/L)q(z)].$$

Given this, it is easy to derive  $a'$  and  $b'$  in (2.3.3) and (2.3.4) as follows;

$$a' = a/\lambda \text{ and } b' = b/\lambda L.$$

On the supply side, I use a modified Ricardian structure. There are two types of workers: blue-collar and white-collar. Blue-collar workers are employed in production only, and white-collar workers in delivery after production.<sup>18</sup> Goods are heterogeneous in terms of production costs. In particular, both countries are more efficient in producing lower-indexed goods:  $\alpha(z)' > 0$ . On the other hand, per unit non-production costs do not vary across goods. Thus the per unit white-collar worker requirement,  $m$ , is not indexed by good.<sup>19</sup>

The average individual is endowed with one unit of blue-collar and  $s$  units of white-collar labour. So, the aggregate supplies of blue-collar and white-collar workers are  $L$  and  $S = sL$ , respectively. The wage rate of a blue-collar worker is  $w$ , and that of a white-collar worker is  $r$ . So, income per individual is equal to

$$I = w + rs + \Pi/L, \tag{2.3.7}$$

---

<sup>18</sup>As I noted in Section 2.1, this is consistent with the classification of skilled and unskilled workers used in a number of empirical studies, e.g. Berman et al. (1994), Feenstra (2003), and Bernard et al. (2003).

<sup>19</sup>This assumption can be rationalised by the existence of a competitive sector that provides services related to the delivery of a good to consumers.



where  $\Pi$  denotes aggregate profits.

Based on the discussion above, marginal cost of producing and distributing a good  $z$  is equal to;

$$c(z) = \left\{ \begin{array}{l} w\alpha(z) + rm, \text{ for domestic sales} \\ w\alpha(z) + r(m + \delta), \text{ for export sales} \end{array} \right\}.$$

I choose the marginal utility of income,  $\lambda$ , as numéraire. So, it is more convenient to use "marginal real factor prices":  $W = \lambda w$  and  $R = \lambda r$ .

We know, from the partial equilibrium analysis, that exporting goods with high production costs is not profitable. It implies that, although all goods are tradable, some of them will be non-traded because of the additional cost of supplying to the export market. There is a threshold good,  $\tilde{z}_X$ , such that goods  $z < \tilde{z}_X$  are traded, and the rest ( $z > \tilde{z}_X$ ) are not traded. It is determined by the following condition:

$$y_X(n, n; \tilde{z}_X) \geq 0 \iff a - W\alpha(\tilde{z}_X) - R[m + \delta(n + 1)] \geq 0, \tilde{z}_X \leq 1. \quad (2.3.8)$$

This is a complementary slackness condition. Since it is more interesting, I only consider the case where  $\tilde{z}_X < 1$ .<sup>20</sup> Thus, setting  $y_X(n, n; \tilde{z}_X)$  to zero pins down  $\tilde{z}_X$ :

$$R = \frac{a - W\alpha(\tilde{z}_X)}{\theta}; \quad (2.3.9)$$

where  $\theta = [m + \delta(n + 1)]$ .

The condition in (2.3.8) implies that countries would be able to trade only those goods which they are efficient at producing. In the paper, I will call the set of goods in which there is positive trade between two countries as the goods margin of trade. At constant factor prices, the goods margin of trade expands when the relative white-collar worker intensity of exports falls –  $\delta$  falls. The goods margin of trade also depends positively on the firms' efficiency in production ( $1/\alpha(z)$ ) and non-production ( $1/m$ ), and negatively on

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<sup>20</sup>The case where  $\tilde{z}_X = 0$  corresponds to autarky, and I will discuss it later.

factor prices. For instance, as a result of a positive productivity shock that leads to a uniform reduction in production costs or a reduction in non-production costs, the goods margin of trade increases. In other words, these two identical countries trade a wider range of goods.

Alternatively, we can interpret the model as follows. There is a continuum of manufacturing goods, each of which is sold by a small number of firms. Each good is sold by  $n$  identical firms, but firms operating in the industry are heterogeneous in productivity. In particular, firms producing lower-indexed goods are more productive than those producing higher-indexed goods. It implies that, given (2.3.8), more productive firms are more likely to export. This is one of the most robust empirical findings in international economics. The model suggests that, before starting to export, the relative employment of white-collar labour is higher at exporters than non-exporters. This is consistent with the empirical findings reported by Bernard and Wagner (1997). They use plant-level data from Germany and find that, compared to non-exporters, exporters employ relatively more white-collar workers not only after they enter the export market but also before they enter. Also, according to the model, when firms start to export, they increase their relative employment of white-collar workers. It implies an employment shift towards white-collar workers within exporters after trade liberalisation, which finds support in the empirical literature. Lawrence and Slaughter (1993) report that the main source of the increase in wage inequality in the US was the shift towards skilled-labour within industries. Therefore, the properties of the model are in line with the empirical evidence.

The market clearing conditions for blue-collar and white-collar workers are;<sup>21</sup>

$$L = L^D = n \left\{ \int_0^{\bar{z}_X} \alpha(z) [y(W, R; n, n; z) + y_X(W, R; n, n; z)] dz + \int_{\bar{z}_X}^1 \alpha(z) y(W, R; n, 0; z) dz \right\}, \quad (2.3.10)$$

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<sup>21</sup>Since countries are identical, whether domestic or foreign white-collar labour is employed for supplying exports does not matter.

$$sL = S^D = n \left\{ \int_0^{\tilde{z}_X} [my(W, R; n, n; z) + (m + \delta)y_X(W, R; n, n; z)] dz \right. \quad (2.3.11) \\ \left. + \int_{\tilde{z}_X}^1 my(W, R; n, 0; z) dz \right\};$$

where  $L^D$  and  $S^D$  are the respective demands for the blue-collar and white-collar workers. The labour market equilibrium conditions (2.3.10) and (2.3.11), together with the equation determining the threshold good (2.3.8) form a system of three equations in three unknowns –  $\tilde{z}_X$ ,  $W$  and  $R$ . Using their equilibrium values, we can determine wage inequality ( $\rho = R/W$ ), and also solve for domestic and export sales in (2.3.3), and consumer income in (2.3.7).

In the model, blue-collar and white-collar workers are complements in supplying goods; both factor demands are decreasing in  $W$  and  $R$ . Assume that the wage of blue-collar workers increases. Then costs of all firms, regardless of their export status, increase. Thus, the firms lower their sales, reducing their demand for both factors. Thus the wage of white-collar workers falls. It implies a negative relationship between  $W$  and  $R$ .

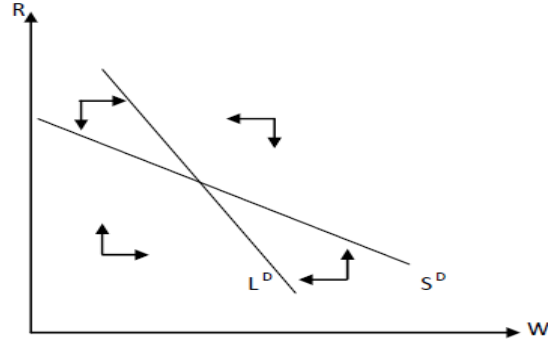
I focus on the cases where both blue-collar and white-collar labour markets are globally stable. Figure 2.3.2 illustrates the stability condition.<sup>22</sup> The points above the white-collar workers equilibrium locus represent excess supply of white-collar workers, which puts downward pressure on  $R$ . The opposite will occur at the points below the locus. Similarly, the points to the right of the equilibrium locus for blue-collar workers represent excess supply of these workers. This tends to lower  $W$ . The opposite will occur at the points to the left of the locus. So, in order for the factor markets to be stable, the equilibrium locus for blue-collar workers should be steeper than the corresponding locus for white-collar workers. The following inequality summarises this condition:

$$\frac{dL^D}{dW} \frac{dS^D}{dR} > \frac{dS^D}{dW} \frac{dL^D}{dR}. \quad (2.3.12)$$

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<sup>22</sup>The relationship between  $W$  and  $R$  is given as linear for illustration purposes.

Figure 2.3.2: Stability in factor markets



## 2.4 Comparing Autarky and Trade Equilibria

What happens to their wage inequality when the countries move from an autarky to trade equilibrium? Goldberg and Pavcnik (2007) document evidence that the episodes of widening wage inequality coincided with significant trade liberalisation in a number of developing countries. Their findings also suggest that the effect of globalisation, trade liberalisation in particular, on wage inequality depends on country characteristics – such as within-country labour mobility and trade protection policies prior to liberalisation. In this section, I derive the model’s predictions regarding wage inequality when the countries start to trade with each other. Furthermore, I discuss how the effect of trade liberalisation on wage inequality is affected by the relative factor endowments and the degree of competition within the countries.

In autarky, the factor market equilibrium conditions are given by;

$$L = (L^D)_A = n \int_0^1 \alpha(z)y(W, R; n, 0; z)dz; \quad (2.4.1)$$

$$sL = (S^D)_A = n \int_0^1 my(W, R; n, 0; z)dz.$$

Compared to the autarky equilibrium, aggregate supply of goods in  $[0, \tilde{z}_X]$  is larger in the

trade equilibrium, implying a higher demand for both factors. Remember the assumption that, compared to supplying domestically, exporting is more intensive in white-collar labour. Therefore, the relative demand for white-collar labour is higher in the equilibrium – and so is its relative price.

This is seen more clearly when we re-write the factor market equilibrium conditions (2.3.10) and (2.3.11) in  $W$  and  $\tilde{z}_X$ . To do it, I use (2.3.9) to eliminate  $R$  from the factor market equilibrium conditions:

$$\begin{aligned}
L &= \frac{nL}{(n+1)b} \left\{ \frac{(n+1)\delta a}{\theta} \int_0^1 \alpha(z) dz + W \int_0^1 \alpha(z) (m\alpha(\tilde{z}_X)/\theta - \alpha(z)) dz \right. \\
&\quad \left. + W \int_0^{\tilde{z}_X} \frac{\alpha(z)}{2n+1} (\alpha(\tilde{z}_X) - \alpha(z)) dz \right\}, \\
sL &= \frac{nL}{(n+1)b} \left\{ \frac{(n+1)\delta am}{\theta} + Wm \int_0^1 (m\alpha(\tilde{z}_X)/\theta - \alpha(z)) dz \right. \\
&\quad \left. + W \int_0^{\tilde{z}_X} \frac{\theta}{2n+1} (\alpha(\tilde{z}_X) - \alpha(z)) dz \right\}.
\end{aligned} \tag{2.4.2}$$

$$\begin{aligned}
sL &= \frac{nL}{(n+1)b} \left\{ \frac{(n+1)\delta am}{\theta} + Wm \int_0^1 (m\alpha(\tilde{z}_X)/\theta - \alpha(z)) dz \right. \\
&\quad \left. + W \int_0^{\tilde{z}_X} \frac{\theta}{2n+1} (\alpha(\tilde{z}_X) - \alpha(z)) dz \right\}.
\end{aligned} \tag{2.4.3}$$

The partial derivative of each demand with respect to the threshold good is positive:

$$\begin{aligned}
\frac{dL^D}{d\tilde{z}_X} &= \frac{nLW\alpha(\tilde{z}_X)'}{(n+1)b} \left[ (m/\theta) \int_0^1 \alpha(z) dz + \int_0^{\tilde{z}_X} \frac{\alpha(z)}{2n+1} dz \right] > 0, \\
\frac{dS^D}{d\tilde{z}_X} &= \frac{nLW\alpha(\tilde{z}_X)'}{(n+1)b} \left[ m^2/\theta + \frac{\tilde{z}_X\theta}{2n+1} \right] > 0.
\end{aligned}$$

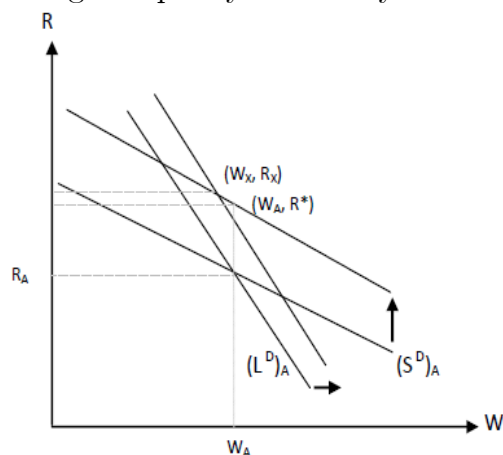
This confirms my earlier claim that exporting increases the firm-level sales of goods  $z < \tilde{z}_X$ , and thus both factor demands increase.<sup>23</sup>

In Figure 2.4.1, both factor market equilibrium loci shift to the right. At the equilibrium factor prices in autarky,  $(W_A, R_A)$ , there is excess demand for white-collar workers after trade liberalisation. So, the wage of white-collar workers increases to  $R^* > R_A$ . In the market for blue-collar workers, the pair  $(W_A, R^*)$  does not clear the market; there

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<sup>23</sup>Appendix 2.A.1 shows that demand for each factor falls as  $W$  increases. It also derives the conditions for the existence of positive factor prices and a stable equilibrium.

Figure 2.4.1: Wage inequality in autarky and trade equilibria



is excess supply of blue-collar workers at these factor prices. This arises because non-exporters lower their sales at the new (higher) white-collar labour wage. As illustrated in Figure 2.4.1, a stable equilibrium requires that the wage of blue-collar workers should fall below  $W_A$  and that of white-collar workers should rise above  $R^*$  in the new equilibrium. Thus, for any level of openness ( $\tilde{z}_X$ ), wage inequality ( $\rho$ ) is higher in the trade equilibrium than in autarky. Appendix 2.A.2 proves this result.

**Result 2.4.1** *Trade liberalisation between two identical countries leads to an increase in wage inequality in favour of white-collar workers.*

The model predicts an increase in wage inequality when a country opens to trade with a similar country. This happens because of two reasons. First, compared to supplying domestically, exporting uses white-collar labour more intensively. Second, the aggregate supply of goods that are relatively more intensive in white-collar labour expands after trade liberalisation. The result implies that one should consider the entire volume of trade of a country when exploring the relationship between trade and wage inequality. The recent increase in wage inequality may have been driven not only by North-South trade, but also North-North trade in Northern countries and South-South trade in Southern ones.

The result that wage inequality is higher in the trade equilibrium compared to autarky does not imply that country characteristics do not matter for the relationship between

trade and wage inequality. According to the Heckscher-Ohlin-Samuelson theory, whether trade liberalisation raises or lowers wage inequality depends on the relative factor endowments between the trading partners. In the current framework, on the other hand, trade liberalisation causes an increase in wage inequality in both trading partners regardless of the relative factor endowments between them. What matters here is the relative factor endowments within the countries. To be specific, the equilibrium level of wage inequality, after trade liberalisation, depends negatively on the relative endowment of white-collar labour in the country. As export sales are relatively intensive in white-collar labour, trade liberalisation increases the relative demand for this factor. If its relative supply is large in the country, then the extra demand can be met without a marked increase in wage inequality. In other words, trade liberalisation between similar countries causes an increase in wage inequality in both trading partners but, for a given openness, its level is lower the higher the relative supply of white-collar labour. It is possible to generalise this result: for a given change in openness, the resulting change in the equilibrium level of wage inequality is lower the higher the relative endowment of white-collar workers in the country. This prediction is consistent with the empirical evidence presented in Section 2.2.

One advantage of assuming an oligopolistic market structure in the model is that it allows us to study how the equilibrium is affected by the degree of competition in the economy. In the model, the number of suppliers of each good in each country is exogenous and given by  $n$ . Although it is fixed, trade liberalisation increases the degree of competition in the economy as some goods ( $z \leq \tilde{z}_X$ ) are supplied by both domestic and foreign firms in the trade equilibrium.<sup>24</sup> In autarky, the average number of firms is equal to  $n$ . In the trade equilibrium, it is equal to

$$2n\tilde{z}_X + n(1 - \tilde{z}_X) = n(1 + \tilde{z}_X),$$

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<sup>24</sup>It is a naive way of measuring the degree of competitiveness, but it still useful to consider the number of firms supplying each good to have an idea about the degree of competitiveness in the country.

which is higher than in autarky.

Trade liberalisation increases the degree of competitiveness in the economy. On the other hand, the degree of competitiveness also shapes the effects of trade liberalisation on the economy. Given the topic of the paper, I am particularly interested in how wage inequality in the trade equilibrium is affected by the degree of competitiveness in the trading partners. Firstly note that wage inequality in the trade equilibrium is determined by the change in the relative demand for white-collar workers, which is mainly determined by the size of export sales. Trade liberalisation induces an increase in the relative demand for white-collar workers because export sales are relatively more intensive in this factor. It implies that a larger volume of exports should result in a higher level of equilibrium wage inequality. The expression for export sales in (2.3.3) shows that an increase in the number of firms lowers the sales of an exporter of good  $z \leq \tilde{z}_X$ , but increases the aggregate export sales of the good:

$$\begin{aligned} \frac{\partial [ny_X(W, R; n, n; z)]}{\partial n} &\propto \frac{W}{(2n+1)^2} (\alpha(\tilde{z}_X) - \alpha(z)) \\ &> 0. \end{aligned}$$

When the competition is tough in a market, i.e.  $n$  is high, exporters in the foreign market face a larger group of firms which supply the same good more efficiently than themselves. Therefore, for a given level of openness ( $\tilde{z}_X$ ), their export sales will be lower compared to the case of low competition. Nevertheless, aggregate export sales of good  $z$  will be larger because of a larger number of exporters, i.e. extensive margin effect. Therefore, we should expect the equilibrium level of wage inequality to be higher in more competitive economies. We can generalise this result: for a given change in openness, the resulting change in equilibrium wage inequality is higher the more competitive the economy.

Result 2.4.2 summarises the predictions of the model regarding the relationship between openness and wage inequality in equilibrium. Appendix 2.A.3 proves the result.



**Result 2.4.2** *The lower the supply of white-collar labour, or the more competitive the economy the higher is the change in equilibrium wage inequality for a given change in openness ( $\tilde{z}_X$ ).*

## 2.5 Increase in White-collar Labour Endowment

Using the factor market equilibrium conditions in (2.4.2) and (2.4.3), we can do comparative statics exercises using the following two differential equations:

$$\frac{dL^X}{dW} dW + \frac{dL^X}{d\tilde{z}_X} d\tilde{z}_X = -\frac{dL^X}{ds} ds \quad (2.5.1)$$

$$\frac{dS^X}{dW} dW + \frac{dS^X}{d\tilde{z}_X} d\tilde{z}_X = -\frac{dS^X}{d\beta} d\beta; \quad (2.5.2)$$

where  $L^X = L^D - L$ ,  $S^X = S^D - S$ . Here, I am interested in the effect of an increase in the relative supply of white-collar labour ( $s$ ) on wage inequality ( $\rho$ ), and the goods margin of trade ( $\tilde{z}_X$ ). These effects can be expressed as follows using (2.5.1), (2.5.2), and (2.3.9);

$$\begin{aligned} \frac{d\tilde{z}_X}{ds} &= \frac{-dS^X/ds + \frac{dS^X/dW}{dL^X/dW} dL^X/ds}{dS^X/d\tilde{z}_X - \frac{dS^X/dW}{dL^X/dW} dL^X/d\tilde{z}_X}, \quad (2.5.3a) \\ \frac{dW}{ds} &= \frac{-dS^X/ds + \frac{dS^X/d\tilde{z}_X}{dL^X/d\tilde{z}_X} dL^X/ds}{dS^X/dW - \frac{dS^X/d\tilde{z}_X}{dL^X/d\tilde{z}_X} dL^X/dW}, \\ \frac{dR}{ds} &= \frac{\partial R}{\partial s} - \frac{\alpha(\tilde{z}_X)dW/ds + W\alpha(\tilde{z}_X)'d\tilde{z}_X/ds}{\theta}. \end{aligned}$$

An increase in the size of the trading partners,  $L$ , does not affect factor prices. Supply of all goods, regardless of whether they are traded or not, increase proportionally. Endowments of both blue-collar and white-collar labour also increase by the same proportion. Therefore, according to equations (2.4.2) and (2.4.3), a rise in  $L$  leaves factor prices,  $W$  and  $R$ , unchanged. Goods prices do not change either. Neary and Tharakan (2012) also show that an increase in the size of the economy is neutral in a general oligopolistic

equilibrium framework as it has no effect on the factor prices.

The same result does not hold when the relative size of the white-collar labour force,  $s$ , increases. Using the expressions in (2.5.3a), we can easily see the following;

$$\begin{aligned}\frac{d\tilde{z}_X}{ds} &= \frac{L}{dS^X/d\tilde{z}_X - \frac{dS^X/dW}{dL^X/dW}dL^X/d\tilde{z}_X} > 0, \\ \frac{dW}{ds} &= \frac{L}{dS^X/dW - \frac{dS^X/d\tilde{z}_X}{dL^X/d\tilde{z}_X}dL^X/dW} > 0, \\ \frac{dR}{ds} &= -(1/\theta)(\alpha(\tilde{z}_X)dW/ds + W\alpha'(\tilde{z}_X)d\tilde{z}_X/ds) < 0.\end{aligned}\tag{2.5.4}$$

An increase in the relative supply of white-collar labour lowers its price,  $R$ . This reduces the cost of supplying any good, with a greater effect on exports relative to domestic sales. Some goods move from non-traded to traded category – the goods margin of trade  $\tilde{z}_X$  increases. The resulting expansion in aggregate goods supply increases the demand for both factors. Thus, the blue-collar wage  $W$  increases. The supply effect, however, dominates the sales-expansion effect in the white-collar labour market. The following result summarises these findings.

**Result 2.5.1** *An increase in the relative size of white-collar labour force,  $s$ , in both trading partners reduces wage inequality  $\rho$  and increases the goods margin of trade  $\tilde{z}_X$ .*

Using the expression for firm-level exports in (2.3.3) and the one for the white-collar wage in (2.3.9), the export volume of good  $z < \tilde{z}_X$  can be derived as

$$\frac{n}{(2n+1)b}W(\alpha(\tilde{z}_X) - \alpha(z)).\tag{2.5.5}$$

Since both  $W$  and  $\tilde{z}_X$  increases as a result of a rise in the relative size of the white-collar labour force, the volume of trade in the already-traded goods also increases.

**Result 2.5.2** *An increase in the relative endowment of white-collar workers leads to endogenous globalisation, increasing both the intensive and the goods margins of trade.*

The result is in line with the theoretical findings of Matsuyama (2007) who shows that an increase in the endowment of factors used intensively in international trade can lead to globalisation. Result 2.5.2 extends the corresponding result in Matsuyama (2007) in a number of ways. First, it strengthens his result by adding an intensive margin adjustment to the goods margin. The availability of a larger endowment of the factor used intensively in international trade, white-collar labour in this case, increases not only the range of traded goods but also the volume of trade in the already traded goods. Second, it shows that the result is robust to relaxing the assumption of Hicks-neutral improvement in exporting technologies. Third, it shows that the result does not rely on the presence of Ricardian differences between the trading partners. An increase in the endowment of white-collar labour increases both the intensive and goods margin of trade even in a world of identical countries.

Results 2.5.2 and 2.4.2 highlight the importance of the country's factor endowments for the relationship between trade and wage inequality. While the Heckscher-Ohlin theory emphasises the differences in factor endowments between the trading partners, the current framework emphasises the differences in factor endowments within the trading partners. The results imply that a greater endowment of white-collar labour – the factor that is used intensively in exporting – mitigates the undesired effect of globalisation on wage inequality. Furthermore, an increase in the relative endowment of this factor leads to endogenous globalisation and reduces wage inequality. These results have two implications. First, although trade liberalisation raises wage inequality in any country, the magnitude of the increase depends on the relative endowment of white-collar labour in the country. Second, an exogenous change in the endowment of white-collar labour affects both wage inequality and the level of openness of the country. Therefore, the endowment of the factor that is used intensively in exporting plays an important role in shaping the consequences of openness in a country.

Next question is about the effect of an increase in the relative supply of white-collar labour on welfare. Neary (2003) shows that we can express the indirect utility function in terms of the second moment of prices;

$$\tilde{U} = -\lambda^2 \mu_2^p. \quad (2.5.6)$$

So, welfare is decreasing in the second moment of the prices. Using the price equation for traded goods in (2.3.3), and for non-traded goods in (2.3.4), we can expand the indirect utility in (2.5.6) as follows;

$$\tilde{U} = - \int_0^{\tilde{z}_X} \left[ \frac{a + 2nW\alpha(z) + nR(2m + \delta)}{2n + 1} \right]^2 dz - \int_{\tilde{z}_X}^1 \left[ \frac{a + nW\alpha(z) + nRm}{n + 1} \right]^2 dz.$$

Now, we can use (2.3.9) to eliminate  $R$  from the above expression:

$$\begin{aligned} \tilde{U} = & - \int_0^{\tilde{z}_X} \{a(m + \delta) + (Wn/(2n + 1)) [2\alpha(z) - ((2m + \delta)/\theta)\alpha(\tilde{z}_X)]\}^2 dz \\ & - \int_{\tilde{z}_X}^1 \{a(m + \delta) + (Wn/(n + 1)) [\alpha(z) - (m/\theta)\alpha(\tilde{z}_X)]\}^2 dz. \end{aligned} \quad (2.5.7)$$

To see the change in welfare as a result of an increase in the supply of white-collar labour, differentiate (2.5.6) with respect to  $s$ . Welfare is affected by a change in  $s$  through factor prices and the threshold good:

$$\frac{d\tilde{U}}{ds} = \frac{\partial \tilde{U}}{\partial W} \frac{dW}{ds} + \frac{\partial \tilde{U}}{\partial \tilde{z}_X} \frac{d\tilde{z}_X}{ds}. \quad (2.5.8)$$

$\begin{matrix} <0 & >0 \\ <0 & >0 \end{matrix}$

Let us first study individual partial derivatives in (2.5.8).<sup>25</sup> First, an increase in blue-collar wage increases prices of any good, and thus reduces welfare. Second, an increase in the goods margin of trade improves welfare as foreign competition reduces goods prices. When the relative supply of white-collar labour increases, the resulting increase in the

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<sup>25</sup>Appendix 2.A.4 formally derives the signs of the partial derivatives.

goods margin of trade tends to improve welfare, and the increase in blue-collar wage tends to reduce it. Appendix 2.A.4 shows that welfare unambiguously improves.

**Result 2.5.3** *An increase in the relative endowment of white-collar workers unambiguously improves welfare.*

The intuition behind Result 2.5.3 is as follows. An increase in the relative supply of white-collar labour lowers its price  $R$ . This reduces costs of all firms regardless of their export status. Therefore, firms increase their domestic sales, and exporters increase their export sales. Wage of blue-collar workers increases because of this sales-expansion effect. So, good prices fall because of two reasons: first, white-collar wage falls; second, aggregate supply of all goods expands. Thus, consumer welfare improves when  $s$  increases.

Result 2.5.3 suggests a new channel through which a worldwide increase in human capital stock can benefit countries. Assuming that exporting is relatively white-collar labour intensive, an increase in its worldwide supply lowers the cost of exporting. So, exporters expand their sales, leading to an increase in the aggregate sales of traded goods and a fall in their prices. Also, some goods move from non-traded to traded category. As a result, global welfare improves.

## 2.6 Conclusion

I present a general equilibrium model where trade integration between two identical countries raises wage inequality between white-collar and blue-collar workers. In the model, trade arises from strategic interactions between firms, and it brings about an increase in wage inequality because, compared to domestic sales, export sales are more intensive in white-collar labour. So, the model suggests a supply-side channel through which trade integration between similar countries raises wage inequality.

I show that trade liberalisation between two identical countries increases wage inequality in both countries. To explain the effect of trade liberalisation on wage inequality,

the model does not rely on differences in relative factor endowments between the trading partners. Nevertheless, I show that relative factor endowments within countries matter for the level of wage inequality in the trade equilibrium. For a given trade openness, wage inequality is higher in countries that are relatively white-collar labour scarce. Also, the degree of competitiveness affects the level of wage inequality in trade equilibrium. For a given openness, wage inequality is higher the more competitive the economy. These findings are consistent with the conclusion reached by Goldberg and Pavcnik (2007) that country characteristics, not necessarily relative to its trading partners, should matter for the link between its level of globalisation and wage inequality.

Next, I consider the effect of an increase in the relative endowment of white-collar labour on wage inequality. As one would expect, it causes a fall in wage inequality. An interesting result is that a greater supply of skilled-labour expands the range of traded goods and increases the export volume of already-traded goods, implying an endogenous increase in globalisation. It introduces a new channel through which an increase in human capital stock improves welfare.

Given that trade between similar countries accounts for more than half of world trade flows, introducing a mechanism through which such trade flows can increase wage inequality is useful. The model developed here can explain why trade liberalisation episodes accompanied by an increase in wage inequality in Southern countries. It can also explain why changes in wage inequality are significant in such countries relative to their degree of openness. In the case of Northern countries, the model suggests that one should consider not only their trade volume with Southern countries but also with other Northern countries when studying the effect of trade openness on their wage inequality.

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## 2.A Appendix

### 2.A.1 Derivatives of Factor Demands and Stability of Equilibrium

Firstly, we need to show that the demand for each factor falls as  $W$  increases. In the text, the factor demands are derived as follows:

$$\begin{aligned}
 L &= L^D = \frac{nL}{(n+1)b} \left\{ \frac{(n+1)\delta a}{\theta} \int_0^1 \alpha(z) dz + W \int_0^1 \alpha(z) (m\alpha(\tilde{z}_X)/\theta - \alpha(z)) dz \right. \\
 &\quad \left. + W \int_0^{\tilde{z}_X} \frac{\alpha(z)}{2n+1} (\alpha(\tilde{z}_X) - \alpha(z)) dz \right\}, \\
 sL &= S^D = \frac{nL}{(n+1)b} \left\{ \frac{(n+1)\delta am}{\theta} + Wm \int_0^1 (m\alpha(\tilde{z}_X)/\theta - \alpha(z)) dz \right. \\
 &\quad \left. + W \int_0^{\tilde{z}_X} \frac{\theta}{2n+1} (\alpha(\tilde{z}_X) - \alpha(z)) dz \right\}.
 \end{aligned}$$

First consider the demand for blue-collar workers. When  $\tilde{z}_X = 0$ , the factor market equilibrium conditions are given by

$$\begin{aligned}
 L &= \frac{nL}{(n+1)b} \left[ \frac{(n+1)\delta a}{\theta} \int_0^1 \alpha(z) dz + W \int_0^1 \alpha(z) (m\alpha(0)/\theta - \alpha(z)) dz \right], \\
 sL &= \frac{nL}{(n+1)b} \left[ \frac{(n+1)\delta am}{\theta} + W \int_0^1 m(m\alpha(0)/\theta - \alpha(z)) dz \right],
 \end{aligned}$$

where  $m\alpha(0)/\theta - \alpha(z) < 0$  for any  $z \in [0, 1]$ . So, in order for an equilibrium with a positive wage to exist, the following should hold;

$$1 - \frac{n\delta a}{\theta b} \int_0^1 \alpha(z) dz < 0, \quad (2.A.1)$$

$$s - \frac{n\delta am}{\theta b} < 0.$$

Rewrite the equilibrium conditions to obtain

$$\begin{aligned} \frac{n+1}{W} \left( \frac{n\delta a}{\theta b} \int_0^1 \alpha(z) dz - 1 \right) &= \int_0^1 \alpha(z) (\alpha(z) - m\alpha(0)/\theta) dz, \\ \frac{n+1}{Wm} \left( \frac{n\delta am}{\theta b} - s \right) &= \int_0^1 (\alpha(z) - m\alpha(0)/\theta) dz. \end{aligned}$$

By Chebyshev's integral inequality, we have

$$\int_0^1 \alpha(z) (\alpha(z) - m\alpha(0)/\theta) dz > \int_0^1 \alpha(z) dz \int_0^1 (\alpha(z) - m\alpha(0)/\theta) dz.$$

Then

$$\begin{aligned} \frac{n+1}{W} \left( \frac{n\delta a}{\theta b} \int_0^1 \alpha(z) dz - 1 \right) &> \int_0^1 \alpha(z) dz \left[ \frac{n+1}{Wm} \left( \frac{n\delta am}{\theta b} - s \right) \right] \\ \Rightarrow \frac{n\delta am}{\theta b} \int_0^1 \alpha(z) dz - m &> \int_0^1 \alpha(z) dz \left( \frac{n\delta am}{\theta b} - s \right), \end{aligned}$$

thus

$$m < s \int_0^1 \alpha(z) dz. \quad (2.A.2)$$

This inequality should hold for positive factor prices to exist. Given the inequality in (2.A.1), we must have

$$\begin{aligned} \frac{dL^D}{dW} &= \frac{nL}{(n+1)b} \left[ \int_0^1 \alpha(z) (m\alpha(\tilde{z}_X)/\theta - \alpha(z)) dz + \int_0^{\tilde{z}_X} \frac{\alpha(z)}{2n+1} (\alpha(\tilde{z}_X) - \alpha(z)) dz \right] < 0, \\ \frac{dS^D}{dW} &= \frac{nL}{(n+1)b} \left[ \int_0^1 m(m\alpha(\tilde{z}_X)/\theta - \alpha(z)) dz + \int_0^{\tilde{z}_X} \frac{\theta}{2n+1} (\alpha(\tilde{z}_X) - \alpha(z)) dz \right] < 0. \end{aligned}$$

A rise in blue-collar wage  $W$  increases costs, and thus reduces firm sales, leading to lower demand for both blue and white-collar workers. On the other hand, a rise in  $W$  leads to a fall in white-collar wage  $R$  so that the initial threshold good  $\tilde{z}_X$  remains unchanged.

This indirect effect reduces firms' costs, and demand for both factors tends to increase. Overall, the direct effect dominates, and the demand for both factors falls as blue-collar wage increases. The signs of the derivatives of the factor demands with respect to  $W$  and  $\tilde{z}_X$  imply a positive relationship between the two variables:  $dW/d\tilde{z}_X > 0$ .

*Stability of equilibrium:* For the equilibrium to be stable, we need  $\frac{dL^D}{dW} \frac{dS^D}{dR} > \frac{dS^D}{dW} \frac{dL^D}{dR}$ , which implies

$$\frac{\theta^2 \tilde{z}_X + (2n+1)m^2}{(2n+1)m \int_0^1 \alpha(z) dz + \theta \int_0^{\tilde{z}_X} \alpha(z) dz} - \frac{\theta \int_0^{\tilde{z}_X} \alpha(z) dz + (2n+1)m \int_0^1 \alpha(z) dz}{(2n+1) \int_0^1 \alpha(z)^2 dz + \int_0^{\tilde{z}_X} \alpha(z)^2 dz} > 0.$$

Expand the terms to obtain,

$$\begin{aligned} & \frac{\theta^2 \tilde{z}_X + (2n+1)m^2}{(2n+1)m \int_0^1 \alpha(z) dz + \theta \int_0^{\tilde{z}_X} \alpha(z) dz} - \frac{\theta \int_0^{\tilde{z}_X} \alpha(z) dz + (2n+1)m \int_0^1 \alpha(z) dz}{(2n+1) \int_0^1 \alpha(z)^2 dz + \int_0^{\tilde{z}_X} \alpha(z)^2 dz} \\ \propto & [\theta^2 \tilde{z}_X + (2n+1)m^2] \left[ (2n+1) \int_0^1 \alpha(z)^2 dz + \int_0^{\tilde{z}_X} \alpha(z)^2 dz \right] \\ & - \left[ (2n+1)m \int_0^1 \alpha(z) dz + \theta \int_0^{\tilde{z}_X} \alpha(z) dz \right] \left[ \theta \int_0^{\tilde{z}_X} \alpha(z) dz + (2n+1)m \int_0^1 \alpha(z) dz \right] \\ > & (2n+1) \left[ \theta^2 \tilde{z}_X \int_0^1 \alpha(z)^2 dz + m^2 \int_0^{\tilde{z}_X} \alpha(z)^2 dz - 2\theta m \int_0^1 \alpha(z) dz \int_0^{\tilde{z}_X} \alpha(z) dz \right], \end{aligned}$$

since  $\int_0^1 \alpha(z)^2 dz > \left( \int_0^1 \alpha(z) dz \right)^2$  and  $\tilde{z}_X \int_0^{\tilde{z}_X} \alpha(z)^2 dz > \left( \int_0^{\tilde{z}_X} \alpha(z) dz \right)^2$  by Chebyshev's integral inequality. Then we obtain

$$\begin{aligned} & \frac{dL^D}{dW} \frac{dS^D}{dR} - \frac{dS^D}{dW} \frac{dL^D}{dR} \\ > & (2n+1) \frac{1}{\tilde{z}_X} \left( \theta \tilde{z}_X \int_0^1 \alpha(z) dz - m \int_0^{\tilde{z}_X} \alpha(z) dz \right)^2 \\ > & 0. \end{aligned}$$

This is the condition required for a stable equilibrium.

## 2.A.2 Proof of Result 2.4.1

The factor market equilibrium conditions in autarky are given by

$$\begin{aligned}\frac{b}{n} &= \int_0^1 \alpha(z) \frac{a - W\alpha(z) - Rm}{n+1} dz, \\ \frac{bs}{n} &= \int_0^1 m \frac{a - W\alpha(z) - Rm}{n+1} dz.\end{aligned}$$

The corresponding conditions in the trade equilibrium are

$$\begin{aligned}\frac{b}{n} &= \int_0^{\tilde{z}_X} \alpha(z) \frac{2(a - W\alpha(z) - Rm) - R\delta}{2n+1} dz + \int_{\tilde{z}_X}^1 \alpha(z) \frac{a - W\alpha(z) - Rm}{n+1} dz, \\ \frac{bs}{n} &= \int_0^{\tilde{z}_X} \left[ m \frac{a - W\alpha(z) + R(\delta n - m)}{2n+1} + (m + \delta) \frac{a - W\alpha(z) - R\theta}{2n+1} \right] dz \\ &\quad + \int_{\tilde{z}_X}^1 m \frac{a - W\alpha(z) - Rm}{n+1} dz.\end{aligned}$$

Assume that the pair  $(W_A, R_A)$  clears the factor markets in autarky. Now, consider the market for white-collar workers at  $(W_A, R_A)$  when the countries start to trade. For the traded goods  $z \in [0, \tilde{z}_X]$ , their aggregate supply is larger after trade liberalisation:

$$\begin{aligned}m \frac{2(a - W_A\alpha(z) - R_A m) - R\delta}{2n+1} + \delta \frac{a - W_A\alpha(z) - R_A\theta}{2n+1} \\ > m \frac{a - W_A\alpha(z) - R_A m}{n+1}.\end{aligned}$$

So, there is excess demand for white-collar workers at  $(W_A, R_A)$  after trade liberalisation. Let  $R^*$  denote the white-collar wage that clears the white-collar labour market at  $W_A$ , then we have  $R^* > R_A$ . Let  $L^D(W_A, R^*)$  denote the demand for blue-collar workers at  $(W_A, R^*)$ . We need to show that there is excess supply of blue-collar workers at these factor prices. We know that  $(L^D)(W_A, R_A)$  is equal to the supply of blue-collar workers.

Thus, there is excess supply of blue-collar workers at  $(W_A, R^*)$  iff

$$L^D(W_A, R^*) - (L^D)_A(W_A, R_A) < 0.$$

Let us expand the expressions

$$\begin{aligned} & L^D(W_A, R^*) - (L^D)_A(W_A, R_A) \\ \propto & \int_0^{\tilde{z}_X} \alpha(z) \frac{2(a - W_A \alpha(z) - R^* m) - R^* \delta}{2n + 1} dz + \int_{\tilde{z}_X}^1 \alpha(z) \frac{a - W_A \alpha(z) - R^* m}{n + 1} dz \\ & - \int_0^1 \alpha(z) \frac{a - W_A \alpha(z) - R_A m}{n + 1} dz \\ = & \int_0^1 \alpha(z) \frac{(R_A - R^*) m}{n + 1} dz + \int_0^{\tilde{z}_X} \alpha(z) \frac{y_X(n, n; z)}{n + 1} dz. \end{aligned}$$

Using the white-collar labour market equilibrium conditions in autarky and trade equilibria, we have

$$0 = \theta \int_0^{\tilde{z}_X} \frac{y_X(n, n; z)}{n + 1} dz + \int_0^1 \frac{(R_A - R^*) m^2}{n + 1} dz.$$

So,

$$\begin{aligned} & L^D(W_A, R^*) - (L^D)_A(W_A, R_A) \\ \propto & \left( \frac{-\theta}{m} \int_0^{\tilde{z}_X} \frac{y_X(n, n; z)}{n + 1} dz \right) \int_0^1 \alpha(z) dz + \int_0^{\tilde{z}_X} \alpha(z) \frac{y_X(n, n; z)}{n + 1} dz \\ \propto & \int_0^{\tilde{z}_X} y_X(n, n; z) \left( \alpha(z) - \frac{\theta}{m} \int_0^1 \alpha(z) dz \right) dz. \end{aligned}$$

Apply Chebyshev's integral inequality to the last line;

$$\begin{aligned} & L^D(W_A, R^*) - (L^D)_A(W_A, R_A) \\ < & \frac{1}{\tilde{z}_X} \left[ \int_0^{\tilde{z}_X} y_X(n, n; z) dz \right] \left[ \int_0^{\tilde{z}_X} \left( \alpha(z) - \frac{\theta}{m} \int_0^1 \alpha(z) dz \right) dz \right] \\ < & \frac{1}{\tilde{z}_X} \left[ \int_0^{\tilde{z}_X} y_X(n, n; z) dz \right] \left[ \int_0^{\tilde{z}_X} \left( \alpha(z) - \int_0^1 \alpha(z) dz \right) dz \right] \\ < & 0, \end{aligned}$$

as  $\int_0^{\tilde{z}_X} (\alpha(z) - \int_0^1 \alpha(z)) dz = \tilde{z}_X \left( \frac{\int_0^{\tilde{z}_X} \alpha(z)}{\tilde{z}_X} - \int_0^1 \alpha(z) \right) < 0$ . Therefore, we obtain

$$L^D(W_A, R^*) - (L^D)_A(W_A, R_A) < 0,$$

implying an excess supply of blue-collar workers at  $(W_A, R^*)$ . As illustrated in Figure 2.4.1,  $W$  should fall below  $W_A$ , and  $R$  should rise above  $R^*$  to restore the equilibrium in both markets. Let  $(W_X, R_X)$  denote the pairs of factor prices that clear the markets in the trade equilibrium. Then, we have  $R_X > R_A$ , and  $W_X < W_A$ , implying  $\rho_X > \rho_A$  for any level of  $\tilde{z}_X$ . This completes the proof.

### 2.A.3 Proof of Result 2.4.2

To prove the result, use (2.3.9) to eliminate  $a$  from the factor market equilibrium conditions. This allows us to write them in terms of  $\rho$ ,  $W$ , and  $\tilde{z}_X$ . We can take their ratio to eliminate  $W$  and obtain

$$1 = \frac{\delta(n+1)m\rho + N(\tilde{z}_X)}{\delta(n+1)s\rho \int_0^1 \alpha(z) dz + sD(\tilde{z}_X)}, \quad (2.A.3)$$

where  $N(\tilde{z}_X) = m \int_0^1 (\alpha(\tilde{z}_X) - \alpha(z)) dz + \int_0^{\tilde{z}_X} \frac{\theta}{2n+1} (\alpha(\tilde{z}_X) - \alpha(z)) dz$ , and  $D(\tilde{z}_X) = \int_0^1 \alpha(z) (\alpha(\tilde{z}_X) - \alpha(z)) dz + \int_0^{\tilde{z}_X} \frac{\alpha(z)}{2n+1} (\alpha(\tilde{z}_X) - \alpha(z)) dz$ , and  $N(\tilde{z}_X) - sD(\tilde{z}_X) > 0$  so that the equilibrium level of  $\rho$  is positive. At any equilibrium, the pair  $(\rho, \tilde{z}_X)$  should satisfy (2.A.3). Let us re-write the expression as

$$\delta(n+1) \left( s \int_0^1 \alpha(z) dz - m \right) \rho + sD(\tilde{z}_X) - N(\tilde{z}_X) = 0. \quad (2.A.4)$$

In Appendix 2.A.1, I show that we need  $s \int_0^1 \alpha(z) dz - m > 0$  for positive equilibrium factor prices. So the left-hand-side is increasing in  $\rho$ . We also need to determine the size of the

following:

$$\frac{\partial}{\partial \tilde{z}_X} (sD(\tilde{z}_X) - N(\tilde{z}_X)) = \alpha(\tilde{z}_X)' \left( s \int_0^1 \alpha(z) dz - m + \int_0^{\tilde{z}_X} \frac{s\alpha(z) - \theta}{2n+1} dz \right).$$

If  $N(\tilde{z}_X) - sD(\tilde{z}_X) > 0$ , we must have  $\frac{\partial}{\partial \tilde{z}_X} (sD(\tilde{z}_X) - N(\tilde{z}_X)) < 0$ . Therefore, the left-hand-side of (2.A.4) is decreasing in  $\tilde{z}_X$ . Then, in equilibrium, holding all else constant, we have

$$\left( \frac{d\rho}{d\tilde{z}_X} \right)_{eq} = \xi = - \left( \frac{\alpha(\tilde{z}_X)' \left( s \int_0^1 \alpha(z) dz - m + \int_0^{\tilde{z}_X} \frac{s\alpha(z) - \theta}{2n+1} dz \right)}{\delta(n+1) \left( s \int_0^1 \alpha(z) dz - m \right)} \right)_{eq} > 0. \quad (2.A.5)$$

In words, greater openness in an equilibrium is associated with higher levels of wage inequality. Now let us derive the responsiveness of the slope of the equilibrium locus with respect to  $s$  and  $n$ , i.e.  $\frac{d\xi}{ds}$  and  $\frac{d\xi}{dn}$ . First let us differentiate  $\xi$  with respect to  $s$ :

$$\begin{aligned} \frac{\partial \xi}{\partial s} &\propto - \left( \int_0^1 \alpha(z) dz + \int_0^{\tilde{z}_X} \frac{\alpha(z)}{2n+1} dz \right) \left( s \int_0^1 \alpha(z) dz - m \right) \\ &\quad + \left( \int_0^1 \alpha(z) dz \right) \left( s \int_0^1 \alpha(z) dz - m + \int_0^{\tilde{z}_X} \frac{s\alpha(z) - \theta}{2n+1} dz \right) \\ &= - \left( \int_0^1 \alpha(z) dz \right) \left( \int_0^{\tilde{z}_X} \frac{\theta}{2n+1} dz \right) + m \left( \int_0^{\tilde{z}_X} \frac{\alpha(z)}{2n+1} dz \right) \\ &< 0, \end{aligned}$$

since  $\theta = m + \delta(n+1) > m$ , and  $\int_0^1 \alpha(z) dz > \frac{\int_0^{\tilde{z}_X} \alpha(z) dz}{\tilde{z}_X}$  by the Mean Value Theorem for integrals. So, we obtain  $\frac{\partial \xi}{\partial s} < 0$ . The result implies that, for a given change in openness, the change in equilibrium wage inequality will be lower the greater the relative endowment of while-collar labour in the country. In the case where  $\tilde{z}_X = 0$ , the equilibrium level of wage inequality will be lower after trade liberalisation the greater the relative endowment of while-collar workers.



Now, let us define the following

$$\begin{aligned} A &= \alpha(\tilde{z}_X)' \left( s \int_0^1 \alpha(z) dz - m + \int_0^{\tilde{z}_X} \frac{s\alpha(z) - \theta}{2n+1} dz \right), \\ B &= \delta(n+1) \left( s \int_0^1 \alpha(z) dz - m \right), \end{aligned}$$

such that  $\xi = -\frac{A}{B}$ . Obviously,  $\frac{\partial A}{\partial n} < 0$  and  $\frac{\partial B}{\partial n} > 0$  given  $s \int_0^1 \alpha(z) dz - m > 0$ . Then,

$$\begin{aligned} \frac{\partial \xi}{\partial n} &= -\frac{B \frac{\partial A}{\partial n} - A \frac{\partial B}{\partial n}}{B^2} \\ &> 0. \end{aligned}$$

For a given change in openness, the change in equilibrium wage inequality is higher the more competitive the economy is. In particular, when  $\tilde{z}_X = 0$ , the equilibrium level of wage inequality for a given openness will be higher the more competitive the economy is.

This completes the proof.

### 2.A.4 Proof of Result 2.5.3

Using (2.5.7), the change in utility due to a change in  $s$  is given by;

$$\frac{d\tilde{U}}{ds} = \frac{\partial \tilde{U}}{\partial W} \frac{dW}{ds} + \frac{\partial \tilde{U}}{\partial \tilde{z}_X} \frac{d\tilde{z}_X}{ds}.$$

The partial derivative with respect to  $W$  is negative;

$$\frac{\partial \tilde{U}}{\partial W} = -2 \left[ \int_0^1 p(n, n^*; z) \frac{\partial p(n, n^*; z)}{\partial W} dz \right]$$

where  $n^* = \{0, n\}$ , and

$$\begin{aligned} \frac{\partial p(n, n^*; z)}{\partial W} &= \frac{n}{2n+1} [2\alpha(z) - [(2m + \delta)/\theta]\alpha(\tilde{z}_X)], z \in [0, \tilde{z}_X), \\ \frac{\partial p(n, n^*; z)}{\partial W} &= \frac{n}{n+1} [\alpha(z) - (m/\theta)\alpha(\tilde{z}_X)], z \in [\tilde{z}_X, 1]. \end{aligned}$$

As shown in Appendix 2.A.1, we have

$$\begin{aligned} 2\alpha(z) - ((2m + \delta)/\theta)\alpha(\tilde{z}_X) &> 0, z \in [0, \tilde{z}_X), \\ \alpha(z) - (m/\theta)\alpha(\tilde{z}_X) &> 0, z \in [\tilde{z}_X, 1]. \end{aligned}$$

So,

$$\frac{\partial \tilde{U}}{\partial W} < 0.$$

Let us derive the sign of the partial derivative with respect to  $\tilde{z}_X$ :

$$\frac{\partial \tilde{U}}{\partial \tilde{z}_X} = 2\alpha(\tilde{z}_X)' \left[ \int_0^{\tilde{z}_X} p(n, n; z) \frac{Wn(2m + \delta)}{\theta(2n + 1)} dz + \int_{\tilde{z}_X}^1 p(n, 0; z) \frac{Wnm}{\theta(n + 1)} dz \right] > 0.$$

Thus we have the following

$$\frac{d\tilde{U}}{ds} = \frac{\partial \tilde{U}}{\partial W} \frac{dW}{ds} + \frac{\partial \tilde{U}}{\partial \tilde{z}_X} \frac{d\tilde{z}_X}{ds}.$$

Using the expressions in (2.5.4), we can expand this as follows

$$\frac{d\tilde{U}}{ds} = \frac{L}{D} \left( \frac{\partial \tilde{U}}{\partial W} \frac{dL^X}{d\tilde{z}_X} - \frac{\partial \tilde{U}}{\partial \tilde{z}_X} \frac{dL^X}{dW} \right),$$

where  $D = (dL^X/d\tilde{z}_X)(dS^X/dW) - (dS^X/d\tilde{z}_X)(dL^X/dW) > 0$  in a stable equilibrium.

Substitute the expressions for  $\frac{dL^X}{d\tilde{z}_X}$  and  $\frac{dL^X}{dW}$  to obtain

$$\begin{aligned} \frac{d\tilde{U}}{ds} &\propto - \int_0^{\tilde{z}_X} \frac{p(n, n; z)}{2n + 1} \left[ \frac{dL^X}{d\tilde{z}_X} \left( 2\alpha(z) - \frac{2m + \delta}{\theta} \alpha(\tilde{z}_X) \right) + \frac{dL^X}{dW} \frac{2m + \delta}{\theta} \right] dz \\ &\quad - \int_{\tilde{z}_X}^1 \frac{p(n, 0; z)}{n + 1} \left[ \frac{dL^X}{d\tilde{z}_X} \left( \alpha(z) - \frac{m}{\theta} \alpha(\tilde{z}_X) \right) + \frac{dL^X}{dW} \frac{m}{\theta} \right] dz \\ &= - \int_0^1 \frac{p(n, n^*; z)}{n + 1} \left[ \frac{dL^X}{d\tilde{z}_X} \left( \alpha(z) - \frac{m}{\theta} \alpha(\tilde{z}_X) \right) + \frac{dL^X}{dW} \frac{m}{\theta} \right] dz \\ &\quad - \int_0^{\tilde{z}_X} \frac{p(n, n; z)}{2n + 1} \left[ - \frac{dL^X}{d\tilde{z}_X} \alpha(\tilde{z}_X) + \frac{dL^X}{dW} \right] dz. \end{aligned}$$

To determine the sign of this expression, we need to determine the size and the sign of

$$-\frac{dL^X}{d\tilde{z}_X}\alpha(\tilde{z}_X) + \frac{dL^X}{dW}:$$

$$\begin{aligned} & -\frac{dL^X}{d\tilde{z}_X}\alpha(\tilde{z}_X) + \frac{dL^X}{dW} \\ \propto & \int_0^1 \alpha(z) \left( \frac{m}{\theta}\alpha(\tilde{z}_X) - \alpha(z) \right) dz + \int_0^{\tilde{z}_X} \frac{\alpha(z)}{2n+1} (\alpha(\tilde{z}_X) - \alpha(z)) dz \\ & - \frac{m}{\theta}\alpha(\tilde{z}_X) \int_0^1 \alpha(z) dz - \frac{\alpha(\tilde{z}_X)}{2n+1} \int_0^{\tilde{z}_X} \alpha(z) dz \\ = & - \int_0^1 \alpha(z)^2 dz - \int_0^{\tilde{z}_X} \frac{\alpha(z)^2}{2n+1} dz < 0. \end{aligned}$$

So, we have

$$\begin{aligned} \frac{d\tilde{U}}{ds} & \propto - \int_0^1 \frac{p(n, n^*; z)}{n+1} \left[ \frac{dL^X}{d\tilde{z}_X} \left( \alpha(z) - \frac{m}{\theta}\alpha(\tilde{z}_X) \right) + \frac{dL^X}{dW} \frac{m}{\theta} \right] dz \\ & - \int_0^{\tilde{z}_X} \frac{p(n, n; z)}{2n+1} \left[ -\frac{dL^X}{d\tilde{z}_X}\alpha(\tilde{z}_X) + \frac{dL^X}{dW} \right] dz \\ & > - \int_0^1 \frac{p(n, n^*; z)}{n+1} \left[ \frac{dL^X}{d\tilde{z}_X}\alpha(z) - \int_0^1 \alpha(z)^2 dz - \int_0^{\tilde{z}_X} \frac{\alpha(z)^2}{2n+1} dz \right] dz \\ & > 0, \end{aligned}$$

since

$$\left( \int_0^1 \alpha(z) dz \right) \left( \int_0^1 \frac{m}{\theta}\alpha(z) dz \right) < \frac{m}{\theta} \left( \int_0^1 \alpha(z)^2 dz \right) < \int_0^1 \alpha(z)^2 dz,$$

and

$$\left( \int_0^{\tilde{z}_X} \alpha(z) dz \right) \left( \int_0^{\tilde{z}_X} \alpha(z) dz \right) < \tilde{z}_X \left( \int_0^{\tilde{z}_X} \alpha(z)^2 dz \right) < \int_0^{\tilde{z}_X} \alpha(z)^2 dz.$$

Thus, we obtain  $\frac{d\tilde{U}}{ds} > 0$ . This completes the proof.

## 2.A.5 Data Appendix

The dataset used in the empirical analysis covers the following 63 countries: Argentina, Australia, Austria, Burundi, Benin, Bangladesh, Belize, Bolivia, Barbados, Central African Republic, Canada, China, Cameroon, Costa Rica, Cyprus, Czech Republic, Germany,

Denmark, Algeria, Estonia, Finland, Gabon, United Kingdom, Guyana, Hong Kong (SAR, China), Honduras, Hungary, India, Italy, Japan, Cambodia, Republic of Korea, Sri Lanka, Latvia, Mexico, Mali, Mauritius, Malawi, Nicaragua, Netherlands, New Zealand, Peru, Philippines, Poland, Portugal, Romania, Russian Federation, Rwanda, Sudan, Singapore, Sierre Leone, Slovak Republic, Slovenia, Sweden, Togo, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uruguay, USA, Venezuela, Zambia.

The data on blue and white-collar wages are taken from the Occupational Wages around the World (OWW) Database published by NBER. The source of the data on labour-force, openness, and GDP is World Development Indicators, published by the World Bank. Data on education indicators come from Barro-Lee (2010).

# Chapter 3

## Cross-border Mergers and Wage Inequality

### Abstract

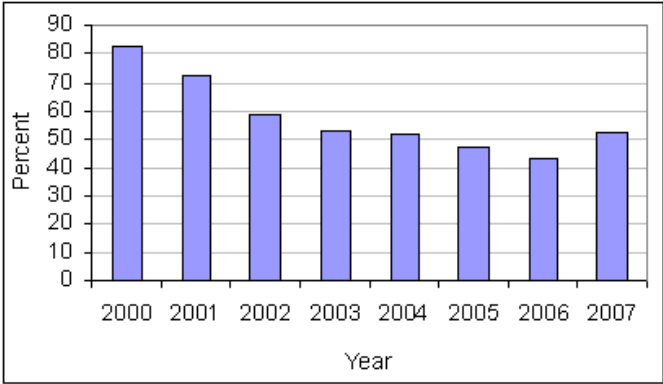
I present a general equilibrium model where cross-border mergers both affect and are affected by wage inequality between white-collar and blue-collar workers. Cross-border mergers are profitable because, first, they reduce competition, and second they create cost synergies by allowing merger partners to avoid the additional cost of supplying to their export markets (in terms of white-collar labour). Cross-border mergers occur in waves and involve firms that are less efficient than exporters. I show that there is a two-way causality between cross-border mergers and wage inequality. On the one hand, wage inequality in favour of white-collar workers increases the profitability of cross-border mergers. On the other hand, at any level of openness, wage inequality is lower in the presence of cross-border mergers than in their absence. This two-way causality creates a potential endogeneity problem in the empirical analysis of the relationship.

### 3.1 Introduction

*Entry by starting a new business unit might also be riskier than acquisition. The going business is a working coalition. From the viewpoint of the foreign MNE, it possesses an operating local management familiar with the national market environment. The MNE that buys the local firm also buys access to its stock of information. (Caves (2007, pp. 86-87).*

Cross-border mergers and acquisitions (CBMAs, henceforth) accounted for about 60 percent of worldwide foreign direct investment (FDI, henceforth) flows over the period 2000-2007 (see Figure 3.1.1).<sup>1</sup> The volume of CBMA transactions increased more than ten-fold in 15 years, from USD 79.2 billion in 1992 to USD 880.5 billion in 2006. This compares to a seven-fold increase in the volume of worldwide greenfield investment flows over the same period.<sup>2</sup> In addition, CBMAs have been an important source of capital for recipient countries, and their importance has been increasing over time.<sup>3</sup> Hence, exploring CBMAs is useful for a better understanding of the economy-wide implications of international capital flows.

Figure 3.1.1: Share of cross-border mergers in total FDI flows



Source: UNCTAD

CBMAs mostly take place between firms from similar countries. According to the CBMA transactions data published by Capital IQ, 76 percent of CBMA transactions in manufacturing took place between Northern or Southern firms over the period 2004-2011 (see Figure 3.1.2).<sup>4</sup> These firms can be assumed to have access to similar technology

<sup>1</sup>I provide pre-crisis figures as the value of CBMAs fell sharply during the recent global crisis. Although the value increased by 36 percent on an annual basis in 2010, it is still around one-third of its pre-crisis value (World Investment Report, 2011). Thus, more recent figures do not reflect the general trend of the CBMA activities.

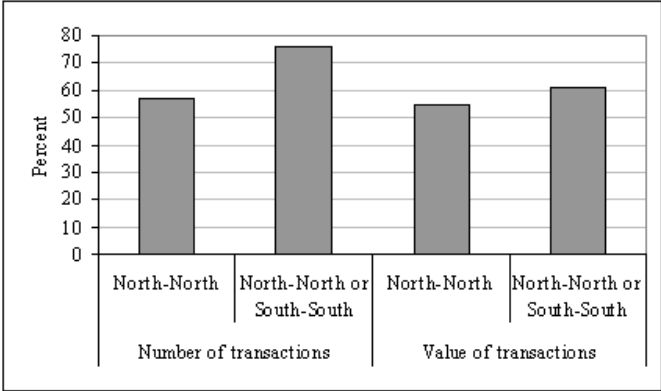
<sup>2</sup>UNCTAD, FDI Statistics, 2012.

<sup>3</sup>According to UNCTAD data, worldwide CBMAs as a share of gross fixed capital formation increased from an average of 2 percent over the period 1990-1994 to almost 8 percent over 2000-2006.

<sup>4</sup>The share drops to 61 percent when the value of transactions is considered. Nevertheless, the value of transactions is not reported for more than half of the CBMAs transactions in the database. Thus the

and operate in a similar environment characterized, among others, by low barriers to international trade. While cross-country differences in factor costs and technological capabilities may explain CBMAs between Northern and Southern countries, they do not satisfactorily explain the motives for CBMAs between Northern countries.

Figure 3.1.2: Share of cross-border mergers between similar countries



Source: Capital IQ, S&P

In this paper, I extend the model developed in Chapter 2 to allow for CBMAs as an alternative mode of foreign market entry, and study the implications of the rise of CBMAs for wage inequality between white-collar and blue-collar workers. In the model, there is a continuum of goods supplied by a small number of firms in two identical countries. Goods differ from each other by the production efficiency of their suppliers. Production is performed by blue-collar, and non-production activities – such as distribution, marketing, consumer services – are performed by white-collar workers. For each good, domestic and export sales differ from each other by the white-collar labour intensity. Exporters have to maintain a distribution network in the foreign country with which they are not familiar,

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figures based on the number of transactions are more reliable. The S&P Capital IQ database provides information on worldwide domestic and cross-border M&As transactions. From the database, I extracted all CBMAs transactions that took place and closed over the period 2004-2011. In the analysis, I included only those in the following industries: materials, transport equipment and components, defence equipment and products, building products, electrical equipment, machinery, consumer durables and apparel, food, beverage and tobacco, household and personal products, computer and internet software, technology hardware and equipment, semiconductors and semiconductor equipment, pharmaceuticals. The final dataset contains about 10,000 CBMAs, and transaction value is reported for 4,677 of them.

and they have to incur costs to gain information about foreign tastes and regulations. So, exporting is more costly than supplying domestically since it requires more white-collar labour. A firm can avoid the additional cost of exporting by engaging in a CBMA. This is mutually beneficial as each firm gains the other firm's local market information and distribution network. Thus, CBMAs arise even between *identical* firms from *identical* countries. This study, for the first time, combines the strategic and efficiency motives for CBMAs in a general-equilibrium model, which have been treated separately in the existing literature.

To the best of my knowledge, this study is also the first attempt at theoretically understanding the impact of CBMAs, the most common mode of FDI, on wage inequality. Three main predictions suggested by the study are as follows. First, CBMAs involve firms that are less efficient than exporters. In equilibrium, the least efficient firms only serve the domestic market, more efficient ones engage in CBMAs, and the most efficient firms serve the foreign market via exports. Second, firms are more likely to enter a foreign market via engaging in a CBMA rather than exporting the higher is the relative wage of white-collar workers (wage inequality). Second, wage inequality is lower in the presence of CBMAs than in their absence. The intuition is as follows: investment liberalisation triggers a CBMA wave in goods markets where engaging in a CBMA is more profitable than exporting. In these markets, post-merger firms undertake the non-production activities more efficiently through their local plants, e.g. supply each market through their local distribution networks. This reduces the employment share of white-collar workers in the post-merger firms. Thus, the relative demand for white-collar labour falls in both countries, leading to a fall in its relative wage. These findings suggest that CBMAs are more likely to take place in countries where wage inequality is high, but an increase in CBMAs relative to exporting lowers wage inequality in the country. It implies a two-way causality between CBMAs and wage inequality, and creates a potential endogeneity problem in the empirical analysis.



A robust stylised fact about mergers is that they happen in waves.<sup>5</sup> One plausible explanation for this empirical fact is that there is strategic interdependence between firms' merger decisions in an industry. Nevertheless, developing a model where mergers arise only from strategic interactions between firms is a difficult task. Under Cournot competition, bilateral mergers between identical firms producing homogeneous goods and facing linear demand are not profitable unless the merger creates a monopoly. This result, which is due to Salant et al. (1983), is known as the Cournot merger paradox. The opposite problem emerges under Bertrand competition: it leads to too many mergers. The following solutions have been proposed to overcome such problems: introducing differentiated products under Bertrand competition (e.g. Deneckere and Davison (1985)), endogenising mergers (e.g. Qiu and Zhou (2007)), and allowing cost synergies (e.g. Perry and Porter (1985), Farrell and Shapiro (1990)).

In an international context, cost synergies can arise from complementarities between foreign and domestic assets. According to Teece (1986), a firm can use its technology efficiently if it is utilised along with other capabilities, which are referred to as complementary assets.<sup>6</sup> Nocke and Yeaple (2007) formalise this idea and show that a firm, by engaging in a CBMA, can reduce its costs in a foreign market as it gains access to its local partner's immobile assets such as local market knowledge. Nevertheless, their approach abstracts from strategic considerations as they assume a monopolistically competitive market structure. Neary (2007) develops a general equilibrium model of oligopoly where a strategic motive for CBMAs arises as they reduce the extent of competition in a market. In his framework, low-cost firms in one country acquire high-cost firms located in the other country. So the model abstracts from cost synergies that may arise from international mergers.<sup>7</sup>

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<sup>5</sup>Toxvaerd (2008) cite several empirical studies reporting this finding.

<sup>6</sup>Cheng (2006) tests the hypothesis that greater need for complementary assets increases the likelihood of foreign market entry through acquisition relative to greenfield investment, and his empirical findings confirm it.

<sup>7</sup>Head and Ries (1997) develop an oligopolistic model where CBMAs occur because post-merger firm enjoys synergies through lower costs. Nevertheless, they take a partial-equilibrium approach.

The current study combines the strategic and efficiency motives for CBMAs, which have been treated separately in the existing literature.<sup>8</sup> In particular, it marries the efficiency motive arising from asset complementarity, introduced by Nocke and Yeaple (2007), with the anti-competitive motive arising from strategic interaction between firms in a general equilibrium framework, developed by Neary (2007). Firms located in either country are identical. Nevertheless, as exporting requires more white-collar labour than supplying domestically, a domestic firm is more efficient than an exporter in a market.<sup>9</sup> This creates an incentive for high-cost firms to engage in CBMAs. By doing so, firms gain access to each others' local distribution networks and market expertise, leading to lower costs of supplying to their respective export markets.<sup>10</sup> Thus, even when there are more than two firms in the market, identical Cournot firms, facing linear demand and producing homogeneous goods, find it profitable to engage in mergers in some goods markets. In other words, the well-known "Cournot merger paradox", proposed by Salant et al. (1983), does not arise in the model. Thus, by combining the strategic motive with an efficiency motive for CBMAs, the model overcomes the difficulties encountered in modelling CBMAs in oligopoly.

The theoretical literature on the effects of FDI on wage inequality is extremely scarce. Markusen and Venables (1997) develop a two-sector general equilibrium model where firms operating in the monopolistically competitive sector can fragment production geographically. Such firms have to incur three types of costs: firm-level fixed costs in terms of skilled-labour, plant-level fixed costs in terms of skilled and unskilled-labour, and production costs in terms of unskilled-labour. Under these assumptions, they show that whether investment liberalisation raises wage inequality (in favour of skilled-labour) depends on the country's factor abundance. In particular, it raises wage inequality in the skill-labour

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<sup>8</sup>Appendix 3.A.5 provides a literature review of the motives for FDI.

<sup>9</sup>Qiu (2010) assumes a similar asymmetric cost structure in an international Cournot duopoly model to study firms' incentives to form strategic alliances. Nevertheless, he does not examine the choice between exports and CBMAs.

<sup>10</sup>In an empirical study, Javorcik (2004) also mentions building distribution networks as a motivation for foreign investment.

abundant country, and in both countries when the countries sufficiently differ from each other in their factor abundance. On the other hand, Feenstra and Hanson (1996) present a North-South model and show that capital flow from the North to the South – interpreted as outsourcing or vertical FDI– increases wage inequality in both regions. This happens because it forces some input production to move from the North to the South; these inputs are more skill-intensive than the ones that have already been produced in the South and less skill-intensive than those left in the North. Thus, FDI raises the relative demand for skilled-labour in both regions. Nevertheless, the result may not follow, or may even be reversed, when the two regions converge in terms of skill abundance; e.g. FDI between Northern or Southern countries.

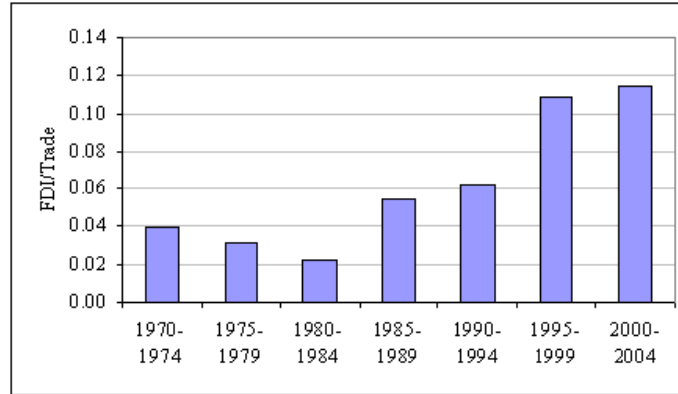
Compared to the theoretical literature, the empirical literature on the relationship between FDI and wage inequality is more extensive, but far from conclusive. Among the industry-level studies, a positive relationship is reported by Figini and Görg (1999) for Ireland, and by Taylor and Driffield (2005) for the UK. On the other hand, Blonigen and Slaughter (2001) find no significant relationship between FDI and wage inequality in the US, with an exception for Japanese FDI into the US. Their results show a negative effect of Japanese foreign investment on wage inequality in the US. One possible reason that the results reported by Blonigen and Slaughter (2001) differ from those reported by Figini and Görg (1999) and Taylor and Driffield (2005) is that they control for industry fixed effects in the estimation, thus their results are less likely to be contaminated by industry heterogeneity. Among the cross-country studies, Gopinath and Chen (2003) use data for 26 countries, 15 developed and 11 developing, and find a positive, though insignificant, association between FDI and wage inequality between non-agricultural and agricultural workers. In another study, Bruno et al. (2004) focus on three Eastern European countries, namely Poland, Czech Republic, and Hungary. Their results show that, between 1994 and 2002, larger inflows of FDI were associated with higher wage inequality in Poland and lower inequality in Czech Republic. In the case of Hungary, their result show no

significant association between FDI and wage inequality. Figini and Görg (2007) study the relationship between FDI and wage inequality across industries in a sample of 100 countries over the period 1980-2002. They find a positive and non-linear relationship for developing countries, and a negative relationship for developed countries.

Empirical studies on the effect of FDI on wage inequality, ex-ante, predict a positive one. The main reason is that FDI is seen as a mode of transferring technology to the host country (Figini and Görg (1999, 2011)). As more advanced technologies arrive, firms located in the host country would upgrade their technologies by employing more skilled-labour, increasing its relative demand and wage. An obvious corollary of such reasoning is that, the employment share of white-collar labour in the acquired plant should increase after acquisition. This is, however, rejected by the empirical findings of Arnold and Javorcik (2009). They use Indonesian plant-level data to study the performance of the acquired plants over the period 1983-2001. Their results suggest that the employment share of white-collar labour in the acquired plants even contracts, albeit slightly, after acquisition. It may explain the lack of positive relationship between FDI and wage inequality reported by a number of studies. I would like to note that the current paper's predictions are consistent with the empirical evidence reported by Arnold and Javorcik (2009).

The model presented in this paper has features that are consistent with the empirical evidence. The model assumes that domestic and foreign sales have different factor intensities. To be specific, employment share of white-collar labour is higher at exporters than at non-exporters, as confirmed empirically by a number of studies (e.g. Bernard and Jensen (1997), Bernard and Wagner (1997), Maurin et al. (2002)). The model predicts that, after trade and investment liberalisation, the least efficient firms do not participate in global business. Among those that participate, less efficient ones engage in CBMAs to save the additional non-production costs associated with exporting. The implied productivity sorting is in line with the empirical findings of Trax (2011). She uses a large dataset

Figure 3.2.1: World FDI and trade flows



Source: UNCTAD, WDI-World Bank

of British firms and reports that, in industries where marketing activities are important, CBMAs involve the least efficient firms among internationally active firms.

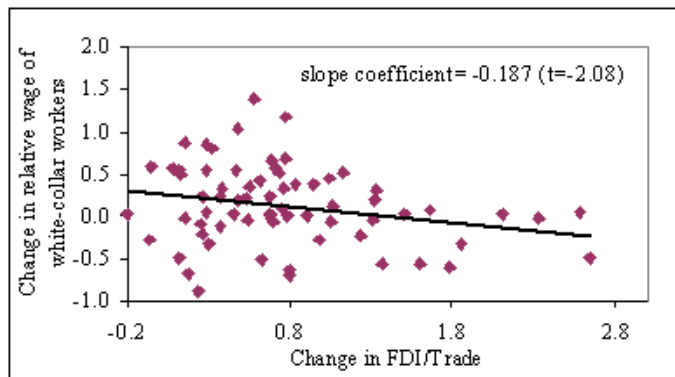
The paper is organised as follows. Section 3.2 reports some stylised facts and econometric evidence regarding the link between FDI and wage inequality. Section 3.3 presents the model, derives CBMA incentives, and studies how they are affected by wage inequality and the degree of competition in the market. Next, the model is extended to general equilibrium to compare wage inequality in the absence and presence of CBMAs. Section 3.4 concludes.

## 3.2 Empirical Motivation

The period starting from mid-1980s to early 2000s witnessed a marked increase in the ratio of worldwide FDI to trade flows (see Figure 3.2.1). The ratio did not increase because of a fall in world trade flows but because of a faster growth in world FDI than in trade. As I discuss in Section 3.1, much of the growth in FDI was due to CBMAs rather than greenfield investment.

In Chapter 2, I show some simple figures that illustrate a positive association between trade and wage inequality – relative wage of white-collar workers to that of blue-collar

Figure 3.2.2: Wage inequality and FDI-to-trade ratio (1985-2003)



Source: Source: NBER-OWW Database, UNCTAD, WDI-World Bank

workers. Here, I will use the same data and try to show what happens if FDI is added in the picture. I consider a sample of 63 countries over the period 1985-2003.<sup>11</sup> Time-series data on CBMAs are not available for such a large set of countries. Given that CBMAs are the dominant form of FDI, I will use FDI data to proxy for the volume of CBMAs.<sup>12</sup> Figure 3.2.2 plots the period change in wage inequality against the period change in the FDI-to-trade ratio.<sup>13</sup> Data show a negative and significant correlation between the two across the countries in the sample: those countries where FDI flows grew faster than trade flows experienced a fall in wage inequality.<sup>14</sup> For instance, in Denmark and Iceland, the FDI-to-trade ratio almost doubled, and wage inequality fell during the period.

To have a better understanding of the relationship between wage inequality and FDI, I also conduct a simple empirical exercise. As in Chapter 2, I take the benchmark empirical specification of wage inequality in Epifani and Gancia (2008). To explain wage inequality, they include openness ratio, market size, and schooling, as a proxy for skilled-labour endowment, in the specification. Their results suggest that openness is positively and significantly associated with wage inequality. In Chapter 2, I replicate their results

<sup>11</sup>See Appendix 3.A.4 for data sources and the list of countries included in the analyses that follow.

<sup>12</sup>The correlation between the value of CBMAs and FDI flows is 0.85 in the sample of countries for which UNCTAD publishes CBMA data.

<sup>13</sup>FDI-to-trade ratio is the sum of FDI inflows and outflows to the sum of imports and exports.

<sup>14</sup>Spearman's rho between the period change in wage inequality and FDI-to-trade ratio is -0.22 with a corresponding p-value of 0.068.

qualitatively and also show that the correlation between wage inequality and openness is smaller the greater the skilled-labour endowment in a country.

Here, I add FDI to the benchmark specification in Epifani and Gancia (2008). As I discuss in Section 3.1, empirical studies mostly use FDI inflows to explain wage inequality. They hypothesise that foreign firms bring advanced technologies into host countries, which are intensive in skilled-labour, and their adoption by domestic firms raises the demand for skilled-labour. Theoretical studies, on the other hand, suggest that outward FDI is equally important (e.g. Markusen and Venables (1997), Feenstra and Hanson (1996)). To capture both strands, I add inward and outward FDI separately in regressions.<sup>15</sup> Table 3.2.1 presents the results. In all specifications, the coefficient on openness is positive and significant. Thus, adding FDI-related variables does not affect qualitatively the association between trade and wage inequality. In Column (1), I include only inward FDI. Its sign indicates that, controlling for openness, inward FDI is negatively associated with wage inequality. Nevertheless, the coefficient is not statistically significant. This is in line with the results reported by a number of empirical studies in the literature, which I discuss selectively in Section 3.1. In column (2), I include only outward FDI. Its coefficient is negative and highly significant. Controlling for their trade volume, a rise in foreign production by a country's firms is associated with lower wage inequality in the country. This result is robust to including inward FDI as an additional covariate (column (3)). In that case, the coefficient of inward FDI also becomes significant. Nevertheless, the results show that, compared to inward FDI, outward FDI matters more for wage inequality.

Overall, the results presented in Table 3.2.1 suggest that, after controlling for trade flows, an increase in the volume of FDI in a country is associated with a lower wage inequality between white-collar and blue-collar workers. In the next section, I present a model that generates predictions in line with this finding.

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<sup>15</sup>In the data, the simple correlation between inward and outward FDI is 0.41.

Table 3.2.1: Cross-border mergers and wage inequality

Dependent variable: relative wage of white-collar workers			
	(1)	(2)	(3)
Openness	0.319 <sup>c</sup>	0.415 <sup>b</sup>	0.319 <sup>c</sup>
	[0.180]	[0.163]	[0.179]
ln(Country size)	0.642	0.759 <sup>c</sup>	0.756 <sup>c</sup>
	[0.415]	[0.443]	[0.450]
Schooling	-0.058	-0.158	-0.169
	[0.098]	[0.105]	[0.111]
Inward FDI	-0.034	...	-0.111 <sup>b</sup>
	[0.042]	...	[0.049]
Outward FDI	...	-0.232 <sup>a</sup>	-0.311 <sup>a</sup>
	...	[0.085]	[0.098]
Number of obs.	529	528	528
Number of groups	63	63	63
R-squared	0.61	0.64	0.65

*Robust standard errors in brackets.*<sup>a</sup> $p < 0.01$ ,<sup>b</sup> $p < 0.05$ ,<sup>c</sup> $p < 0.1$ . All specifications include a full set of country and year fixed effects. Openness is the ratio of the sum of merchandise exports and imports to GDP. Country size is measured by total labour force. Schooling denotes the average years of secondary schooling. Inward (or outward) FDI is measured as a share of GDP. In all specifications, schooling and FDI variables are lagged one-year.

### 3.3 Model

Here, I extend the model developed in Chapter 2 to allow for CBMAs as an alternative mode of foreign market entry. I do it in two steps. First, I identify the cases where engaging in a CBMA is more profitable than exporting. In doing so, I take a partial equilibrium perspective. An additional cost of supplying to the export market, when combined with sufficiently high production costs, can make engaging in a CBMA more profitable than exporting. In the second step, I add labour markets to derive the implications of CBMAs for factor prices.

I start with a short summary of the model developed in Chapter 2. There are two identical countries and a continuum of goods,  $z \in [0, 1]$ , each of which is produced by a small number of firms  $n > 2$  in each country, home and foreign. Cost of producing good  $z$  is denoted by  $\alpha(z)$  and independent of the destination market. Cost of supplying



the good, however, depends on the destination; it is equal to  $m$  if the good is sold in the domestic market, and  $m + \delta$ ,  $\delta > 0$ , if it is exported. The two activities, production and non-production, are performed by two types of workers – blue-collar and white-collar, respectively. Goods are ordered on the unit interval such that production efficiency of their suppliers is decreasing:  $\alpha(z)' > 0$ . Non-production costs are not indexed by good. The cost of supplying one unit of good  $z$  is;

$$c(z) = \begin{cases} w\alpha(z) + rm, & \text{for domestic sales} \\ w\alpha(z) + r(m + \delta), & \text{for export sales} \end{cases};$$

where  $w$  denotes the wage of blue-collar workers, and  $r$  denotes that of white-collar workers. There are  $L$  individuals in the economy, each with income of  $I$ . They have identical continuum-quadratic preferences, implying linear demand functions from the perspective of firms:

$$U[\{x(z)\}] = \int_0^1 \left[ ax(z) - \frac{1}{2}bx(z)^2 \right] dz,$$

$$p(z) = \frac{1}{\lambda} [a - (b/L)q(z)],$$

where  $p(z)$  denotes the market clearing price,  $q(z)$  the aggregate output of good  $z$ , and  $\lambda$  is the Lagrange multiplier attached to consumer's budget constraint.<sup>16</sup> It is equal to

$$\lambda[\{p(z)\}, I] = \frac{a\mu_1^p - bI}{\mu_2^p},$$

where  $\mu_1^p$  denotes the first moment of the distribution of prices, and  $\mu_2^p$  denotes the second moment:

$$\mu_1^p = \int_0^1 p(z)dz \text{ and } \mu_2^p = \int_0^1 p(z)^2 dz.$$

The aggregate supplies of blue-collar and white-collar workers are given by  $L$  and  $sL$ ,

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<sup>16</sup>In the equilibrium, we must have  $q(z) = Lx(z)$ .

respectively. The income of an average individual is then equal to

$$I = w + rs + \Pi/L,$$

where  $\Pi$  denotes aggregate firm profits in the country. In these models, it is convenient to choose the marginal utility of income  $\lambda$  as numéraire. So, I will use "marginal real factor prices":  $W = \lambda w$  and  $R = \lambda r$ . Now, it is easy to derive the firm level outputs (domestic and export) and the resulting market-clearing price of good  $z$ :<sup>17</sup>

$$\begin{aligned} y(n, n; z) &= \frac{a - W\alpha(z) + R(\delta n - m)}{(2n + 1)b/L}, \\ y_X(n, n; z) &= \frac{a - W\alpha(z) - R[m + \delta(n + 1)]}{(2n + 1)b/L}, \\ p(n, n; z) &= \frac{a + 2nW\alpha(z) + nR(2m + \delta)}{2n + 1}. \end{aligned} \tag{3.3.1}$$

In Chapter 2, I show that only some goods are traded in equilibrium. In particular, good  $z$  is traded between the countries if  $z \in [0, \tilde{z}_X]$ , and the threshold good is determined by the following condition

$$y_X(n, n; \tilde{z}_X) \geq \iff a - W\alpha(\tilde{z}_X) - R\theta_X \geq 0, \tilde{z}_X \leq 1,$$

where  $\theta_X = m + \delta(n + 1)$ . This is a complementary slackness condition. As in Chapter 2, I only consider the case where  $\tilde{z}_X < 1$ . Thus, setting  $y_X(n, n; \tilde{z}_X)$  to zero pins down  $\tilde{z}_X$ . If a good is not traded, its market-clearing price and firm-level sales are given by:

$$\begin{aligned} y(n, 0; z) &= \frac{a - W\alpha(z) - Rm}{(n + 1)b/L}, \\ p(n, 0; z) &= \frac{a + n(W\alpha(z) + Rm)}{n + 1}. \end{aligned}$$

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<sup>17</sup>Since countries are identical, I focus on the equilibrium in one market. As in Chapter 2,  $y(\cdot)$  denotes a firm's domestic sales, and  $y_X(\cdot)$  its export sales. They are expressed in terms of the number of domestic firms and exporters. For instance,  $y(n, n; z)$  denotes domestic sales of a firm selling good  $z$  when there are  $n$  domestic firms and  $n$  exporters.

Now, we are ready to introduce CBMAs and study firms' incentives to prefer CBMAs to exporting.

### 3.3.1 Incentives for CBMAs

Our first task is to determine the goods markets where firms prefer engaging in CBMAs to exporting. This will determine the industry structure for each good market when the model is extended to general equilibrium in Section 3.3.2.

I use the sequential merger game setup proposed by Salvo (2008) who extends the game setup developed by Nilssen and Sørgaard (1998) to a two-country world. Here is the game setup: there are  $n$  merger stages, and a final production stage. Prior to the first merger stage, each home country firm is paired with one foreign country firm.<sup>18</sup> At every merger stage, a pair of firms decides whether to merge. If a pair decides not to merge, then in the production stage the firms independently compete with other firms. If a pair decides to merge, the merged firm supplies each market from a local plant. In the production stage, independent and merged firms engage in Cournot competition. This is the simplest merger game one can think of. To make it more realistic, one can extend the game in various ways.<sup>19</sup> Nevertheless, as the merger formation process is not the focus of this paper, I use this simple setup.

To determine the cases where CBMAs are profitable, we need to define firms' net gain from forming a merger.<sup>20</sup> A CBMA takes place only if the net gain from a merger is positive. Following Neary (2007), define the net merger gain,  $G(n-1, n-1, 1)$ , as the difference between profits of the merged firm ( $\pi_M(\cdot)$ ) and combined pre-merger profits of

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<sup>18</sup>Only bilateral mergers are allowed – assuming that multilateral mergers are costly to form, and that engaging in such a merger does not create any additional cost synergies to merger partners.

<sup>19</sup>For instance, a recent paper by Toxvaerd (2008) provides a complete explanation of merger waves by developing a quite sophisticated model.

<sup>20</sup>Please note that domestic mergers are not profitable. From the well-known result derived by Salant et al. (1983), we know that when a market is populated by more than two identical firms that produce homogeneous goods, have constant marginal costs, and face a linear demand, a bilateral merger is not profitable unless it creates cost synergies.

the merger partners:<sup>21</sup>

$$G(n-1, n-1, 1) = \pi_M(n-1, n-1, 1) - 2\pi(n, n, 0). \quad (3.3.2)$$

So, if the first pair of firms decides to merge,  $G(n-1, n-1, 1)$  should be positive. The condition is necessary but not sufficient for a merger to take place. Or, as Neary (2007) calls it, the condition is myopic: it does not take into account mergers that may take place in the subsequent stages. This drawback is, however, not crucial for the focus of the paper. Here, I focus on merger incentives between producers of different goods, and on the role that additional cost of exporting plays in shaping such incentives. In this sense, it is enough to know that, if a merger takes place, the merger gain should be positive. And whether a merger always takes place when the merger gain is positive is another research question that is out of the paper's scope.

Since the game is one of perfect information, its subgame perfect (Nash) and backward induction equilibria coincide.<sup>22</sup> Therefore, we can start with deriving the equilibrium of the production stage. Then, using the equilibrium outputs in the production stage, we can derive the merger gains for each pair of firms. To find the subgame perfect Nash equilibria (SPNE), we can refer to a study by Salvo (2008). For a class of oligopoly models, Salvo (2008) states two conditions that lead to an "all-or-none" merger result in equilibrium. The "all-or-none" merger result implies that the SPNE of the game include either no merger or a merger wave where all firms engage in bilateral mergers. Our first task is to derive the conditions under which a single merger is profitable in isolation –  $G(n-1, n-1, 1) > 0$ . The second is that, under such conditions, we need to check whether Salvo's two conditions for an all-or-none merger result are satisfied.

As I mentioned before, a merged firm supplies each market from a local plant. So, its output in a market is not different from the output of a domestic firm:  $y_M(n-1, n-1, 1) =$

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<sup>21</sup> $G(n-1, n-1, 1)$  is expressed in terms of the number of domestic firms, exporters, and merged firms, respectively. Sales and prices are defined accordingly.

<sup>22</sup>I am focusing on pure strategies only. Also, I assume that mergers are irreversible.

$y(n-1, n-1, 1)$ . In other words, when two firms merge, the resulting market output is equal to the one that would arise when  $n$  domestic and  $n-1$  foreign firms produce in the market. We can use the firm-level sales derived earlier to formulate the gain from a single merger for producers of good  $z$ :<sup>23</sup>

$$\begin{aligned} G(n-1, n-1, 1) &= \pi_M(n-1, n-1, 1) - 2\pi(n, n, 0) \\ &\propto y_X(n, n, 0) \left[ \frac{y_M(n-1, n-1, 1) + y(n, n, 0)}{2n} - y_X(n, n, 0) \right]. \end{aligned} \quad (3.3.3)$$

According to the expression, the condition  $G(n-1, n-1, 1) > 0$  defines a range of goods which can be profitably exported, but their producers find engaging in a CBMA even more profitable:

$$\frac{y_M(n-1, n-1, 1) + y(n, n, 0)}{2n} - y_X(n, n, 0) > 0; \quad y_X(n, n, 0) > 0.$$

Now substitute the corresponding outputs in the first condition above to obtain:

$$\frac{y_M(n-1, n-1, 1) + y(n, n, 0)}{2n} - y_X(n, n, 0) > 0 \text{ iff } -\varphi_1(n)(a - W\alpha(z)) + R(\varphi_1(n) + \delta\varphi_2(n)) > 0$$

where  $\varphi_1 = 4n^2 - 4n - 1$  and  $\varphi_2 = 4n^3 + 8n^2 - n - 1$ . Thus, in a case where exporting is profitable, engaging in a CBMA is even more profitable iff the following inequality holds

$$\alpha(z) > \frac{a}{W} - \rho\theta_M, \quad (3.3.4)$$

where  $\rho = R/W$  and  $\theta_M = m + \delta(\phi_2/\phi_1)$ . Furthermore, we know that exporting is profitable,  $y_X(n, n, 0) > 0$ , iff the following condition holds:

$$\alpha(z) < \frac{a}{W} - \rho\theta_X.$$

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<sup>23</sup>See Appendix 3.A.1 for the derivation of the following expression.

It is easy to see the following relationship between  $\theta_X$  and  $\theta_M$ :

$$\theta_M - \theta_X = \lambda\delta > 0 \quad \text{for } n > 1 \text{ and } \delta > 0,$$

where  $\lambda = \frac{4n(2n+1)}{4n^2-4n-1}$ . So, engaging in a CBMA is more profitable than exporting when

$$\alpha(\tilde{z}_M) = \frac{a - R\theta_M}{W} < \alpha(z) < \frac{a - R\theta_X}{W} = \alpha(\tilde{z}_X). \quad (3.3.5)$$

In Neary (2007), the situation where identical domestic and foreign firms compete in a market is a special case. He usually assumes that a domestic and a foreign firm have different production technologies, and thus they produce at different costs. For the special case, he shows that a CBMA, unless it creates a monopoly, is never profitable. This provides an example of the well-known "merger paradox" result by Salant et al. (1983). Here, I modify the case in two ways: first by distinguishing between a firm's production and non-production costs, and second by introducing an extra cost that creates a wedge between non-production costs at home and in the export market. With such extension, I show that when production costs are sufficiently high, a CBMA between two identical firms can take place. It can take place even when more than two firms operate in the market. The reason is that, by engaging in a CBMA, the firms gain access to each others' local market knowledge, and reduce the cost of supplying to their respective export markets. The relative employment of white-collar labour by a post-merger firm is  $m/\alpha(z)$  while that by an exporting firm is  $(m + \delta)/\alpha(z)$ .<sup>24</sup> So, a CBMA creates cost synergies by allowing merger partners to save white-collar labour costs.

Now, we can study when serving the foreign market through engaging in a CBMA becomes more attractive than exporting. To do so, we need to consider the interval defined in (3.3.5). It is easy to see that the interval shrinks as the number of firms

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<sup>24</sup>This is in line with the empirical findings of Arnold and Javorcik (2009).

increases:

$$\frac{\partial(\alpha(\tilde{z}_X) - \alpha(\tilde{z}_M))}{\partial n} = \frac{\partial}{\partial n} [\rho(\theta_M - \theta_X)] = -4\rho \frac{12n^2 + 4n + 1}{(4n^2 - 4n - 1)^2} < 0, \quad (3.3.6)$$

and it expands as wage inequality increases:

$$\frac{\partial(\alpha(\tilde{z}_X) - \alpha(\tilde{z}_M))}{\partial \rho} = \theta_M - \theta_X > 0.$$

The following result summarises the findings so far.

**Result 3.3.1** *Assume that firms can serve the foreign market through either exports or engaging in a CBMA. The least efficient firms do not serve the foreign market. The most efficient firms serve the foreign market through exports, and less efficient ones through engaging in CBMAs. Market concentration and wage inequality in favour of white-collar workers expand the range of goods markets where firms serve the foreign market through engaging in CBMAs.*

The range of goods markets where CBMAs are more profitable than exporting expands with market concentration. The post-merger firm reduces its sales, and given that outputs are strategic substitutes in Cournot competition, outside firms free-ride on the merger by expanding their sales. As higher market concentration is associated with a smaller number of free-riders, CBMAs become profitable in a wider range of goods markets.

Wage inequality in favour of white-collar labour also expands the range of goods markets where CBMAs are profitable. The intuition is straightforward: the extra cost of supplying to the export market is paid in terms of white-collar labour units, thus a higher relative wage of white-collar labour increases the profitability of CBMAs by boosting the resulting cost savings from a CBMA. This result is important as it implies that, from an individual firm's perspective, wage inequality affects the profitability of CBMAs relative to exporting.

In this framework, greenfield investment can easily be added as another mode of foreign market entry. In that case, the productivity sorting explained in Result 3.3.1 would be altered. The sorting between firms undertaking greenfield investment and those engaging in CBMAs would be determined by the fixed cost of establishing a plant in the foreign market and its factor intensity. Nocke and Yeaple (2007) consider the choice between greenfield investment and CBMA in a model with monopolistic competition. Their results suggest that the sorting between firms that choose greenfield investment and those that choose CBMAs depends on industry characteristics. In particular, they show that, in industries where non-mobile firm capabilities (e.g. marketing, distribution) are important, CBMAs involve the least efficient firms among internationally active ones. This is consistent with the productivity sorting prediction described in Result 3.3.1.

Having shown that engaging in a CBMA can be more profitable than exporting in some goods markets, we can check whether the game satisfies the conditions for an all-or-none merger result. Salvo (2008) shows that all-or-none merger result is the SPNE of a merger game if the game satisfies the following conditions:

1. Mergers have anti-competitive effect: a merger increases the profits of the outside firms.
2. Outside firms respond pro-competitively to a merger: a merger increases the profitability of subsequent mergers. The reason is that each merger reduces the number of free-riding firms.

Appendix 3.A.2 shows that the merger game studied here satisfies both conditions. As a result, the game has two SPNE: one with all possible bilateral mergers taking place (all-merger equilibrium), and the other with all firms competing independently (none-merger equilibrium).

**Result 3.3.2** *Assume that a single CBMA is profitable in the market for good  $z$ . If it takes place, then subsequent CBMAs will also take place. In other words, CBMAs occur*



in waves.

### 3.3.2 General Equilibrium in the Presence of Cross-border Mergers

From Chapter 2, we know the general equilibrium implications of the none-merger equilibrium. Now, it is time to derive the implications of the other – a CBMA wave in some goods markets – for wage inequality.<sup>25</sup>

In (3.3.5), the upper bound of the interval is the production cost of the threshold good for exporting:  $\tilde{z}_X$ . The lower bound defines another threshold good,  $\tilde{z}_M$ , producers of which are indifferent between exporting and engaging in a CBMA. So, we obtain the following industrial structure: producers of goods  $[0, \tilde{z}_M]$  export to the foreign market; those producing  $(\tilde{z}_M, \tilde{z}_X)$  engage in CBMAs to serve the foreign market; those producing  $[\tilde{z}_X, 1]$  serve domestic market only. As mentioned earlier, a merged firm serves each market from its local plant, it implies that for goods markets  $z > \tilde{z}_M$ , the ownership of firms does not matter; sales volume of a merged firm is equal to the one of a domestically-owned firm. So, CBMAs will simply restrict the range of traded goods in equilibrium. The implied labour market conditions are given by:

$$L = (L^D)_M = n \left\{ \int_0^{\tilde{z}_M} \alpha(z) [y(W, R; n, n; z) + y_X(W, R; n, n; z)] dz + \int_{\tilde{z}_M}^1 \alpha(z) y(W, R; n, 0; z) dz \right\} \quad (3.3.7a)$$

$$sL = (S^D)_M = n \left\{ \int_0^{\tilde{z}_M} [my(W, R; n, n; z) + (m + \delta)y_X(W, R; n, n; z)] dz + \int_{\tilde{z}_M}^1 my(W, R; n, 0; z) dz \right\}. \quad (3.3.7b)$$

We can use the equation for the threshold good  $\tilde{z}_X$  and eliminate  $R$  from the labour market

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<sup>25</sup>There is also an intermediate case: mergers occur in some of the goods markets where they are profitable. As it is not possible to predict which ones, I skip such case.

equilibrium conditions;

$$R = \frac{a - W\alpha(\tilde{z}_X)}{\theta_X},$$

to obtain

$$L = (L^D)_M = \frac{nL}{(n+1)b} \left\{ \frac{(n+1)\delta a}{\theta_X} \int_0^1 \alpha(z) dz + W \int_0^1 \alpha(z) (m\alpha(\tilde{z}_X)/\theta_X - \alpha(z)) dz \right. \quad (3.3.8a)$$

$$\left. + W \int_0^{\tilde{z}_M} \frac{\alpha(z)}{2n+1} (\alpha(\tilde{z}_X) - \alpha(z)) dz \right\},$$

$$sL = (S^D)_M = \frac{nL}{(n+1)b} \left\{ \frac{(n+1)\delta am}{\theta_X} + Wm \int_0^1 (m\alpha(\tilde{z}_X)/\theta_X - \alpha(z)) dz \right. \quad (3.3.8b)$$

$$\left. + W \int_0^{\tilde{z}_M} \frac{\theta_X}{2n+1} (\alpha(\tilde{z}_X) - \alpha(z)) dz \right\}.$$

Four key endogenous variables in the model –  $W$ ,  $R$ ,  $\tilde{z}_X$ ,  $\tilde{z}_M$  – can be solved using the two factor market equilibrium conditions in (3.3.7a) and (3.3.7b), and the two equations that determine the threshold goods markets for exporting and CBMAs in (3.3.5).

Here, I would like to discuss how introducing CBMAs as an alternative mode of foreign market entry changes the model's properties. When we look at the factor market equilibrium conditions in (3.3.7a) and (3.3.7b), the only difference we see is that the range of traded goods shrinks from  $[0, \tilde{z}_X]$  in the absence of CBMAs to  $[0, \tilde{z}_M]$  in their presence. This has two important general equilibrium implications. First, the responsiveness of the factor demands to the threshold good is now non-negligible. In the no-CBMA case, the responsiveness of the factor demands to a change in  $\tilde{z}_X$  is given by:

$$\begin{aligned} \frac{\partial (L^D)_X}{\partial \tilde{z}_X} &= \alpha(\tilde{z}_X) (y(W, R; n, n; \tilde{z}_X) + y_X(W, R; n, n; \tilde{z}_X) - y(W, R; n, 0; \tilde{z}_X)), \\ \frac{\partial (S^D)_X}{\partial \tilde{z}_X} &= m (y(W, R; n, n; \tilde{z}_X) + y_X(W, R; n, n; \tilde{z}_X) - y(W, R; n, 0; \tilde{z}_X)) \\ &\quad + \delta y_X(W, R; n, n; \tilde{z}_X). \end{aligned}$$

Both are zero since  $y(W, R; n, 0, 0; \tilde{z}_X) = 0$ . In the presence of CBMAs, the corresponding partial derivatives are

$$\begin{aligned}\frac{\partial (L^D)_M}{\partial \tilde{z}_X} &= \alpha(\tilde{z}_M) (y(W, R; n, n, 0; \tilde{z}_M) + y_X(W, R; n, n, 0; \tilde{z}_M) - y(W, R; n, 0, 0; \tilde{z}_M)), \\ \frac{\partial (S^D)_X}{\partial \tilde{z}_X} &= m (y(W, R; n, n, 0; \tilde{z}_M) + y_X(W, R; n, n, 0; \tilde{z}_M) - y(W, R; n, 0, 0; \tilde{z}_M)) \\ &\quad + \delta y_X(W, R; n, n, 0; \tilde{z}_M).\end{aligned}$$

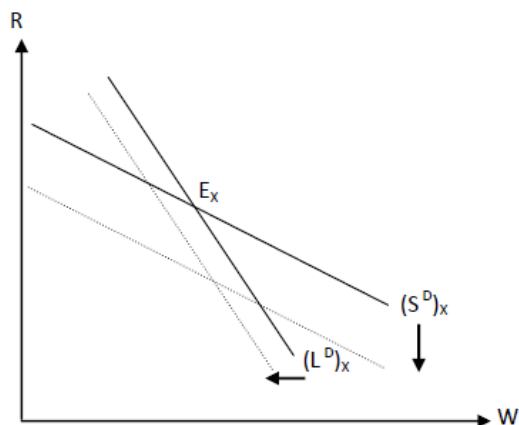
In this case, both partial derivatives are greater than zero as  $y_X(W, R; n, n, 0; \tilde{z}_M) > 0$ . In the absence of CBMAs, the range of goods that can be profitably traded is the same as the one where goods are actually traded. On the other hand, in their presence, the range of goods that can be profitably traded is larger than the one where goods are actually traded. So, an increase in  $\tilde{z}_M$ , an increase in the range of traded goods, induces a non-negligible increase in both factor demands. The second important general equilibrium implication of allowing for CBMAs in the model is that an increase in the range of traded goods has a non-negligible effect on welfare. In the absence of CBMAs, the effect of a change in  $\tilde{z}_X$  has a negligible effect on welfare since export sales of the newly-traded goods are very small. In their presence, an increase in  $\tilde{z}_M$  significantly increases the aggregate supply in the newly-traded goods markets, and thus reduces their prices. So, it has a non-negligible positive effect on welfare.

An interesting question is, what would be the effect of investment liberalisation that allows for CBMAs on the level of wage inequality in a country? The answer is, it reduces, but why? Here, I give an intuitive explanation and relegate the proof to Appendix 3.A.3. A CBMA wave simply restricts the range of traded goods. Compared to a no-CBMA equilibrium, the aggregate sales of goods  $z \in (\tilde{z}_M, \tilde{z}_X)$  are lower, and so is the total demand for both factors (see Figure 3.3.1).<sup>26</sup> As post-merger firms reduce their relative employment of white-collar workers, the resulting fall in the demand for white-

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<sup>26</sup>Stability in the factor markets requires  $\frac{d(L^D)_M}{dW} \frac{d(S^D)_M}{dR} > \frac{d(S^D)_M}{dW} \frac{d(L^D)_M}{dR}$ .

Figure 3.3.1: Factor prices with and without cross-border mergers



collar workers is relatively higher. Thus, wage inequality is lower in the presence of CBMAs than in their absence.

**Result 3.3.3** *Assume that foreign market entry via CBMA is made available to firms as an alternative to entry via exports. For any level of openness ( $\tilde{z}_X$ ), equilibrium wage inequality in the presence of CBMAs is lower than in their absence.*

Here, I compare two equilibria: one without CBMAs, and one with CBMAs. Result 3.3.3 tells that, at any level of trade openness, wage inequality is lower in the presence of CBMAs. When combined with Result 3.3.1, it implies that CBMAs are attracted by high wage inequality in favour of white-collar workers, but once they occur, they tend to reduce wage inequality. When this potential endogeneity is addressed, Result 3.3.3 suggests a negative effect of CBMAs on wage inequality. This prediction is in line with the empirical findings I present in Section 3.2.

I would like to highlight another implication of Result 3.3.3. In Chapter 2, I show that wage inequality with any level of openness is higher than in autarky. Since we have  $\tilde{z}_M > 0$ , some goods are traded in equilibrium in the presence of CBMAs. Therefore, compared to autarky, wage inequality should be higher when the country is open to both international trade and investment. Furthermore, Result 3.3.3 implies that wage inequality is higher when the country is open to only international trade compared to when it is open to both

trade and investment. These together suggest the following inequalities:

$$\rho_{autarky} < \rho_M < \rho_X.$$

In other words, all else equal, wage inequality in a country with internationally active firms is higher than the one in autarky. Also, wage inequality in a country that is close to foreign investment is higher than the one open to both international trade and investment. These suggest that globalisation has an effect on wage inequality, but the extent depends on the dominant mode of globalisation in the country.

### 3.4 Conclusion

Despite their increasing importance, there is little theoretical understanding of how cross-border mergers and acquisitions (CBMAs) affect factor prices in home and host countries. This paper tries to fill this gap by presenting a model where cross-border mergers both affect and are affected by wage inequality between white-collar and blue-collar workers.

In Section 3.2, I present some empirical results suggesting a negative relationship between FDI and wage inequality. Motivated by these findings. I extend the model developed in Chapter 2 to allow for CBMAs as an alternative mode of foreign market entry. In the model, CBMAs arise because firms, by engaging in a CBMA, avoid the additional cost of supplying to their export markets, saving white-collar labour costs. Engaging in a CBMA is mutually beneficial to both merger partners as each firm gains the other firm's local market information and distribution network. Thus, CBMAs arise even between *identical* firms from *identical* countries.

In the model, CBMAs occur in waves; if a single merger is profitable in isolation, then subsequent mergers are also profitable. Then, assuming a continuum of goods, suppliers of which differ in their production efficiency, I show that CBMAs are more profitable than exports in goods markets where suppliers are relatively less efficient in production. In

other words, the more productive firms prefer exports to CBMAs. Two factors affect the profitability of CBMAs relative to exports. Both market concentration and wage inequality in favour of white-collar workers increase the relative profitability of CBMAs and expand the range of goods markets where CBMAs take place. Next, I endogenise factor prices to derive the effect of the presence of CBMAs as an alternative mode of foreign market entry on wage inequality. At any level of openness, wage inequality between white-collar and blue-collar workers is lower in the presence of CBMAs than in their absence. The intuition is straightforward: in the goods markets where CBMAs take place, post-merger firms undertake the non-production activities more efficiently through their local plants, and this reduces the employment share of white-collar workers in the post-merger firms. Thus, the relative demand for white-collar labour falls in both countries, leading to a fall in its relative wage.

Overall, the results suggest a two-way causality between CBMAs and wage inequality: CBMAs are more likely to take place in countries where wage inequality is high, but an increase in CBMAs relative to exporting lowers wage inequality in the country. This creates a potential endogeneity problem, which needs to be addressed in any empirical analysis of the relationship.

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## 3.A Appendix

### 3.A.1 Derivation of merger gains

When one domestic and one foreign firm engage in a CBMA, the number of both domestic and foreign firms in the market falls to  $n - 1$ . As the post-merger firm supplies each market from its local plant, it does not behave differently from a domestic firm. Thus, we can easily derive the resulting outputs by setting the number of exporting firms in the market to  $n - 1$  in (3.3.1):

$$y_M(n - 1, n - 1, 1) = \frac{a - W\alpha(z) - R[m - \delta(n - 1)]}{2nb/L}.$$

So, we can derive gains from the first possible merger as follows:

$$\begin{aligned} G(n - 1, n - 1, 1) &= \pi_M(n - 1, n - 1, 1) - 2\pi(n, n, 0) \\ &\propto y_M^2(n - 1, n - 1, 1) - [y^2(n, n, 0) + y_X^2(n, n, 0)] \\ &= \left[ \frac{a - W\alpha(z) - R[m - \delta(n - 1)]}{2nb/L} \right]^2 - \left[ \frac{a - W\alpha(z) + R(\delta n - m)}{(2n + 1)b/L} \right]^2 \\ &\quad - \left[ \frac{a - W\alpha(z) - R[m + \delta(n + 1)]}{(2n + 1)b/L} \right]^2 \\ &\propto \left\{ \left[ \frac{a - W\alpha(z) - R\theta_X}{(2n + 1)(2n)} \right] [y_M(n - 1, n - 1, 1) + y(n, n, 0)] \right. \\ &\quad \left. - \left[ \frac{a - W\alpha(z) - R\theta_X}{(2n + 1)} \right]^2 \right\} \\ &= y_X(n, n, 0) \left[ \frac{y_M(n - 1, n - 1, 1) + y(n, n, 0)}{2n} - y_X(n, n, 0) \right]. \end{aligned}$$

This is the expression used in the text.

### 3.A.2 Proof of the "all-or-none" merger result

Assume that  $m < n$  mergers have taken place. When there are  $m$  merged,  $n - m$  independent domestic firms, and  $n - m$  independent exporters in a market, the Cournot equilibrium outputs are

$$y(n - m, n - m, m) = y_M(n - m, n - m, m) = \frac{a - W\alpha(z) - R[m - \delta(n - m)]}{(2n - m + 1)b/L},$$

$$y_X(n - m, n - m, m) = \frac{a - W\alpha(z) - R\theta_X}{(2n - m + 1)b/L}.$$

To obtain the all-or-none merger result, we need to prove that mergers are anti-competitive and outside firms respond pro-competitively to a merger.

Mergers are anti-competitive if the profits of the outside firms increase in the number of mergers. The change in the profits of an outside firm when one more merger takes place is

$$\begin{aligned} & \pi(n - m - 1, n - m - 1, m + 1) - \pi(n - m, n - m, m) \\ = & b[y^2(n - m - 1, n - m - 1, M + 1) - y^2(n - m, n - m, m) \\ & + y_X^2(n - m - 1, n - m - 1, m + 1) - y_X^2(n - m, n - m, m)]. \end{aligned}$$

Since outputs of an outside firm increase in  $m$ :

$$\begin{aligned} & y(n - m - 1, n - m - 1, m + 1) - y(n - m, n - m, m) \\ = & \frac{y_X(n - m, n - m, m)}{2n - m} > 0, \end{aligned}$$

we obtain

$$\pi(n - m - 1, n - m - 1, m + 1) - \pi(n - m, n - m, m) > 0.$$

So, the merger game satisfies the first condition: mergers are anti-competitive.

The second condition says that outside firms respond pro-competitively to a merger. In other words, a merger increases the profitability of subsequent mergers:

$$G(n - m - 1, n - m - 1, m + 1) - G(n - m, n - m, m) > 0.$$

Or

$$\begin{aligned} & G(n - m - 1, n - m - 1, m + 1) - G(n - m, n - m, m) \\ = & [\pi_M(n - m - 1, n - m - 1, m + 1) - 2\pi(n - m, n - m, m)] \\ & - [\pi_M(n - m, n - m, m) - 2\pi(n - m + 1, n - m + 1, m - 1)]. \end{aligned}$$

Rearranging the expression, we obtain

$$\begin{aligned} & G(n - m - 1, n - m - 1, m + 1) - G(n - m, n - m, m) \\ \propto & \frac{y_X(n - m, n - m, m)}{2n - m} \left[ \frac{y_X(n - m, n - m, m)}{2n - m} + 2y(n - m, n - m, m) \right] \\ & - \frac{y_X(n - m + 1, n - m + 1, m - 1)}{2n - m + 1} \left\{ \frac{y_X(n - m + 1, n - m + 1, m - 1)}{2n - m + 1} \right. \\ & \left. + 2y(n - m + 1, n - m + 1, m - 1) \right\}. \end{aligned}$$

Since

$$\frac{y_X(n - m, n - m, m)}{2n - m} > \frac{y_X(n - m + 1, n - m + 1, m - 1)}{2n - m + 1}$$

and

$$y(n - m, n - m, m) > y(n - m + 1, n - m + 1, m - 1).$$

We obtain;

$$G(n - m - 1, n - m - 1, m + 1) - G(n - m, n - m, m) > 0.$$

Thus, outside firms respond pro-competitively to mergers; merger increases the profitability of subsequent mergers.

Since Salvo's two conditions for an all-or-none merger result hold, the SPNE of this merger game is that either no firm merges, or every pair of firms merges.

### 3.A.3 Proof of Result 3.3.3

The factor market equilibrium conditions in the presence of CBMAs are given by

$$\begin{aligned}
\frac{b}{n} &= \int_0^{\tilde{z}_M} \alpha(z) \frac{2(a - W_M \alpha(z) - R_M m) - R_M \delta}{2n + 1} dz + \int_{\tilde{z}_M}^1 \alpha(z) \frac{a - W_M \alpha(z) - R_M m}{n + 1} dz, \\
\frac{bs}{n} &= \int_0^{\tilde{z}_M} \left[ \frac{m(a - W_M \alpha(z) + R_M(\delta n - m))}{2n + 1} + \frac{(m + \delta)(a - W_M \alpha(z) - R_M \theta_X)}{2n + 1} \right] dz \\
&\quad + \int_{\tilde{z}_M}^1 \frac{(a - W_M \alpha(z) - R_M m)}{n + 1} dz,
\end{aligned} \tag{3.A.1}$$

where the pair  $(W_M, R_M)$  denotes the factor prices that clear the markets. The factor demand functions in the absence of CBMAs (no-CBMA case) are;

$$\begin{aligned}
(L^D)_X &= \int_0^{\tilde{z}_X} \alpha(z) \frac{2(a - W_X \alpha(z) - R_X m) - R \delta}{2n + 1} dz + \int_{\tilde{z}_X}^1 \alpha(z) \frac{a - W_X \alpha(z) - R_X m}{n + 1} dz, \\
(S^D)_X &= \int_0^{\tilde{z}_X} \left[ \frac{m(a - W_X \alpha(z) + R_X(\delta n - m))}{2n + 1} + \frac{(m + \delta)(a - W_X \alpha(z) - R_X \theta_X)}{2n + 1} \right] dz \\
&\quad + \int_{\tilde{z}_X}^1 \frac{m(a - W_X \alpha(z) - R_X m)}{n + 1} dz.
\end{aligned} \tag{3.A.2}$$

To prove the result, we need to show that the market clearing factor prices in the no-CBMA case  $(W_X, R_X)$  satisfy

$$\frac{R_X}{W_X} > \frac{R_M}{W_M}.$$

We know that  $\tilde{z}_M < \tilde{z}_X$ . Consider the demand for white-collar workers in the no-

CBMA case at  $(W_M, R_M)$ . For goods  $z \in (\tilde{z}_M, \tilde{z}_X)$ , we have

$$\begin{aligned}
& m \frac{a - W_M \alpha(z) + R_M(\delta n - m)}{2n + 1} + (m + \delta) \frac{a - W_M \alpha(z) - R_M \theta_X}{2n + 1} \\
& - m \frac{a - W_M \alpha(z) - R_M m}{n + 1} \\
= & \frac{\theta_X}{n + 1} y_X(W_M, R_M; n, n, 0; z) \\
> & 0.
\end{aligned}$$

For goods  $z \notin (\tilde{z}_M, \tilde{z}_X)$ , aggregate supply remains unchanged in the no-CBMA case. So, we have

$$\begin{aligned}
& (S^D)_X(W_M, R_M) - (S^D)_M(W_M, R_M) \\
= & (S^D)_X(W_M, R_M) - \frac{bs}{n} \\
> & 0,
\end{aligned}$$

implying excess demand for white-collar workers in the no-CBMA case at  $(W_M, R_M)$ . Stability requires that wage of white-collar workers should increase:

$$(S^D)_X(W_M, R^*) - \frac{bs}{n} = 0,$$

where  $R^* > R_M$ .

Next consider the demand for blue-collar workers at  $(W_M, R^*)$ . We need to show that there is excess supply of blue-collar workers at these factor prices. Since  $(L^D)_M(W_M, R_M) = b/n$ , we are interested in the sign of

$$(L^D)_X(W_M, R^*) - (L^D)_M(W_M, R_M).$$

Expand this expression using the factor demand functions in (3.A.1) and (3.A.2):

$$\begin{aligned}
& (L^D)_X(W_M, R^*) - (L^D)_M(W_M, R_M) \\
= & \int_0^{\tilde{z}_M} \alpha(z) \frac{(R_M - R^*)(2\delta + m)}{2n + 1} dz + \int_{\tilde{z}_M}^{\tilde{z}_X} \alpha(z) \frac{y_X(W_M, R^*; n, n, 0; z)}{n + 1} dz \\
& + \int_{\tilde{z}_M}^1 \alpha(z) \frac{(R_M - R^*)m}{n + 1} dz.
\end{aligned}$$

Now use the demand for white-collar workers with and without CBMAs to obtain

$$\begin{aligned}
& \int_0^{\tilde{z}_M} \alpha(z) \frac{(R^* - R_M) [(2\delta + m)m + \delta\theta_X]}{2n + 1} dz + \int_{\tilde{z}_M}^1 \frac{(R^* - R_M)m^2}{n + 1} dz \quad (3.A.3) \\
= & \frac{\theta_X}{n + 1} \int_{\tilde{z}_M}^{\tilde{z}_X} \frac{y_X(W_M, R^*; n, n, 0; z)}{n + 1} dz.
\end{aligned}$$

By Chebyshev's integral inequality, we have

$$\begin{aligned}
& (L^D)_X(W_M, R^*) - (L^D)_M(W_M, R_M) \\
< & \int_0^{\tilde{z}_M} \alpha(z) \frac{(R_M - R^*)(2\delta + m)}{2n + 1} dz + \frac{1}{\tilde{z}_X - \tilde{z}_M} \int_{\tilde{z}_M}^{\tilde{z}_X} \alpha(z) dz \int_{\tilde{z}_M}^{\tilde{z}_X} \frac{y_X(W_M, R^*; n, n, 0; z)}{n + 1} dz \\
& + \int_{\tilde{z}_M}^1 \alpha(z) \frac{(R_M - R^*)m}{n + 1} dz.
\end{aligned}$$

Now substitute  $\int_{\tilde{z}_M}^{\tilde{z}_X} y_X(W_M, R^*; n, n, 0; z) dz$  from (3.A.3) and note that we can write the whole expression as a factor of  $(R^* - R_M) > 0$ , so we obtain

$$\begin{aligned}
& (L^D)_X(W_M, R^*) - (L^D)_M(W_M, R_M) \\
< & \int_0^{\tilde{z}_M} \left[ -\frac{\alpha(z)(2\delta + m)}{2n + 1} + \frac{(2\delta + m)m + \delta\theta_X}{(2n + 1)\theta_X(\tilde{z}_X - \tilde{z}_M)} \int_{\tilde{z}_M}^{\tilde{z}_X} \alpha(z) dz \right] dz \\
& + \int_{\tilde{z}_M}^1 \left[ -\frac{\alpha(z)m}{n + 1} + \frac{m^2}{(n + 1)\theta_X(\tilde{z}_X - \tilde{z}_M)} \int_{\tilde{z}_M}^{\tilde{z}_X} \alpha(z) dz \right] dz.
\end{aligned}$$

Note that  $\alpha(z)$  is an increasing function on the unit interval. Then by the Mean Value



Theorem for Integrals, we have

$$\frac{\int_{\tilde{z}_M}^{\tilde{z}_X} \alpha(z) dz}{\tilde{z}_X - \tilde{z}_M} < \alpha(\tilde{z}_X).$$

So,

$$\begin{aligned} & (L^D)_X(W_M, R^*) - (L^D)_M(W_M, R_M) \\ & < \int_0^{\tilde{z}_M} \left[ -\frac{\alpha(z)(2\delta + m)}{2n + 1} + \alpha(\tilde{z}_X) \frac{(2\delta + m)m + \delta\theta_X}{(2n + 1)\theta_X} \right] dz \\ & \quad + \int_{\tilde{z}_M}^1 \left[ -\frac{\alpha(z)m}{n + 1} + \alpha(\tilde{z}_X) \frac{m^2}{(n + 1)\theta_X} \right] dz \\ & \propto \int_0^1 m(m\alpha(\tilde{z}_X)/\theta_X - \alpha(z)) dz + \int_0^{\tilde{z}_M} \frac{\theta_X}{2n + 1} (\alpha(\tilde{z}_X) - \alpha(z)) dz. \end{aligned}$$

Note that the term in the last line is proportional to  $\frac{\partial(S^D)_M}{\partial W}$  in (3.3.8a), which is negative.

So, we have

$$(L^D)_X(W_M, R^*) - (L^D)_M(W_M, R_M) < \frac{\partial(S^D)_M}{\partial W} < 0.$$

It implies that there is excess supply of blue-collar workers at  $(W_M, R^*)$ , in which case blue-collar wage should fall below  $W_M$ , and white-collar wage should rise above  $R^*$  in the no-CBMA equilibrium:

$$W_X < W_M \text{ and } R_X > R^* > R_M \Rightarrow \rho_M < \rho_X.$$

This completes the proof.

### 3.A.4 Data Appendix

The dataset used in the empirical analysis covers the following 63 countries: Argentina, Australia, Austria, Burundi, Benin, Bangladesh, Belize, Bolivia, Barbados, Central African Republic, Canada, China, Cameroon, Costa Rica, Cyprus, Czech Republic, Germany,

Denmark, Algeria, Estonia, Finland, Gabon, United Kingdom, Guyana, Hong Kong (SAR, China), Honduras, Hungary, India, Italy, Japan, Cambodia, Republic of Korea, Sri Lanka, Latvia, Mexico, Mali, Mauritius, Malawi, Nicaragua, Netherlands, New Zealand, Peru, Philippines, Poland, Portugal, Romania, Russian Federation, Rwanda, Sudan, Singapore, Sierre Leone, Slovak Republic, Slovenia, Sweden, Togo, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uruguay, USA, Venezuela, Zambia.

The data on blue and white-collar wages are taken from the Occupational Wages around the World (OWW) Database published by NBER. The source of the data on openness and labour force is World Development Indicators, published by the World Bank. Data on education indicators come from Barro-Lee (2010). Finally, FDI inward and outward stock data are taken from UNCTAD.

### **3.A.5 Motives for CBMAs**

The literature studying the forces driving FDI has been dominated by the assertions of the eclectic (OLI or ownership-location-internalization) paradigm developed by Dunning (1977).<sup>27</sup> The OLI paradigm is a framework that aims to explain "the extent and pattern of international production" (Dunning, 2001). Accordingly, the pattern of international production is determined by the interaction of many factors which can be grouped into three categories. The first category consists of "Ownership" related factors. These may arise from a firm's ownership of intangible assets and/or ability to coordinate these assets with other assets in another country without incurring high costs. Provided that a firm possesses some ownership advantages over its competitors, it faces a choice between using them itself and selling them to other firms. A firm is said to possess "Internalization" advantages if it chooses the former option. Finally, given that a firm possesses Ownership and Internalization advantages, it will locate its production such that it can exploit the advantages it possesses to the full extent. These are called "Location" specific

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<sup>27</sup>The earlier contributions to this area were made by Hymer (1960, published in 1976) and Vernon (1966).

advantages.

The OLI framework has led to the development of a new theoretical understanding of FDI, which attempts to explain activities of multinational firms as an outcome of a "proximity-concentration trade-off" – the trade-off that firms face between exploiting scale economies by serving a market through exports and reducing trade costs through FDI (Brainard, 1993). There is a number of studies predicting that a reduction in trade costs should discourage FDI (e.g., Horstman and Markusen (1987), Markusen and Venables (1998), and Helpman et al. (2004)). Nevertheless, the 1990s represented a significant challenge to the proximity-concentration trade-off framework since falling trade costs was accompanied with a notable surge in FDI flows, particularly within the European Union. Neary (2009), after providing an extensive overview of the proximity-concentration trade-off framework and empirics of FDI, proposes two explanations for this paradox. First, establishment of a free-trade area among a group of countries encourages FDI into these countries since foreign firms use one country as an export platform to serve other countries in the free-trade area without incurring any tariffs. Second, a reduction in trade costs encourages CBMAs while it discourages greenfield investment, the former being quantitatively more important than the latter. Nevertheless, most of the studies on FDI do not differentiate between greenfield investment and CBMAs.

Most of the existing studies on CBMAs focus on the role they play in industrial restructuring, and their increasing importance in the wake of declining trade costs. Both strands combine the international trade and industrial organisation literatures, with different weights attached to each. Given the focus of this study, I will review the latter here.

Some of the existing studies on CBMAs particularly aim to resolve the puzzling 1990s boom in international mergers, e.g., Horn and Persson (2001), Bjorvatn (2004), and Neary (2007). All three studies assume Cournot-type competition in product markets, but they differ from each other in some other respects. While others rely on a non-cooperative

approach, Horn and Persson (2001) follow a cooperative game theory approach when modelling mergers. Among them, it is only Neary (2007) that develops a general equilibrium rather than a partial equilibrium model. Despite the differences in their modelling strategies, all three studies reach the same conclusion: trade liberalisation may induce CBMAs. Neary (2007) also predicts that CBMAs occur in waves in response to trade liberalisation.

In contrast, there also exist studies that do not find a clear-cut relationship between trade costs and CBMAs. For instance, Bertrand and Zitouna (2006) conclude that the impact of trade liberalization on CBMA incentives depends on the technological gap between firms. Falvey (1998) presents similar inconclusive findings. In another study, Long and Vousden (1995) present a two-country Cournot model and show that CBMAs are discouraged by both unilateral and bilateral tariff reductions if the merged firm serves each market from a local plant.

There is a recently growing literature on CBMA waves, which has its roots back in Knickerbocker (1973) story of "oligopolistic reaction". Knickerbocker suggests that FDI decisions are strategic complements in oligopolistic markets as a firm's foreign investment reduces the investment risks faced by its rivals. Thus, they imitate the first mover's action. Similar to this approach, some studies scrutinize the strategic complementarity between CBMAs, but their main motivation is trade/capital-market liberalisation instead of uncertainty-reducing motive for such investments; e.g., Fumagalli and Vasconcelos (2009), Neary (2007), and Salvo (2008). They all assume Cournot-type competition in product markets. Neary (2007) and Salvo (2008) show that if a single CBMA occurs, it will trigger a merger wave in a market. In contrast, the findings of Fumagalli and Vasconcelos (2009) suggest that mergers will not occur when trade costs are sufficiently low. Nevertheless, this result should be interpreted cautiously since non-occurrence of mergers is not because they are unprofitable, but because they will not be approved by the competition authorities as they reduce welfare.

Another motive for firms to engage in CBMAs is acquiring local assets that would complement their technological capabilities in the production process. Caves (2007, pp. 86-87) explains this motive as follows:

*Entry by starting a new business unit might also be riskier than acquisition. The going business is a working coalition. From the viewpoint of the foreign MNE, it possesses an operating local management familiar with the national market environment. The MNE that buys the local firm also buys access to its stock of information.*

This idea has been used by a recent study by Javorcik and Saggi (2010). They study how a firm's technological capabilities relative to its rivals' affect its decision on the foreign market entry mode. In the model, when a foreign firm engages in a joint venture with a local firm, it enjoys lower unit labour requirement in distribution since its partner has better local market knowledge. This constitutes the main advantage of engaging in a joint venture against establishing a wholly-owned subsidiary. Another study that addresses the idea of asset complementarities in international mergers is Mugele and Schnitzer (2008). They show that the foreign market entry decision of a multinational firm depends on (cultural) distance, and the nature of this dependence changes across industries. In the study, distance is considered as a proxy for cultural differences between the home and foreign countries. In particular, a larger distance makes marketing the multinational's product in the foreign market more costly. On the other hand, a local firm possesses tacit knowledge of local market conditions. The main idea is that a multinational can access this knowledge by engaging in a joint venture with a host country firm. They show that such incentives are stronger in more marketing-intensive industries. It is worth noting that their model deals only with the foreign market entry incentives of a single firm, abstracting from market structure considerations and general equilibrium interactions.

On the empirical side, Anand and Delios (2002) test the capability-augmenting motive for FDI using data on British, German and Japanese firms investing in the United

States. This study provides support for the hypothesis that the propensity of firms to choose acquisition is higher in industries where "geographically infungible" downstream (marketing) capabilities are relatively more important.

# Conclusion

Globalisation brings new opportunities to firms. They expand, selling their products to new markets. They also gain access to new productive resources and processes available in other markets, which they can use to reduce their costs, as well as to diversify their products. What consumers demand in different markets affects a firm's decision what to produce, and also how to produce.

Firms, however, do not benefit equally from globalisation. Globalisation brings not only opportunities but also threats. Some firms find themselves unable to cope with the tough competition induced by globalisation. Strong ones, however, benefit from a larger market, economies of scale, and new productive resources.

Globalisation offers firms a variety of alternative ways of accessing foreign markets. Firms can directly export their products to a foreign market, or establish a plant there, or merge with a domestic firm located in that market to become a multinational. Firms in a country make their own choices to maximise their private benefits from globalisation. Nevertheless, the country as a whole has to face the consequences of their decision for a variety of variables, including consumer prices, wages, welfare, and inequality.

In this thesis, I try to address the questions why firms diversify their export baskets, what role imported inputs play in firm's product diversification, why firms choose different modes of foreign market entry, and what country characteristics matter for this choice. I also study the consequences of firms' choices for their home country in terms of welfare and inequality. These questions have been motivated by the empirical evidence, for which

I suggest some answers. Nevertheless, one has to take the various mechanisms proposed in the thesis to data to assess their validity, and in my next work I hope to go down that route and also to explore the theoretical robustness of some of the results derived here.