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Low-Wage Competition: Pains From Trade for Medium-Wage Countries

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Abstract

The entry of a low-wage country into a world economy with pre-existing wage differentials puts the gains from trade in a former low-wage and then medium-wage country under pressure. If negotiations over the formation of a free trade area cover international transfers, there is a strong presumption that they bring about global free trade and compensation of the medium-wage country if necessary. In the absence of international transfers, by contrast, the medium-wage country is not compensated when global free trade causes a reduction in its gains from trade, and it may even happen that it is not part of the equilibrium free trade area.

JEL classification: F11, F61

Key words: gains from trade, low-wage competition, North-South trade, free trade area, core, equality

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1 Introduction

Newspaper headlines accompany the relocation of smartphone production from China to Vietnam by Google and Samsung. While recently the looming U.S.-Chinese trade war and the Coronavirus outbreak are cited as causes, the trend has been going on before with "cheap labour" playing a vital role, as a story in the April 12th 2018 edition of *The Economist*[1] documents (manufacturing wages equaled $ 227 per month in Vietnam compared to $ 493 per month in China in 2018 according to the Japan External Trade Organization[2]) A couple of years earlier, Blecker and Esquivel (2010, pp. 25, 29) had proposed the following explanation for why the launch of NAFTA in 1994 did not stop three decades of real wage stagnation in Mexico starting in the early 1980s: "although Mexico is the low-wage country in North America, it is a medium-wage country globally ... Thus, Mexico does not have a global advantage in labor costs and should not have been expected to reap large gains in wages from opening up to trade ... increasing regional integration in the late 1990s ... was partially reversed as the lower trade barriers within North America were overwhelmed by other developments, including ... the emergence of China as an economic powerhouse." These two incidences are anecdotal evidence of competitive pressure on former low-wage countries as new trading partners with still lower wages appear in the world economy, with China having switched roles in the interim. They illustrate a well documented long-run change in the pattern of world trade, viz., the successive emergence and subsequent rise of low-wage countries as exporters of manufacturing goods to industrial countries (see Krugman, 2008, pp. 107 ff.). Table 1 (an update of Table 2 in Krugman, 2008, p. 109) describes this trend from the viewpoint of the U.S.: East Asian low-wage countries replaced European economies and then moved upwards in the list of top U.S. trading partners, leading to a monotonic decrease in average hourly compensation in manufacturing of the top ten U.S. trading partners since 1990. And this

[1] See https://www.economist.com/asia/2018/04/12/why-samsung-of-south-korea-is-the-biggest-firm-in-vietnam.

[2] See https://www.jetro.go.jp/en/news/releases/2019/6980a2e6ad84b745.html.

figure captures the impact of "cheap labor" only partially, since countries that export to the U.S. (like China) import parts and half-finished goods from third countries with still lower wages (like Vietnam).

Table 1: Average Hourly Compensation in Manufacturing of the top ten U.S. Trading Partners, 1975, 1990, 2005, 2011, and 2016

Year	Top ten trading partners (largest first)	Average hourly compens. (percent of U.S. average)[a]
1975	Canada, Japan, Germany, United Kingdom, Mexico, France, Italy, Brazil, Netherlands, Belgium	76
1990	Canada, Japan, Mexico, Germany, United Kingdom, Taiwan, South Korea, France, Italy, China	81
2005	Canada, Mexico, China, Japan, Germany, United Kingdom, South Korea, Taiwan, France, Malaysia	65
2011	Canada, China, Mexico, Japan, Germany, United Kingdom, South Korea, France, Taiwan	59
2016	China, Canada, Mexico, Japan, Germany, South Korea, United Kingdom, France, India, Taiwan	46[b]

Sources: Krugman (2008), U.S. Bureau of Labor Statistics (2012), The Conference Board (2018).

[a] Averages are weighted by the countries' shares in total U.S. trade.

[b] China's and India's hourly compensation are estimated to be 18 and 5 percent of the U.S. level, respectively.

This paper analyzes the effects of the entry of a low-wage country into the world economy, with a particular focus on the new medium-wage country, using the three-country version of Krugman's (1979) model of international trade with absolute cost advantages. We show that, while the high-wage country benefits, the gains from trade in the former low-wage and then medium-wage country may go down. This happens if the benefits in terms of access to cheap varieties produced in the new low-wage country do not outweigh the deterioration in the terms of trade with the high-wage country caused by the relocation of production to the newcomer country. This case tends to occur if the high-wage country has a big technological advantage or the cost differential between the other two countries is small. As all

inhabitants of the medium-wage country are alike, such "pains from trade" (Sapir, 2000, p. 180) are not a distributional issue.

We proceed to investigate the formation of the equilibrium free trade area (FTA), assuming there is no external trade with non-member countries. If international transfers are part of the negotiations over the formation of an FTA, then global free trade is the likely outcome. This is because global free trade is the only way to achieve the unique allocation of production across countries that is part of any Pareto-optimal allocation. The medium-wage country is compensated for the reduction in its gains from trade if necessary. In the absence of international transfers, by contrast, there is no compensation for the medium-wage country in case of pains from trade. Even worse, sequential bargaining may lead to an FTA that does not include the medium-wage country. Given the fact that trade agreements usually do not involve international transfers, these results corroborate worries about potential pains from trade for medium-wage countries.

The paper is organized as follows. Related literature is discussed in Section 2. Section 3 introduces the model and characterizes its equilibria. Section 4 analyzes the conditions under which pains from trade emerge. Sections 5 and 6 investigate the formation of the equilibrium FTA with or without international transfers, respectively. Section 7 concludes. Appendices A, B, and C contain proofs, details of the algebra, and a social welfare analysis, respectively.

2 Related literature

The paper makes a contribution to the literature that consists of the diverse set of models which leave the canonical two-country setup in order to analyze the middle-income country in general equilibrium with wage differentials. Our result that entry of a new low-wage country possibly harms a former low-wage and then medium-wage country offers a new explanation for the middle-income trap, i.e., the "sharp deceleration in growth, following a period of sustained increases in

per capita income" (Agénor, 2017, p. 771) observed in many countries.[3] Existing theoretical explanations (diminishing returns to physical capital, exhaustion of imitation gains, lack or misallocation of human or financial capital; see Agénor, 2017, Section 3) rely on two-country models. In our three-country model free trade with a high-wage country brings gains from trade initially, which come under pressure when later on a new low-wage competitor steps in. This explanation of a middle-income trap squares nicely with the idea of being "caught in the middle" (the title of Agénor's, 2017, survey). Collins' (1985) analysis of technical progress in the Ricardian model with a continuum of goods is an early contribution to the economics of middle-income countries. She shows that technical progress in one of two less developed countries reduces welfare in the other one. It can be shown that the same holds true when one of the two countries newly enters the world economy (which can be interpreted as an initial step forward technologically). So the Ricardian continuum model is an alternative framework that could be used to obtain results similar to ours. There is no cost differential between the two less developed countries, however, in Collins (1985), so that the producers in neither of the two less developed countries face low-cost competition. Özyildirim (1996) shows that of two less developed countries which export raw materials to an industrial country, the more productive country prices the less productive one out of the market. Chu (2009) considers a three-country endogenous growth model with product cycles in which a middle-income country both innovates and imitates. He shows that an increase in the labor force or technical progress in the low-wage country has an ambiguous effect on the the middle-income country's relative wages but in any case speeds up growth in the world economy. Lin (2010) analyzes a product variety model with a medium-wage country that faces a tradeoff between imitation of varieties innovated in a high-wage country and outward foreign direct investment (FDI) in a low-wage country. He shows that it tends to be beneficial to constrain outward FDI.

[3]Countries are classified as middle-income if their gross national income per capita is between \$1,036 and \$12,535 (see https://datahelpdesk.worldbank.org/knowledgebase/articles/906519).

Secondly, this paper contributes to the literature that investigates the formation of FTAs between countries with wage differentials. We focus on the question of whether global free trade occurs despite the medium wage country's possible concerns and, if so, the medium-wage country is compensated. In doing so, we make eclectic use of cooperative and strategic approaches from the theory of regional trade agreements (RTAs; see Maggi, 2014, Section 4, and Limão, 2016, Section 6). The analysis is simplified by assuming that countries trade with each other either without any impediments or not at all. This concern "not with marginal changes in protection, but with the possibility of fundamental economic reform" (cf. Ethier, 1998, p. 1222) can be justified by our focus on newly industrializing countries. Early studies of trade liberalization between countries at different stages of economic development found that liberalization in developed countries provides incentives for less developed countries to cut the influence of special interest groups aimed at securing rents (Ethier, 1998) and reduces the wage gap by reducing the extent of agglomeration of industry in high-wage countries (Puga and Venables, 1998). Das and Ghosh (2006) show in a model with two high-wage and two low-wage countries that the coalition-proof Nash equilibrium of the trading bloc formation game entails either global free trade or polarization, i.e., two trading blocs each made up of one type of countries. The FTA that excludes the medium-wage country in our model is an example of the opposite outcome. Missios and Yildiz (2017) show that a preferential trade agreement with a high-wage country may harm a low-wage country and that the dynamic incentives to maintain global free trade are weaker when the fallback option is any FTA that includes a high-wage country compared to no agreement.

3 Model and free trade equilibrium

The model we analyze is the three-country version of Krugman (1979). There are three countries, East (E), South (S), and North (N). Country i ($\in \{E, S, N\}$) is populated by L^i (> 0) consumers, each of whom supplies one unit of labor, the

only factor of production. There are $\bar{A}^N$ Dixit-Stiglitz goods indexed $[0, \bar{A}^N]$. The utility of an inhabitant of country i is

$$U^i = \left[\int_0^{\bar{A}^N} y^i(j)^\alpha dj \right]^{\frac{1}{\alpha}}, \quad 0 < \alpha < 1, \tag{1}$$

where $y^i(j)$ is the quantity of variety j she consumes. Firms in country i are able to produce the varieties indexed $[0, \bar{A}^i]$. a^i (> 0) units of labor yield one unit of a producible variety in country i. There is perfect competition.

For each pair of countries, there is either free trade or no trade, there are no (non-prohibitive) tariffs. Due to perfect competition, the price of varieties produced in country i is $P^i = w^i a^i$, where w^i is the wage rate in country i. Denote the mass of goods produced in i as A^i and the quantity consumed of varieties produced in i as Y^i. Utility maximization implies $P^i/P^{i'} = (Y^{i'}/Y^i)^{1-\alpha}$ for each pair of varieties. Labor market clearing implies $L^i = A^i a^i Y^i$. Hence, the terms of trade between countries i and i' are

$$\frac{w^i a^i}{w^{i'} a^{i'}} = \left(\frac{\frac{a^i}{L^i} A^i}{\frac{a^{i'}}{L^{i'}} A^{i'}} \right)^{1-\alpha}. \tag{2}$$

A country's terms of trade are high if it is technologically advanced in that the mass of varieties it is able to produce is large relative to its labor supply.

We consider the world economy with no trade, with FTAs made up of two countries and no trade with the third country, and with the FTA that covers all three countries, i.e., global free trade. The FTA made up of countries E and S is called ES. The FTAs EN, SN, and ESN are defined analogously. Any such partition of the set of countries is called a trading system. For a given trading system, an equilibrium consists of a free trade equilibrium of the FTA, if there is one, and autarky equilibria of the countries not in the FTA.

We focus on equilibria with absolute cost differentials between the member countries of an FTA. The North has the highest unit cost $w^i a^i$, and unit cost is higher in the South than in the East if both are in an FTA. As a result, of the set of varieties they can produce $[0, \bar{A}^i]$ firms in i produce the subset of varieties no foreign

firm can produce more cheaply in an FTA. The following assumption ensures the existence of an equilibrium with absolute cost advantages for all trading systems:

$$\frac{a^i}{L^i}\bar{A}^i < \frac{a^{i'}}{L^{i'}}(\bar{A}^{i'} - \bar{A}^i), \quad (i, i') \in \{(E,S),(E,N),(S,N)\}. \tag{3}$$

That (3) implies the existence of a free trade equilibrium for the two-country FTAs is obvious from (2). Validity of (3) for (S,N) implies $(a^S/L^S)(\bar{A}^S - \bar{A}^E) < (a^N/L^N)(\bar{A}^N - \bar{A}^S)$ and, therefore, the existence of a free trade equilibrium with absolute cost differentials of ESN.

4 Pains from trade

A consumer from country i has income w^i. She faces prices $w^i a^i$ for domestic varieties and prices $w^{i'}a^{i'}$ and $w^{i''}a^{i''}$ for varieties produced in other countries i' and i'' that trade with i. Maximization of (1) subject to the budget constraint yields her indirect utility

$$U^i = \frac{1}{a^i}\left[A^i + A^{i'}\left(\frac{w^i a^i}{w^{i'}a^{i'}}\right)^{\frac{\alpha}{1-\alpha}} + A^{i''}\left(\frac{w^i a^i}{w^{i''}a^{i''}}\right)^{\frac{\alpha}{1-\alpha}}\right]^{\frac{1-\alpha}{\alpha}}, \tag{4}$$

where $A^{i'} = 0$ if i' is not in an FTA with i and $A^{i''} = 0$ if i'' is not in an FTA with i. There are two potential sources of gains from trade. First, due to her love of variety, the worker benefits from additional varieties supplied by her home country i's trading partners i' and i''. Second, she benefits from the opportunity of buying goods that could also be produced at home but are imported from a country with lower cost (i.e., if $(w^{i'}a^{i'})/(w^i a^i) < 1$ or $(w^{i''}a^{i''})/(w^i a^i) < 1$).

Use subscripts $i\,i'$ and ESN to distinguish values of variables in an equilibrium of FTA $i\,i'$ and of ESN, respectively. Our first main result is that the South might prefer not to affiliate the East in an FTA with the North.

Proposition 1: *Agents rank the the equilibria of ESN and SN as follows: $U^E_{ESN} >$*

U^E_{SN}, $U^S_{ESN} > U^S_{SN}$ if, and only if,

$$(\bar{A}^N - \bar{A}^S)\left[\left(\frac{w^S a^S}{w^N a^N}\right)^{\frac{\alpha}{1-\alpha}}_{SN} - \left(\frac{w^S a^S}{w^N a^N}\right)^{\frac{\alpha}{1-\alpha}}_{ESN}\right] < \bar{A}^E\left[\left(\frac{w^S a^S}{w^E a^E}\right)^{\frac{\alpha}{1-\alpha}}_{ESN} - 1\right], \quad (5)$$

and $U^N_{ESN} > U^N_{SN}$.[4]

The proof is in Appendix A. If (5) holds, the three countries Pareto-prefer the trading system that includes the East. If, on the other hand, the inequality sign in (5) is reversed, then the South prefers an FTA with the North only to global free trade. This case arises if the effect of the reduction in its terms of trade with the North in ESN compared to SN (the left-hand side of (5)) outweighs the effect of access to cheap imports from the East (the right-hand side of (5)). A sufficient condition for this case to arise is that $\bar{A}^N$ is sufficiently large, which makes the terms-of-trade effect matter a lot. This follows from the fact that, from (2), increases in $\bar{A}^N$ raise the left-hand side of (5) and leave the right-hand side unaffected. Another simple sufficient condition is that $[(w^S a^S)/(w^E a^E)]_{ESN}$ is close enough to unity, i.e., that the positive effect of cheap imports from the East is sufficiently small.

Analogous results can be derived from the three-country Ricardian model with a continuum of goods (Collins, 1985) and from a one-factor neoclassical model with technology differences (Thompson, 2015). A related result also holds in the Heckscher-Ohlin model: A country's gains from trade relative to autarky can diminish when a newcomer emerges in the world economy. A simple example is that of an entrant whose factor endowments equalize the global relative supplies to one country's national relative supplies, so that that country ceases to trade with the rest of the world (cf. Dixit and Grossman, 2005). The three-country Krugman (1979) model provides a novel explanation of a reduction in gains from trade for the case of a medium-wage country that loses market shares to a new low-wage competitor.

[4]Appendix B provides examples which show that, here and in what follows, parameter combinations that satisfy inequality constraints used to distinguish cases exist.

5 International transfers and global free trade

This section and the next one investigate the endogenous formation of an FTA in our three-country model. As markets are perfectly competitive and there is no lobbying, the formation of the equilibrium FTA is determined by terms-of-trade effects alone (cf. Maggi, 2014, Section 2). We maintain the simplifying assumption made in Section 3 that countries in an FTA do not trade with non-member countries, i.e., external tariffs are prohibitive. The present section allows for international transfers within the FTA. As usual in general equilibrium theory, we think of transfers of goods. Transfers of income serve the same purpose. We show that there is strong presumption that global free trade emerges, as this is the only way to achieve a Pareto-optimal allocation. Whether or not the South is compensated for a reduction in its gains from trade if necessary depends on the specific rules that govern the formation of the equilibrium FTA.

Global free trade is the only way to achieve a Pareto-optimal allocation:

Proposition 2: *The set of Pareto-optimal allocations is characterized as follows: E produces the varieties in $[0, \bar{A}^E]$, S produces the varieties in $(\bar{A}^E, \bar{A}^S]$, and N produces the varieties in $(\bar{A}^S, \bar{A}^N]$. Each country i produces the same quantity $Y^i = L^i/(a^i A^i)$ of each variety it produces. A given consumer k gets the same fraction λ_k of the output of each variety, and the λ_k's add up to unity.*[5]

The proof is quite intricate and delegated to Appendix A. The intuition why the allocation in the proposition is Pareto-optimal is simple enough: From (3), the output per variety is lower in the North than in the South and lower in the South than in the East. So consumers would benefit from a shift of Southern labor to varieties produced in the North or of Eastern labor to varieties produced in the South. But that is not feasible, since the South is unable to produce the varieties manufactured in the North and the East is unable to produce the varieties manufactured in the South. The proof in Appendix A is constructive, it establishes

[5]Here and in what follows we omit the qualification "except for a set of varieties of measure zero".

that no other Pareto-optimal allocations exist.

In the equilibrium of ESN firms' production decisions lead to the outputs described in Proposition 2, and each consumer k buys a fraction of the output of each variety that is equal to her share in world income. So the equilibrium allocation with global free trade and no transfers is Pareto-optimal. Since the Pareto-optima differ only with respect to the proportions of production individual consumers get, any Pareto optimal allocation can be established as an equilibrium allocation using transfers. All other trading systems lead to a different equilibrium pattern of production and, therefore, to Pareto inefficiency.

For the sake of clarity, suppose consumers' individual utilities are cardinal and interpersonally comparable and define the (Utilitarian) social welfare of a set of consumers k as the sum of these consumers' utilities $\sum_k U_k$. An allocation that is not Pareto-optimal does not maximize worldwide social welfare. Given that Pareto-optimal allocations differ only with respect to the proportions of aggregate output that accrue to the individual consumers, the fact that all consumers have the same linearly homogeneous utility function (1) implies that worldwide social welfare is uniform across all Pareto optima. So Pareto optimality is equivalent to maximization of worldwide social welfare. The fact that the only trading system that brings forth Pareto optimality is global free trade implies grand-coalition superadditivity: social welfare is maximum with global free trade (cf. Aghion et al., 2007, p. 8).

From Proposition 2, any rule that determines the equilibrium trading system leads to global free trade if it obeys the Pareto principle or, equivalently, welfare maximization. Whether or not the South is better-off than in SN depends on the specific rules that govern the formation of the FTA. Three standard examples serve to illustrate this: the core principle (cf. Riezman, 1985), cooperative Nash bargaining, and strategic sequential bargaining (cf. Aghion et al., 2007).[6]

[6]The core principle and bargaining games are the standard approaches to the endogenous formation of regional trade agreements among a small number of countries. The multi-country network approach (cf. Goyal and Joshi, 2006) does not lend itself well to our three-country setup. See Limão (2016, pp. 348 ff.).

Consider first the core. A coalition of countries is said to block a trading system if, using the resources available to it by forming an alternative FTA, it can make each member better-off. The core is the set of trading systems that cannot be blocked by any coalition of countries (see Mas-Colell et al., 1995, Definitions 18.B.1 and 18.B.2, pp. 653 f.).

Proposition 3: *In the presence of international transfers, each trading system in the core entails the FTA ESN.*

Each trading system except ESN is blocked by the set of all three countries, as switching to global free trade and using international transfers to distribute the ensuing welfare gains appropriately makes consumers in all countries better-off. In Appendix A we prove that there are international transfers in ESN such that no coalition can improve upon its situation. This proves that the core is non-empty. The transfers in the proof of the proposition in Appendix A entail that the consumers in the South receive only their autarky utility level U^S_{EN}. However, different transfer payments in ESN lead to different distributions of welfare across countries, and numerical analysis shows that it is always possible to compensate the South for possible pains from trade (an example is in Appendix B). Anyway, the non-uniqueness of the core does not allow an unequivocal answer to the question of whether the South is compensated.

Again, there is a parallel in the Heckscher-Ohlin model. As pointed out by Dixit and Norman (1980), if countries differ only in terms of factor endowments, global free trade with factor price equalization reproduces the "integrated" Walrasian equilibrium that would emerge in the absence of national borders. The fact that Walrasian equilibrium satisfies the core property (see Mas-Colell et al., 1995, Proposition 18.B.1, p. 654) implies that no coalition of individuals and, hence, no coalition of countries can block the "grand coalition".

A simple way to obtain a determinate system of international transfers is Nash bargaining. Suppose countries bargain over the expansion of the preexisting FTA SN, so that the disagreement payoffs are U^i_{SN} for $i \in \{E, S, N\}$. Global free trade emerges, and the South gets utility higher than or equal to U^S_{SN}, depending

on whether it has positive bargaining power or not, respectively. In any case, its utility does not drop at a value U^S_{ESN} lower than U^S_{SN}.

Finally, suppose the North as the leader proposes the expansion of the FTA and rejection leads to keeping SN. The North offers the South a transfer that keeps its utility at U^S_{SN}, the South accepts, global free trade emerges, and the South is as well-off as before.

In both examples with bargaining, Southern consumers get utility that is at least as high as in the FTA SN. By contrast, if the disagreement point in the Nash bargain corresponds to autarky and the South has no bargaining power or if breakdown of strategic bargaining leads to autarky, then the South has to make do with its autarky utility both before and after entry of the East.

6 Free trade without international transfers

This section analyzes the formation of the equilibrium FTA in the absence of international transfers. While transfers are used to compensate the South if necessary in the examples in the preceding section, the outlook is bleaker here. If global free trade emerges, then the South gets no compensation for a possible reduction in its gains from trade. If not, it is possibly the South that is excluded from the equilibrium FTA when the East enters the world economy. To illustrate, we consider again the core and strategic bargaining.[7]

Consider first formation of the equilibrium FTA as the core of the set of trading systems:

Proposition 4: *In the absence of international transfers, the core of the set of trading systems is* $\{ESN\}$ *or* $\{EN, ESN\}$ *or* $\{SN, ESN\}$.

The proof is in Appendix A. Parameters that lead to each of the three cases exist. The grand coalition is always in the core. If it forms, the South receives no compensation in case of pains from trade. The core may also include EN, which

[7]We skip Nash bargaining here, as the convexity property underlying its axiomatization is not satisfied with the discrete choice set considered here.

is a worst-case scenario for the excluded South. From the proof of Proposition 4 in Appendix A, a necessary condition for EN to be in the core is that the North prefers bilateral trade with the East to global free trade (i.e., $U^N_{EN} > U^N_{ESN}$).

Proposition 5: $U^N_{EN} > U^N_{ESN}$ *exactly if*

$$(\bar{A}^S - \bar{A}^E)\left[\left(\frac{w^N a^N}{w^S a^S}\right)^{\frac{\alpha}{1-\alpha}}_{ESN} - 1\right] < \bar{A}^E\left[\left(\frac{w^N a^N}{w^E a^E}\right)^{\frac{\alpha}{1-\alpha}}_{EN} - \left(\frac{w^N a^N}{w^E a^E}\right)^{\frac{\alpha}{1-\alpha}}_{ESN}\right].$$

Comparing EN to global free trade, the left-hand side of the inequality measures the reduction in Northern consumers' utility due to loss of cheap access to varieties in $(\bar{A}^E, \bar{A}^S]$. The right-hand side is the North's utility gain due to higher terms of trade compared to the East, which is due to to the fact that it spreads its labor force across a broader range of varieties in EN than in ESN (see (2)). North-East trade excluding the South is an "anti-polarization" outcome: the country at one end of the world income distribution prefers to trade with the country at the opposite end and not with the middle-income country. This contrasts with Das and Ghosh's (2006) result that equilibrium FTAs contain countries with similar wages. The third trading system that is possibly in the core is SN, which means that the potential new low-wage competitor is kept out of the FTA made up of S and N. A necessary condition for this case to arise is that this is in the South's interest (i.e., $U^S_{ESN} < U^S_{SN}$).

Next, consider sequential bargaining with the North as the leader. Suppose the North makes a take-it-or-leave-it offer to the East, the South, or both. If the offer is not accepted, there is no free trade between any two countries. The North then has the choice between EN, SN, or ESN. Suppose the condition of Proposition 5 holds, so that the North prefers EN to ESN. From Proposition 1, it follows that the North then also prefers EN to SN. Hence, it proposes EN and the East accepts. The South is excluded from the equilibrium FTA, it suffers not from a reduction in but from an outright loss of its gains from trade.

To sum up, the middle-income country cannot be compensated for pains from trade

if necessary in the absence of international transfer payments. Even worse, it may be excluded from the equilibrium free trade area. While expulsion of a member state when a new one enters an FTA is of course not observed in practice, this highlights again the pressure new low-wage competitors exert on medium-wage countries.[8]

7 Conclusions

Emerging economies with low wages increase the efficiency of the world economy as a whole, but potentially pose a threat to the gains from trade of former low-wage countries. Successive emergence of newly industrializing countries to the world economy, as observed over the past decades, thus provides an explanation for a middle-income trap, i.e., a situation in which the gains from trade of former entrants come under pressure from new low-wage competition. Given the aggregate increase in efficiency, appropriate transfers in the enlarged FTA can be used in principle to compensate countries if necessary. However, as direct transfers are not commonly part of trade agreements, compensation is unlikely to happen in practice.

The three-country Krugman (1979) technology transfer model provides a convenient framework for the analysis of these issues. The two most promising directions for future research are imperfect competition and non-prohibitive tariffs. With imperfect competition Southern producers can reap part of the benefits due to entry of the East by outsourcing to the East and repatriating the profits (cf. Arnold and Trepl, 2015). This raises the question under which circumstances this is sufficient to rule out pains from trade. Non-prohibitive tariffs allow a closer inspection of countries' incentives to form an FTA (with non-uniform external tariffs) or a customs union (with uniform external tariffs). In conjunction with imperfect competition, they allow the consideration of production shifting (see Baldwin and

[8]Exclusion of the South can also be the outcome of the maximization of a social welfare functional with sufficiently heavy weight on equality if one modifies (3) in such a way that unit cost equalizes in E and S (see Appendix C).

Venables, 1995, Subsection 2.2.1). This promises further insights into the incentives and strategies of countries at different stages of economic development in negotiations over deepening free trade.

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A Proofs

Proof of Proposition 1:

Proof: The inequality for the East follows from revealed preference: An Eastern worker can get her SN-equilibrium utility $U^E_{SN} = (1/a^E)(\bar{A}^E)^{(1-\alpha)/\alpha}$ at the equilibrium of ESN by consuming only domestically produced goods. The fact that she chooses to import varieties from the South and from the North implies that this makes her better-off, even though the imported varieties are more expensive than domestically produced ones.

The fact that $U^S_{ESN} > U^S_{SN}$ exactly if (5) holds follows from (4).

From (2), the North's terms of trade with the South are higher in the equilibrium of ESN than in the equilibrium of SN, and the terms of trade with the East are higher still:

$$\left(\frac{w^N a^N}{w^E a^E}\right)_{ESN} > \left(\frac{w^N a^N}{w^S a^S}\right)_{ESN} > \left(\frac{w^N a^N}{w^S a^S}\right)_{SN}.$$

Since the amount of product variety does not change for Northern consumers, it follows from (4), that the more favorable terms of trade raise Northern workers' utility (i.e., $U^N_{ESN} > U^N_{SN}$). q.e.d.

Proof of Proposition 2:

Proof: That Pareto optimality requires that the proportion of total output a consumer gets is uniform across varieties follows from homotheticity of (1).

From (3), the outputs in the proposition satisfy $Y^E > Y^S > Y^N$.

If country i produces positive amounts of different varieties, then the worldwide outputs of these varieties must be identical. Otherwise, given symmetry of (1) and uniform input coefficients within each country, the consumers' utility could be increased by shifting labor to the low-output high-marginal utility variety in i.

It follows that the total output of the set of varieties that E produces is uniform and no less than Y^E and that N produces a uniform amount of the varieties in $(\bar{A}^S, \bar{A}^N]$ (that no other country can produce) which is no greater than Y^N. From $Y^E > Y^N$, it follows that the sets of varieties produced in E and N are disjoint.

Suppose S produces a positive mass of varieties also produced in E. Then the

total output of all varieties S produces is no less than Y^E. Since the labor supplies in E and S are just sufficient to produce Y^E of varieties $j \in [0, \bar{A}^E]$ and Y^S ($< Y^E$) of $j \in (\bar{A}^E, \bar{A}^S]$, this implies that N produces positive amounts of some varieties $j \in [0, \bar{A}^S]$. However, since the uniform output per variety in N is no greater than Y^N ($< Y^E$), consumers' utility increases if S shifts labor from varieties also produced in E to varieties in $[0, \bar{A}^S]$ produced in N. This contradicts Pareto optimality, so the sets of varieties produced in E and S must be disjoint.

From (3), the Southern output per variety $L^S/(a^S\bar{A}^S)$ exceeds Y^N if the South produces a uniform amount of all varieties in $[0, \bar{A}^S]$. Given that E produces some of these varieties (which are not produced in S), the total output of the remaining varieties exceeds Y^N. This is incompatible with positive output in N, so the sets of varieties produced in S and N are also disjoint.

Taken together, it follows that consumer k's utility is

$$U_k = \lambda_k \left[\left(A^E\right)^{1-\alpha} \left(\frac{L^E}{a^E}\right)^{\alpha} + \left(A^S\right)^{1-\alpha} \left(\frac{L^S}{a^S}\right)^{\alpha} + \left(A^N\right)^{1-\alpha} \left(\frac{L^N}{a^N}\right)^{\alpha} \right]^{\frac{1}{\alpha}}.$$

Differentiating U_k, holding A^E constant, yields

$$dU_k = \frac{1-\alpha}{\alpha} U_k^{1-\alpha} \left[\left(\frac{a^S}{L^S} A^S\right)^{-\alpha} dA^S + \left(\frac{a^N}{L^N} A^N\right)^{-\alpha} dA^N \right].$$

From (3),

$$\frac{a^S}{L^S} A^S \leq \frac{a^S}{L^S} \bar{A}^S < \frac{a^N}{L^N} (\bar{A}^N - \bar{A}^S) \leq \frac{a^N}{L^N} A^N$$

for all $A^S \leq \bar{A}^S$ and $A^N \geq \bar{A}^N - \bar{A}^S$. It follows that $dU_k > 0$ for $dA^S = -dA^N > 0$. So Pareto optimality requires that, given the mass of varieties E produces A^E, S produces all other varieties it is able to produce: $A^S = \bar{A}^S - A^E$. This implies that N produces only those varieties S cannot produce: $A^N = \bar{A}^N - A^E - A^S = \bar{A}^N - \bar{A}^S$.

Differentiating U_k, holding A^N constant, yields

$$dU_k = \frac{1-\alpha}{\alpha} U_k^{1-\alpha} \left[\left(\frac{a^E}{L^E} A^E\right)^{-\alpha} dA^E + \left(\frac{a^S}{L^S} A^S\right)^{-\alpha} dA^S \right].$$

From (3),

$$\frac{a^E}{L^E}A^E \leq \frac{a^E}{L^E}\bar{A}^E < \frac{a^S}{L^S}(\bar{A}^S - \bar{A}^E) \leq \frac{a^S}{L^S}(\bar{A}^S - A^E) = \frac{a^S}{L^S}A^S$$

for all $A^E \leq \bar{A}^E$. Thus, $dU^k > 0$ for $dA^E = -dA^S > 0$, so that $A^E = \bar{A}^E$. q.e.d.

Proof of Proposition 3:

Proof: We have to prove that the core is non-empty. The proof is an application of Scarf's (1967, pp. 51–53) result for superadditive three-player market models with convex preferences. Let $\bar{U}^i_{i'i''}$ denote social welfare in country i given that i' and i'' form an FTA. $\bar{U}^i_{ESN}$ is defined analogously. In autarky the South produces $L^S/(a^S\bar{A}^S)$ of each variety in $[0, \bar{A}^S]$. From (1), the South's autarky social welfare is

$$\bar{U}^S_{EN} = x_S^{\frac{1}{\alpha}},$$

where

$$x_S = \left(\bar{A}^S\right)^{1-\alpha}\left(\frac{L^S}{a^S}\right)^{\alpha}.$$

Similarly, social welfare in a set of countries that form an FTA is given by (1) evaluated the outputs of the varieties produced in the FTA:

$$\begin{aligned}
\bar{U}^E_{ES} + \bar{U}^S_{ES} &= (x_E + x_{ES})^{\frac{1}{\alpha}} \\
\bar{U}^S_{SN} + \bar{U}^N_{SN} &= (x_S + x_{SN})^{\frac{1}{\alpha}} \\
\bar{U}^E_{ESN} + \bar{U}^S_{ESN} + \bar{U}^N_{ESN} &= (x_E + x_{ES} + x_{SN})^{\frac{1}{\alpha}},
\end{aligned}$$

where

$$\begin{aligned}
x_E &= \left(\bar{A}^E\right)^{1-\alpha}\left(\frac{L^E}{a^E}\right)^{\alpha} \\
x_{ES} &= \left(\bar{A}^S - \bar{A}^E\right)^{1-\alpha}\left(\frac{L^S}{a^S}\right)^{\alpha} \\
x_{SN} &= \left(\bar{A}^N - \bar{A}^S\right)^{1-\alpha}\left(\frac{L^N}{a^N}\right)^{\alpha}.
\end{aligned}$$

Let V^i denote the social welfare of country i with the FTA ESN and with international transfers. ESN is in the core if there are V^E, V^S, and V^N such that

$$\begin{aligned} V^E + V^S + V^N &= \bar{U}^E_{ESN} + \bar{U}^S_{ESN} + \bar{U}^N_{ESN} && \text{(A.1)} \\ V^E &\geq \bar{U}^E_{SN} && \text{(A.2)} \\ V^S &\geq \bar{U}^S_{EN} && \text{(A.3)} \\ V^N &\geq \bar{U}^N_{ES} && \text{(A.4)} \\ V^E + V^S &\geq \bar{U}^E_{ES} + \bar{U}^S_{ES} && \text{(A.5)} \\ V^E + V^N &\geq \bar{U}^E_{EN} + \bar{U}^N_{EN} && \text{(A.6)} \\ V^S + V^N &\geq \bar{U}^S_{SN} + \bar{U}^N_{SN}. && \text{(A.7)} \end{aligned}$$

The following example satisfies these inequalities:

$$\begin{aligned} V^E &= \left(\bar{U}^E_{ESN} + \bar{U}^S_{ESN} + \bar{U}^N_{ESN}\right) - \left(\bar{U}^S_{SN} + \bar{U}^N_{SN}\right) \\ V^S &= \bar{U}^S_{EN} \\ V^N &= \left(\bar{U}^S_{SN} + \bar{U}^N_{SN}\right) - \bar{U}^S_{EN}. \end{aligned}$$

Conditions (A.1), (A.3), and (A.7) are satisfied by construction. The validity of (A.2) and (A.6) follows from grand-coalition superadditivity. The presence of gains from trade (i.e., $U^S_{SN} > U^S_{EN}$ and $U^N_{SN} > U^N_{ES}$) implies that (A.4) holds. Condition (A.5) can be rewritten as

$$(x_E + x_{ES} + x_{SN})^{\frac{1}{\alpha}} + x_S^{\frac{1}{\alpha}} \geq (x_E + x_{ES})^{\frac{1}{\alpha}} + (x_S + x_{SN})^{\frac{1}{\alpha}}.$$

From convexity of the power function with exponent $1/\alpha$ (> 1), it follows that this inequality is satisfied for $x_S < x_E + x_{ES}$.[9] Using the definitions of the x's and

[9] A differentiable function $f(x)$ with $f''(x) > 0$ satisfies $f(a+c) < f(a) + [f(b) - f(a)]c$ and $f(b-c) < f(b) - [f(b) - f(a)]c$ and, therefore, $f(a+c) + f(b-c) < f(a) + f(b)$ for $a + c < b$ and $c > 0$. Setting $f(x) = x^{1/\alpha}$, $a = x_S$, $b = x_E + x_{ES} + x_{SN}$, and $c = x_{SN}$ yields the result. The inequality $a + c < b$ becomes $x_S < x_E + x_{ES}$.

rearranging terms, $x_S < x_E + x_{ES}$ can be rewritten as

$$\frac{\left(\bar{A}^S\right)^{1-\alpha} - \left(\bar{A}^S - \bar{A}^E\right)^{1-\alpha}}{\left(\bar{A}^E\right)^{1-\alpha}} < \left(\frac{\frac{L^E}{a^E}}{\frac{L^S}{a^S}}\right)^{\alpha}.$$

From (3),

$$\frac{\bar{A}^E}{\bar{A}^S - \bar{A}^E} < \frac{\frac{L^E}{a^E}}{\frac{L^S}{a^S}}.$$

So the validity of the preceding inequality is implied by

$$\frac{\left(\bar{A}^S\right)^{1-\alpha} - \left(\bar{A}^S - \bar{A}^E\right)^{1-\alpha}}{\left(\bar{A}^E\right)^{1-\alpha}} < \left(\frac{\bar{A}^E}{\bar{A}^S - \bar{A}^E}\right)^{\alpha}.$$

This inequality is satisfied for all $\bar{A}^E < \bar{A}^S$. q.e.d.

Proof of Proposition 4:

Proof: Some simple algebra along the same lines as in the proof of Proposition 1 shows

$$U^i_{ESN} > U^i_{ES}, \quad i \in \{E, S, N\}, \tag{A.8}$$

and

$$U^i_{ESN} > U^i_{EN}, \quad i \in \{E, S\}. \tag{A.9}$$

From Proposition 1, (A.8), and (A.9), no coalition of two countries blocks ESN. Because of gains from trade, no single country has an incentive to leave ESN either. So ESN is in the core. The autarky equilibrium is blocked by the set of all three countries. From (A.8), the same holds true for ES. EN is in the core if

$$U^N_{ESN} < U^N_{EN},\ U^E_{ES} < U^E_{EN},\ U^N_{SN} < U^N_{EN}.$$

The first inequality implies that EN is not blocked by ESN. The second and third inequalities ensure that it is not blocked by ES or SN either. SN is in the core if

$$U^S_{ESN} < U^S_{SN},\ U^S_{ES} < U^S_{SN},\ U^N_{EN} < U^N_{SN}.$$

The three inequalities imply that SN is not blocked by ESN, ES, or EN. From the final inequalities in the two rows, it follows that EN and SN cannot be in the core simultaneously. q.e.d.