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Welfare Effect of Exporting the High-tech Intermediate Products for a Newly Industrialized Country

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1 Introduction

The increasing level of trade liberalization has raised concerns about the welfare changes for different countries. Firms in newly industrialized countries (NICs) may export their high-tech intermediate goods to other developing countries as input for downstream final goods, and then import the final goods back to the home country or even export them to other countries.[1] For example, Taiwan, one of the four Asian NICs, exports many intermediate goods to China, the world's largest developing economy, especially integrated circuits, micro-assemblies, and other electronic parts.[2] These commodities constitute around 19% of total exports from Taiwan to China in 1998 and even rise to 38% in 2006 as shown in Figure 1-1.[3]

With its abundant labor, China is becoming the production site for many countries. Many Taiwanese firms are urging their government to further liberalizing the regulations on trade, FDI, or outsourcing activities to China. From the developing countries' perspectives, many studies have shown that technology spillover from abroad has positive effects on their productivity growth. These effects are even stronger when they are more open t

to study the trade liberalization effects. The three countries are: a newly industrialized country T, a developing country C, and the rest of the world R.

2 Model

This paper assumes a three-country, three-sector, and three-factor model to analyze the effects of trade liberalization for a newly industrialized country. The specifications of the model are illustrated below.

2.1 Framework

There are three countries: a newly industrialized country T, a developing country C, and the rest of the world R. In the benchmark, both T and C produce the differentiated high-tech intermediates D, the final good X, and the final good Y, respectively (D, X, and Y denote both the production sectors and their corresponding outputs). R only produces the final good Y.

There are three different primary factors: skilled labor S, unskilled labor L, and capital K. The production of D uses S and K. Each firm in sector D has some market power in producing the differentiated intermediate good.[7] Under the symmetric assumption, every firm's markup is the same. For simplicity, the mark up in producing D is also assumed to be the same across countries. The production of X uses the composite of D, and all three kinds of primary factors, while the production of Y uses only L and K. T and C have all the three primary factors as endowments while R only has L and K. All goods are tradable but the primary factors are not. Final good X is homogeneous only if being produced by the same country. Final good Y is homogenous among different countries.

Several key assumptions for the benchmark are: first, T, C, and R have the comparative advantages in producing D, X, and Y, respectively. For example, T has the comparative advantage in producing D since its marginal production cost in terms of the other goods is the lowest among the three countries (i.e., the opportunity cost in producing D in country T is the lowest among the three countries), as presented in Table 2-2. Also, C uses the primary factors more intensively than T in

[7] The theoretical background for the monopolistic co

producing X, and R has already specialized in producing Y.[8] Since each country's comparative advantage will not be changed under the considered simulations, the direction of trade will not be altered.

Second, in the benchmark, T exports D and X to C and R, respectively, and imports X from C (X is heterogenous if being produced by different countries). C exports X both to T and R, and import D from T. R exports Y to both T and C, and imports X from both T and C. These settings are summarized in Figure 2-1. Thus, country T and C compete in exporting the final good X to R. Trade balance is assumed to hold for each country all the time.

Third, the model assumes that in the benchmark, T imposes the export quota constraint on D and the import tariff on X. C imposes the import tariff on D. R does not impose any trade barrier. The implication of this assumption is that although trade between T and C can be terminated by the above policy variables, trade between T and R and between C and R will never be halted.

Finally, this paper assumes that the GDP for each country is the same since the different size of the economies is not the focus of this paper.

8

Table 2-1 Model Framework

Country	T	C	R
Production sector	{D, X, Y}	{D, X, Y}	{Y}
Comparative advantage	D	X	Y
Export	D, X	X	Y
Import	X, Y	Y	X
Factor endowment	{S, L, K}	{S, L, K}	{L, K}
Production technology	D=f□□□S, K□ X=f□□□S, L, K□ Y=f□□□L, K□	D=f□□□S, K□ X=f□□□S, L, K□ Y=f□□□L, K□	Y=f□□□L, K□

Trade barriers

Third, sector X uses composite intermediate good CD produced by sector D in a fixed proportion. More specifically, according to the trade relationship presented in 2.1, in T, CD used by sector X in T only comes from part of the composite intermediate produced in T while in C, CD is composed of both its domestic composite intermediate and the imported composite intermediate from T. As a result, CD will be a two-level CES aggregation in C, as shown in equation (6), where $\square_{\square}$ and $\square_{\square}$ are the number of firms in sector D in country T and C, respectively.

$$\square\square \; \square \; \square \, \square \sum_{\square\square\square}^{\square_{\square}} \square_{\square}^{\square\square_{\square}} \square^{\frac{\square\square}{\square_{\square}}} \; \square \; \square\square_{\square} \cdot \square$$

$\rho_{□}$ □ □□$1,0$□, the composite output CD is homogeneous of degree $\frac{□□}{□_{□}}$ □ 1 in $N_{□}$ or $N_{□}$, which is an “augmented output” that has already included the spillover effect.[10]

2.2.2 Profit maximization

The cost function for each good can be derived from the firm’s cost minimization problem, which of the price indices for its domestic composite intermediate and the imported composite intermediate from T. TEVTD is the shadow export duty from the export quota constraint imposed by T, while

income and expenditure.

The complete model is presented in Appendix A-03, where equations (A1) to (A21) are zero profit conditions, (A22) to (A26) are income balance conditions, and (A32) to (A58) are market clearing conditions. (A27) to (A31) are auxiliary equations for policy simulation. There are 58 equations and 58 corresponding variables. For these 58 equations, one of them is not independent of the others by Walras law. As a result, the shadow price for one unit of the utility in T, denoted by PWT, is chosen to be the numeraire. All prices are measured in terms of it. The model is solved by MPS/GE.

3 Simulation

The following three simulations answer the research questions presented in Section 1. The first one studies the effect of changing T's export quota constraint on the high tech intermediates D. The second one investigates the effects of changing both T's export quota constraint on D and the import tariff on the final good X. The last simulation analyzes the strategic interactions on trade polices between country T and C.

Several key assumptions are, first, while the model that T and C produce and export more goods with lower opportunity costs.

Note that R only has sector Y and its output is constant. This is because of the full employment assumption and the fact that there is no reallocation of its production factors. However, in R, the price index for the imported composite final good CX goes down (since R imports more low-priced X from C and less high-priced X from T), while the price index for its exported good Y goes up (since the world output of Y goes down). This implies the welfare level in R goes up all the way when T liberalizes its export quota constraint on D.

In C, the lower price for the composite D imported from T helps the expansion of its sector X. This explains the growth of its export as shown in Figure 3-2. Note that the composite D imported from T has already included the technology spillover that "inflates" the effective intermediate input to sector X in C.

This paper focuses on the welfare change of T. While T exports more D to C and imports more X from C, however, T's export of X to R will be hurt

Figure 3-4 Simulation 1: Final Goods Consumptions and Welfare Level in Country T

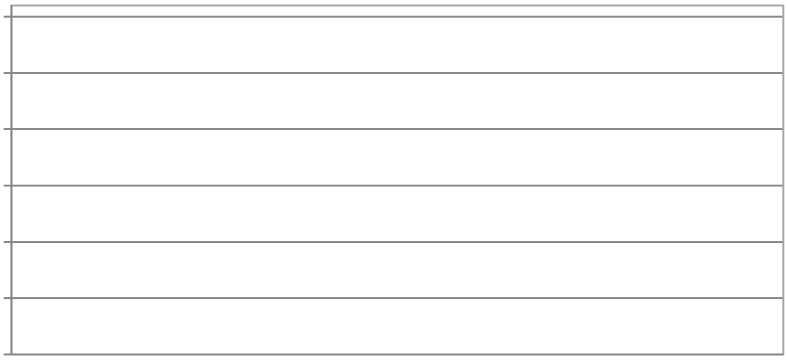

Figure 3-5 Simulation 1: Sectoral Output in Country T

Figure 3-6 Simulation 1: Factor Prices in Country T

3.2 Liberalizing the Export of the Intermediate Goods and the Import of the Final Product

Figure 3-7 Simulation 2: The Welfare Level in Country T

Tariff rate on XCT / Quota on DTC	125%	100%	87.5%	75%	62.5%	50%	37.5%	25%	12.5%	0%
0.05	0.85	0.86	0.86	0.86	0.87	0.87	0.87	0.87	0.87	0.87

propose the policy combination [(1.4, 0%); 20%], i.e., T significantly liberalizes its trade barriers and also asks C to do so. If both countries can reach this agreement, then compared to the Nash equilibrium scenario, T's and C's welfare levels go up by 7.92% and 0.11%, respectively.

Figure 3-9 Simulation 3: The outcome of the Simultaneous Move Game

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4 Conclusion

This paper establishes a theoretical general equilibrium model to simulate the effect of trade liberalization on a NIC. The main conclusions are, first, when country T, the NIC, liberalizes the export quota constraint on the high-tech intermediate goods D from the most restrictive scenario, the global welfare level goes up until the constraint does not bind. However, the distribution of the benefit is quite different. The export of the final good X by country C, the developing country, becomes more competitive from adopting more composite D produced by T. Since both T and C compete in exporting X to the third country R, this implies that T cannot internalize all the benefit from this liberalization policy.

Second, for country T, lowering the tariff rate on the import of X from C can partially internalize the benefit created from exporting D to C. Also, for a given tariff rate imposed by C on the import of considered in this paper. Investigating the welfare effects on the NIC from these activities would be an interesting extension for the future research.

Appendix A-02: Definition of the Variables

1	**DT**	Sector D's composite output in T	30	**DPADC**	Output subsidy rate in MPS/GE for the IRS production in sector D in C
2	**XT**	Sector X's total output in T	31	**DQADC**	

(A13)	□□□ □ □□□	**YRC**	QYRC0=50
(A14)[17]	□$\frac{□}{□.□}$□ · □**1**$^{□}$ · □□□$^{□□□}$ □ **1**$^{□}$ · □□□□$^{□□□}$□$^{\frac{□}{□□□}}$ □ □□□□ ; □ □ **2**	**XTA**	QXTA0=100
(A15)	□$\frac{□}{□.□□}$□ · □**0.5774**$^{□}$ · □□□$^{□□□}$ □ **1**$^{□}$ · □□□□$^{□□□}$□$^{\frac{□}{□□□}}$ □ □□□□ ; □ □ **2**	**DCA**	QDCA0=80/1.875
(A16)	□$\frac{□}{□.□□□□}$□ · □**1.0206**$^{□}$ · □□□□$^{□□□}$ □ **1**$^{□}$ · □□□□$^{□□□}$□$^{\frac{□}{□□□}}$ □ □□□□ ; □ □ **2**	**XRA**	QXRA0=110
(A17)	□□□$^{□.□}$□□□$^{□.□}$ □ □□□	**NT**	QFT0=16
(A18)	□□□$^{□.□}$□□□$^{□.□}$ □ □□□	**NC**	QFC0=4
(A19)	□□□□$^{□.□}$□□□$^{□.□}$ □ □□□	**WT**	QWT0=200
(A20)	□$\frac{□□□}{0.80}$□ $^{□.□}$□□□$^{□.□}$ □ □□□	**WC**	QWC0=200
(A21)	□□□□$^{□.□□}$		

(A32)[18]	[illegible]0 · [illegible] 0.32 · [illegible]0 · [illegible] $\frac{4}{3}$ [illegible] · [illegible]0.5774 [illegible] · [illegible] / [illegible] · [illegible] · [illegible]0 · [illegible]	PDT	PDT0=1.25
(A33)[19]	[illegible] · [illegible]1 [illegible] · [illegible]1 [illegible]	PDTC	PDTC0=1.875
(A34)[20]	[illegible]0 · [illegible]0 · [illegible] [illegible] 0.5 · [illegible] $\frac{1}{0.5}$ [illegible] · [illegible]1 [illegible] · [illegible] 1 [illegible] · [illegible]		

(A56) □□□0 □ $\frac{1}{4}$ · □□□$\frac{□}{□}$□□□

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