Infant industry protection revisited:

The learning-by-exporting hypothesis when credit constraint matters

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Infant industry protection revisited:

The learning-by-exporting hypothesis when credit constraint matters♦

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Abstract

This paper develops a theoretical framework to study the policy implications of learning-by-exporting. We introduce credit constraint into the learning-by-exporting model and discuss possible government intervention. The analysis shows that supporting a learning industry via an export subsidy improves social welfare when the economy maintains a balanced trade condition. However, infant industry protection is not necessarily justified if consumers can access to the international financial market. A learning sector's goods could be overproduced (relative to another non-tradable sector goods) when consumers can borrow freely for their consumption. Social welfare will be improved once the government levies a tax on the production.

JEL classification: F1; F4; O2

Keywords: Export Subsidy; Infant industry; Learning by exporting; Knowledge spillover

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Introduction

One of the recent policy concerns in the area of development is whether globalization really helps to attain the goal of economic growth in developing countries. International organizations advocate the merit of accessing the global economy via international trade. The empirical literature (Levine & Renelt, 1992; Harrison, 1996; Frankel & Romer, 1999) shows a positive relationship between trade and growth. However, we observe that not all developing countries experienced trade-induced economic growth. Like Asian dragons, those which have successfully raised domestic manufacturing sectors enjoyed a high growth rate by exporting manufacturing goods. Countries that employ import substitution policy and/or export natural resources did not seem to enjoy trade's benefits much. The fact implies a possible relationship between export and economic growth (i.e., export-led economic growth).

The learning-by-exporting hypothesis gets an attention in the recent empirical literature in the area of trade and economic development (e.g., refer to the survey of Wagner, 2007[1]). The hypothesis suggests export experience (or participation) could improve production efficiency, since export-oriented industries learn new production methods, inputs, and product designs that appeal to foreign consumers through experiences such as the contact with foreign clients and international competition. Several works show the evidence of learning-by-exporting (Aw, Chung & Roberts (2000) for Korea; Castellani (2002) for Italy; Fafchamps et al. (2002) for

[1] Wagner (2007) studies 54 microeconometric studies covering 34 countries, which examine the "causes of productivity differentials between exporters and their counterparts, which sell on the domestic market only." Previous microeconometric studies discuss the relationship between productivity and manufacturing firms' participation decisions in the export market and examine either leaning-by-exporting (export-market participation or experience raises productivity) or self-selection (more efficient firms participate into the export market) is more important. Some works distinguish export experience from export participation by referring to the idea of learning-by-doing, where learning experience helps to reduce production costs.

Morocco; Baldwin & Gu (2004) for Canada; Bigsten et al. (2004) for four African countries; Blalock & Gertler (2004) for Indonesia; Girma et al. (2004) for the U.K.; Alvarez & López (2005) for Chile; Fernandes & Isgut (2005) for Columbia; Van Biesebroeck (2005) for nine African countries; Crespi et al. (2008) for the U.K.; Harris & Li (2008) for the U.K.; Trofimenko (2008) for Columbia).[2]

This paper develops a theoretical framework to study the policy implications of learning-by-exporting. The literature provides a few theoretical models that account for export externality (de Melo & Robinson, 1992; Castellani, 2002). Referring to the theoretical literature on learning-by-doing and trade policy (Bardhan, 1971; Dasgupta & Stiglitz, 1988; McKay & Milner, 1993; Amblera et al., 1999; Benchekroun et al., 1999; Leahy & Neary, 1999; Benarroch & Gaisford, 2001), we introduce the argument on infant industry protection into the learning-by-exporting model. Our analysis distinguishes different scenarios: the counter part of a learning export sector is either a non-tradable sector or a tradable sector. We also introduce knowledge spillovers (i.e., a learning industry generates positive externalities on the production efficiency of another industry) to see whether we have different policy implications.

The analysis shows that supporting a learning industry via a subsidy improves social welfare when the economy is composed of a learning tradable sector and another tradable sector, and maintains a balanced trade condition. The result is valid even after introducing knowledge

[2] More recent works point out that industry characteristics are important factors in determining learning-by-doing (Greenaway & Kneller, 2007). For example, learning-by-exporting is more dominant for young than for old plants (Fernandes & Isgut, 2005) and when exporting to high-income countries (Fernandes & Isgut, 2005; Trofimenko, 2008). Other works emphasize the importance of self-selection (Bernard & Wagner (1997) for Germany; Clerides et al. (1998) for Colombia, Mexico, and Morocco; Bernard & Jensen (1999) for the U.S.; Aw et al. (2000) for Taiwan; Isgut (2001) for Columbia; Delgado et al. (2002) for Spain; Girma et al. (2004) for the U.K.; Alvarez & López (2005) for Chile; Fariñas & Martín-Marcos (2007) for Spain; Tsou et al. (2008) for Taiwan electronics industry).

spillovers from a learning tradable sector to another tradable sector. However, infant industry protection is not necessarily justified if the economy is composed of a learning tradable sector and a non-tradable sector and consumers can borrow/lend to finance their consumption. This is because a learning sector's goods could be overproduced when consumers can borrow freely for their consumption. Social welfare will be improved once the government levies a tax on the production. So far we are not aware of the empirical literature incorporating the role of credit constraint, except Van Biesebroeck (2005). Our theoretical framework will provide a platform from which the learning-by-exporting hypothesis can be explored.

The paper is organized as follows. Section 2 provides a framework to analyze the policy implications of learning-by-exporting. In Section 3, the analysis incorporates knowledge spillovers from a learning sector to another tradable sector. We further extend the analysis by replacing a tradable sector with a non-tradable sector in Section 4. Section 5 concludes the paper.

Model

We use the standard 2 x 2 Heckscher-Ohlin-Samuelson framework in a small open economy. The economy is composed of two sectors, a manufacturing sector, M, and an agricultural sector, A, and is endowed with a fixed amount of two inputs, capital, K, and labor, L. Our analysis further decomposes the manufacturing sector into two sectors, an export-oriented sector, H, and a domestic-market-oriented sector, F, and introduces a learning-by-exporting mechanism, i.e., a positive correlation between export experience and production efficiency.

Production functions are defined as

$$\begin{aligned} Y_M &= B(Q_H)\left[F\left((1-\alpha)K_M,(1-\alpha)L_M\right)+H\left(\alpha K_M,\alpha L_M\right)\right], \\ Y_A &= G(K_A,L_A), \end{aligned} \tag{1}$$

where Y_i is output, K_i is capital, and L_i for each sector $i \in \{M, A\}$, $B(\cdot)$ represents learning effects from export, Q_H is export experience, F is the production function for the domestic-oriented manufacturing sector, H is the production function for the export-oriented manufacturing sector, G is the production function for the agricultural sector, and $\alpha \in [0,1]$ is the proportion of inputs allocated to the export-oriented sector within the manufacturing sector. If $\alpha = 0$, the manufacturing sector does not export at all. Alternatively, the manufacturing sector exports all outputs when $\alpha = 1$. The export-oriented manufacturing sector is assumed to be more efficient than the domestic-oriented manufacturing sector; $H_j \geq F_j$ for $j = K, L$ (the marginal product of each input in the export-oriented manufacturing sector is larger than the one of the domestic-oriented manufacturing sector).

Learning effects are completely external to each firm in the manufacturing sector. Namely, the sector is not dominated by few gigantic firms and each firm is not large enough to affect export experience. Referring to the literature on learning by doing, learning by exporting is modeled to occur as an increase in the level of accumulated output in the export-oriented sector at time, t. The process of output accumulation follows depreciation; learning experience is forgotten at the rate of δ.

$$Q_H(t) = \int_0^t \{B(Q_H)H(\tau) - \delta Q_H(\tau)\} d\tau \,. \qquad (2)$$

The learning effect has a ceiling of $\overline{B}$ after the export experience of $\overline{Q}_H$: $B(Q_H) = \overline{B}$ for $Q_H \geq \overline{Q}_H$. A possible interpretation is that the learning sector reaches the efficiency level of foreign firms in developed countries and/or exhausts the customer survey in the foreign market; it does not learn from export. This function is assumed to be strictly concave, $B'(\cdot) > 0$ and $B''(\cdot) < 0$, and satisfies the Inada conditions.

Let p^d be the relative domestic price expressed using the price of agricultural goods as a numeraire (i.e., the price of goods in the manufacturing sector relative to the price of goods in the agricultural sector). Assuming both factor inputs and final goods are traded in competitive markets, rental, *r*, and wage, *w*, are calculated as $r = p^d B(Q_H)[(1-\alpha)F_K + \alpha H_K] = G_K$, $w = p^d B(Q_H)[(1-\alpha)F_L + \alpha H_L] = G_L$, where G_j is the marginal product with respect to each input j. Thus, the profit maximizing conditions of firms allow us expressing the relative domestic price in the two sectors as

$$p^d = \frac{G_j}{B(Q_H)[(1-\alpha)F_j + \alpha H_j]} \tag{3}$$

using the marginal rate of transformation.

In order to discuss infant industry (or manufacturing sector here) protection, we need to introduce social welfare. Suppose the society's utility increases with the consumption of the two goods. A social planner's issue is models as the following intertemporal utility maximization:

$$\max_{C_M \geq 0, C_A \geq 0} \int_0^\infty \{U(C_M(t), C_A(t))\} e^{-\rho t} dt$$

subject to Equations (1), (2), and

$$K_M + K_A = \overline{K} \text{ and } L_M + L_A = 1, \tag{4}$$

$$(Y_A - C_A) + \overline{p}^w (Y_M - C_M) = 0, \tag{5}$$

where $U(\cdot,\cdot)$ is a concave instantaneous utility function; (4) is resource constraints with the assumption of no factor growth and is normalized using the labor endowment in the economy; (5) is the balanced trade condition; $\overline{p}^w$ is the relative world price, (which is decided in the world market and is given in the model). Denoting $X_M = Y_M - C_M$, the current-value Hamiltonian is:

$$\begin{aligned} &U(C_M, C_A) + \lambda[B(Q_H)\{F((1-\alpha)K_M, (1-\alpha)L_M) + H(\alpha K_M, \alpha L_M)\} + X_M - C_M] \\ &\quad + \mu[G(\overline{K} - K_M, 1 - L_M) - \overline{p}^w X_M - C_A] + \gamma[B(Q_H)H(\alpha K_M, \alpha L_M) - \delta Q_H] \end{aligned}$$

The first-order conditions with respect to C_M, C_A, X_M, K_M, L_M give

$$U_M = \lambda, \tag{6}$$

$$U_A = \mu, \tag{7}$$

$$\bar{p}^w = \frac{\lambda}{\mu}, \tag{8}$$

$$\frac{\lambda}{\mu} + \frac{\gamma}{\mu}\phi = \frac{G_j}{B(Q_H)\left[(1-\alpha)F_j + \alpha H_j\right]},$$

$$\text{where } \phi(\alpha) = \frac{\alpha H_j}{\left[(1-\alpha)F_j + \alpha H_j\right]}, \text{ for } j = K, L \tag{9}$$

The intertemporal envelop conditions (6) and (7) mean that the marginal utility of consumption is equal to the shadow price for the consumption of manufacturing (or agricultural) goods. Equation (8), (together with (6) and (7)), indicates that the marginal rate of substitution is equal to the world relative price (i.e., the world's terms of trade). γ is the shadow price of export experience. If learning by exporting effect is bounded, γ is not zero.

Equation (9), the domestic marginal rate of transformation, implies the necessity of infant (or manufacturing) industry protection. Using Equations (3), (8) and (9), we have the following relationship between p^d and $\bar{p}^w$:

$$p^d \equiv \frac{\lambda}{\mu} + \frac{\gamma}{\mu}\phi \geq \frac{\lambda}{\mu} = \bar{p}^w, \quad 0 \leq \phi \leq 1. \tag{10}$$

The domestic relative price of manufacturing goods is larger than the world relative price. Note that firms produce based on the domestic relative price (or the marginal rate of transformation), which is larger than the world relative price (or the marginal rate of substitution in consumption). This indicates that a learning industry of the manufacturing sector produces less than socially optimal output. The production of manufacturing goods increases if the government subsidizes the gap between p^d and $\bar{p}^w$. Since the market equilibrium does not fully account for positive

externality from export, the export subsidy of $\frac{\gamma}{\mu}\phi$ amplifies the benefit of learning by export and improves the social welfare of the country.

Knowledge spillovers on tradable sector

We introduce the externality of learning by exporting into the analysis in the previous section. We consider the case when export in the manufacturing sector benefits a non-manufacturing sector through improved production efficiency. Some small open economies such as Singapore and Hong Kong do not have a large agricultural sector but a service sector. In this section, we consider a service sector, instead of the agricultural sector. It is more appealing to discuss knowledge spillovers on the service sector rather than on the agricultural sector.

Production functions are modified as follows:

$$\begin{aligned} Y_M &= B(Q_H)\left[F\left((1-\alpha)K_M,(1-\alpha)L_M\right)+H\left(\alpha K_M,\alpha L_M\right)\right], \\ Y_S &= E(Q_H)G(K_S,L_S) \end{aligned} \tag{1'}$$

While the production function in the manufacturing sector is the same as before, the production in the service sector, S, increases with export in the manufacturing sector. A function, $E(.)$, captures knowledge spillovers from export experiences. The analysis focuses on a positive spillover case, i.e., $E(.)>1$. Correspondingly, the relative domestic price p^d changes to

$$p^d = \frac{E(Q_H)G_j}{B(Q_H)\left[(1-\alpha)F_j+\alpha H_j\right]} \tag{3'}$$

A modified social planner's problem gives the first order conditions of (6), (7), (8), and

$$\frac{\tilde{\lambda}}{\tilde{\mu}}+\frac{\tilde{\gamma}}{\tilde{\mu}}\phi = \frac{E(Q_H)G_j}{B(Q_H)\left[(1-\alpha)F_j+\alpha H_j\right]} \tag{9'}$$

where we change the notation of the current-value Hamiltonian's multipliers in the previous section by adding ~.

The argument in the previous section is still robust despite the introduction of knowledge spillovers on another tradable sector, i.e., the service sector. Using (3'), (8), and (9'), we obtain the relationship similar to (10).

$$p^d \equiv \frac{\tilde{\lambda}}{\tilde{\mu}} + \frac{\tilde{\gamma}}{\tilde{\mu}}\phi \geq \frac{\tilde{\lambda}}{\tilde{\mu}} = \bar{p}^w, \quad 0 \leq \phi \leq 1. \tag{10'}$$

Again, a learning industry of the manufacturing sector produces less than socially optimal output. Social welfare improves if the government provides the subsidy equivalent to the gap between p^d and $\bar{p}^w$.

The analysis indicates a larger subsidy in the current case than in the previous section. As is seen from (9') and (10'), the gap between p^d and $\bar{p}^w$ becomes larger due to the term $E(.) > 1$. This makes sense since the growth of the manufacturing sector benefits not only its own sector but also the service sector via positive externalities.

Access to the financial market

We further extend our analysis by considering a non-tradable service sector. While some services (such as entertainment) are tradable, most service targets for domestic markets and, thus, is treated as non-tradable in the trade literature. This extension does not affect the supply-side argument in Section 3. The relative domestic price p^d is still equivalent to (3'). However, the demand-side argument needs to be modified by replacing the balanced trade condition (5) with a new budget constraint:

$\dot{b} = \bar{p}^w(Y_M - C_M) + rb$, where b is bond and $\dot{b} = db/dt$.

The balanced trade condition requires exporting service goods in order to import manufacturing goods (i.e., to consume manufacturing goods more than the country produces).[3] The new budget constraint does not require such a condition. Now consumers can borrow and lend freely in the international financial market.

A modified social planner's problem gives the following current-value Hamiltonian:

$$U(C_M, C_S) + \hat{\lambda}\left[\overline{p}^w B(Q_H)\{F((1-\alpha)K_M, (1-\alpha)L_M) + H(\alpha K_M, \alpha L_M)\} - \overline{p}^w C_M + rb\right] + \hat{\mu}\left[E(Q_H)G(\overline{K} - K_M, 1 - L_M) - C_S\right] + \hat{\gamma}\left[B(Q_H)H(\alpha K_M, \alpha L_M) - \delta Q_H\right]$$

The first-order conditions with respect to C_M, C_A, K_M, and L_M give

$$U_M = \hat{\lambda}\overline{p}^w, \tag{6"}$$

$$U_S = \hat{\mu}, \tag{7"}$$

$$\frac{\hat{\lambda}}{\hat{\mu}}\overline{p}^w + \frac{\hat{\gamma}}{\hat{\mu}}\phi = \frac{E(Q_H)G_j}{B(Q_H)\left[(1-\alpha)F_j + \alpha H_j\right]} \tag{9"}$$

It is not obvious whether the government should subsidize the learning manufacturing sector, although we still observe a gap between p^d and $\overline{p}^w$. Using (3'), (6"), (7") and (9"), both prices are expressed as

$$\overline{p}^w = \frac{U_M}{\hat{\lambda}} \quad \text{and} \quad p^d = \frac{\hat{\gamma}}{\hat{\mu}}\phi + \frac{U_M}{\hat{\mu}}.$$

The gap between p^d and $\overline{p}^w$ can be either positive or negative:

$$p^d - \overline{p}^w = U_M \frac{\hat{\lambda} - \hat{\mu}}{\hat{\lambda}\hat{\mu}} + \frac{\hat{\gamma}}{\hat{\mu}}\phi. \tag{11}$$

If $\hat{\lambda} > \hat{\mu}$ (or the shadow price of manufacturing goods is larger than the one of service goods), then the price gap is always positive and manufacturing goods are under produced. This is the

[3] The balanced trade condition implies $X_S = -\overline{p}^w X_M$ from $X_S = \overline{p}^w(Y_M - C_M)$ and $-X_M = Y_M - C_M$.

case where consumers evaluate manufacturing goods relative to service goods. The government can improve social welfare by protecting the infant manufacturing industry via a subsidy. On the other hand, the price gap can be negative if $\hat{\mu}$ is much larger than $\hat{\lambda}$ (or the marginal utility in consumption for service goods is very high). Consumers evaluate service goods much more than manufacturing goods but they can not consume enough amounts of service goods. In this case, the government may want to discourage the production of manufacturing goods through a tax so that some input factors will be released for the production of service goods.

Infant industry protection is not always justified when the economy is composed of a learning-by exporting tradable sector and a non-tradable sector, together with the access to the financial market. The result is different from the one in Section 3. The analysis in Sections 2 and 3 always suggests supporting a learning infant industry. Where does the difference between Sections 3 and 4 come from? The economy in Section 3 is composed of two tradable sectors. A balanced trade condition relates the production decisions between the two sectors through international trade (or the good market).[4] Consumers need to sacrifice the consumption for service goods in order to consume additional manufacturing goods. On the other hand, the analysis in this section does not impose such restriction. Consumers can borrow in the financial market to consume additional goods. The financial market in Section 4 does not operate as the good market in Section 3 does. Thus, the government needs to play the role of the good market under the analytical framework in Section 4. This can be seen from the first term of the right hand side of Equation (11), which is an additional term to the price gap observed in Section 3.

[4] Remember that maximizing social welfare requires the international marginal rate of substitution (or the world's terms of trade) to be equal to the marginal rate of substitution (see Equation (8)).

For the purpose of industry policy making, the government has to examine the degree of the gap between the two variables, $\hat{\lambda}$ and $\hat{\mu}$.

Concluding remarks

Revisiting infant industry protection, this paper develops a theoretical framework to analyze the learning-by-exporting hypothesis. Infant industry protection is often advised under the economy with positive externalities. A learning infant industry may disappear without government intervention due to the penetration of cheaper foreign goods. We examine the different scenarios of export-led economic growth by using the 2 x 2 Heckscher-Ohlin-Samuelson framework in a small open economy.

The analysis shows that supporting a learning industry via a subsidy improves social welfare when the economy is composed of a learning tradable sector and another tradable sector, and maintains a balanced budget condition. The result is valid even after introducing knowledge spillovers from a learning tradable sector to another tradable sector. However, infant industry protection is not necessarily justified if the economy is composed of a learning tradable sector and a non-tradable sector and consumers can access to the financial market. Lending/borrowing availability for consumers isolates the linkage of production decisions between the two sectors. The government needs to judge a relative importance of two goods (or consumers' preferences) when making industry policy regarding a subsidy/tax.

It is not straightforward whether the government should protect a learning infant industry despite its positive externalities. Our analysis sheds light on the importance of a non-trade sector in the economy with the access to the financial market, when judging industrial policy. So far we are not aware of the empirical literature incorporating credit constraint, except Van

Biesebroeck (2005). Our theoretical framework will provide a platform from which industrial policy facing globalization can be explored.

This analytical framework is applicable to other interesting but more complicated situations. One possible extension is to include how to finance export subsidies. The current model treats subsidies as exogenous. The assumption could be reasonable when the World Bank provides financial support to developing countries. However, the assumption may not be relevant to discuss infant industry protection in developed countries. While this extension is beyond the scope of this paper, it would be helpful to study the self-dependent sustainable development of developing countries. All of these topics represent future lines of research.

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