Financial and Product Market Integration under Increasing Returns to Scale

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Abstract
The impact of financial integration and product market integration is studied in a general equilibrium model with increasing returns in both the manufacturing sector and the financial sector. Firms engage in oligopolistic competition. An increase of the degree of competition in the financial sector resulting from financial integration may not change the degree of competition in the product market. With product market integration, the level of technology, the wage rate, and the interest rate paid to depositors increase. Joint integration increases the level of technology, the wage rate, and the interest rate paid to depositors. The impact of separate financial integration or separate product market integration will not be reversed under joint integration. Social welfare increases under all integration regimes.

JEL Classification Numbers: F10, F30

Keywords: Financial integration, product market integration, increasing returns to scale, choice of technology, oligopolistic competition

1. INTRODUCTION

There are increasing returns to scale in the manufacturing sector and the financial sector. For the manufacturing sector, increasing returns is discussed in detail in Chandler [1990]. Chandler shows that near the end of the 19^{th} century and the beginning of the 20^{th} century many industries such as the petroleum industry became highly concentrated with the existence of increasing returns in production, distribution, and management. For the financial sector, without increasing returns in the intermediation of financial services, there is no need for financial intermediation and a manufacturing firm may contact individuals directly for capital. There are various sources of increasing returns to scale in the financial sector, such as the commercial banking industry. First, as discussed in Pilloff [2005, p. 145], one source of increasing returns is technology. Banks rely on computer systems extensively. Compared with their variable costs, the level of fixed costs of these computer systems is very significant. Second, another source of increasing returns comes from advertising. Compared with small banks, large banks operate over wide geographic regions. It might be more efficient for them to advertise through various media, such as radio and television. Third, monitoring is an important function of banks [Tirole, 2006]. As discussed in Williamson [1986], monitoring cost is a fixed cost. The existence of significant monitoring cost is another source of increasing returns in the financial sector. With increasing returns to scale in the manufacturing sector and the financial sector, product market integration and financial integration can increase the size of the market and thus have the potential of increasing national welfare.

Historically, the process of product market integration and financial integration was not smooth as it was interrupted by wars and other forms of international conflict. The process of product market integration and financial integration went at different paces. As discussed in Bagwell and Staiger [2002, Ch. 1], the average level of tariff rate of the United States in the 1930s could be as high as 50 per cent. With the decrease of tariff sponsored by the General Agreement on Trade and Tariff and later by the World Trade Organization, trade liberalization proceeded significantly after World War II. The average tariff rate of the United States is now lower than 5 per cent. Compared with product market liberalization after World War II, the process of financial liberalization was slower. Many developed countries lifted their control on capital only in the 1970s, and some developing countries such as South Korea began to lift control on capital only in the 1980s.

The financial sector and the manufacturing sector are interrelated in various ways. First, the financial sector provides capital for the manufacturing sector as an input. Second, the two sectors may also face the same factor markets, such as markets for certain types of labor. As the financial sector and the manufacturing sector are interrelated, financial integration and product market integration are also interrelated because liberalization in the financial market may change the degree of competition in the manufacturing sector and vice versa. As countries differ in their degrees of financial and product market integration, there are some interesting questions to be addressed. First, for countries having financial integration only, through the linkages between the financial sector and the manufacturing sector, how will the situation be different from the case that countries having product market integration only? Second, for countries with financial or product market integration, but not both, might a move to joint integration reverse the effects of partial integration?

Given the possible interactions between the financial and productive sectors, it is desirable to study the effects of different types of integration using a unified model. However, as discussed by Arndt and Richardson [1987], there are very few studies unifying the trade and financial aspects in the literature.[1] In this paper, we study the impact of financial integration and product market integration in a unified general equilibrium model. In this model, the financial sector attracts deposits from individuals and makes loans to the manufacturing sector. With the existence of significant fixed costs, financial firms and manufacturing firms engage in oligopolistic competition. Firms producing manufactured goods also choose their technologies of production to maximize profit. For a closed economy, we show that the interest rate paid to depositors increases with the labor endowment. We also show that the level of technology in the manufacturing sector and the wage rate increase with the capital endowment.

Under financial integration, markets for capital in different countries are integrated. Because financial integration increases the degree of competition in the financial sector, the interest rate paid to depositors increases. An increase of competition in the financial market does not necessarily increase the degree of competition in the product market. Under product market integration, markets for manufactured goods in different countries become integrated and the degree of competition in the product market increases. With product market integration, we show that the level of technology, the wage rate, and the interest rate paid to depositors increase. Both wage earners and interest earners gain from product market integration. Even with linkages between the manufacturing sector and the financial sector, the impact of financial integration is significantly different from that of product market integration.

Moving from autarky to joint integration, both markets for manufactured goods and markets for capital in different countries are integrated. We show that joint integration increases the level of technology, the wage rate, and interest rate paid to depositors. For countries in which financial integration is already established, the addition of product market integration leads to increases in the level of technology, the wage rate, and the interest rate paid to depositors. For two countries already established product market integration, if they also establish financial integration, this will increase the interest rate paid to depositors. Thus, the impact of an increase of the interest rate paid to depositors under product market integration will not be reversed under joint integration.

In the literature, the impact of financial liberalization has been studied by Bhagwati [1998], Martin and Rey [2000], Stiglitz [2002], Obstfeld and Taylor [2004], Stulz [2005], and

[1] Arndt and Richardson [1987, Ch. 1] argue that one reason there are few unifying studies is because that scholars studying international trade and scholars studying international finance address separate sets of questions.

Kose et al. [2009]. The impact of product market liberalization has been studied by Markusen, Rutherford, and Hunter [1995], Tybout and Westbrook [1995], Gu, Sawchuk, and Whewell [2003], and Ju, Wu, and Zeng [2010]. Financial and product market liberalization in various countries is discussed in McKinnon [1993]. This paper contributes to the literature by studying the interaction of financial integration and product market integration in a unified general equilibrium framework. This unified framework is useful in comparing implications under different integration regimes.

The rest of the paper is organized as follows. First, we set up the model for a closed economy. Second, we study the impact of financial integration without product market integration. Third, we study the impact of product market integration without financial integration. Fourth, we study the impact of joint integration. Finally, we discuss some extensions and generalizations of the model and conclude.

2. THE MODEL

There are two countries: home and foreign. Both countries are assumed to have access to the same production technologies and have the same endowments of capital and labor. In this section, each country is assumed to be in autarky. Without loss of generality, we focus on the presentation of the home country as the analysis for the foreign country is similar. First, utility maximization for a consumer is studied. Second, the respective profit maximization problems for a manufacturing firm and for a bank are addressed. Finally, market clearing conditions are imposed.

There is a continuum of manufactured goods indexed by a number $\varpi \in [0,\ 1]$.[2] All manufactured goods are symmetric in the sense that they enter a consumer's utility function in the same way and they have the same costs of production. If a consumer's consumption of the manufactured good ϖ is $c(\varpi)$, the utility function of this consumer is specified as

[2] As discussed in Neary [2003], the main purpose of having a continuum of final goods rather than one final good is to eliminate market power of a manufacturing firm and a bank in the labor market. Otherwise, it can be viewed that there is only one final good. When there is only one final good and there are only few firms producing it, a manufacturing firm or a bank is one of the small number of buyers of labor and will have market power in the labor market. With a continuum of final goods, even though each final good is still produced by a small number of firms, a manufacturing firm or a bank is only one of the infinite number of buyers of labor and does not have market power in the labor market.

$\int_0^1 \ln c(\varpi) d\varpi$.[3] With this specification of the utility function, a consumer's utility maximization leads to a unitary elasticity of demand for a given manufactured good.

There are two factors of production, labor and capital. There are L individuals in the home country. An individual supplies one unit of labor inelastically. The total amount of capital available in the home country is K. Capital is owned by individuals and individuals supply their capital inelastically to banks. If the utility function is nonhomothetic, the total demand for a good may be affected by the distribution of income and thus the distribution of the ownership of capital because the distribution of income is affected by the distribution of ownership of capital. With the specification of the homothetic utility function, it is not necessary to assume that individuals in a country have equal ownership of capital.

There are two sectors: the manufacturing sector and the financial sector. The financial sector attracts deposits from the individuals and provides capital to the manufacturing sector. With increasing returns in the manufacturing sector, it is assumed that firms producing the same manufactured good engage in Cournot competition. A firm providing financial services is called a bank. Variables associated with a bank are usually identified with a subscript b. To capture increasing returns to scale in the financial sector, for each bank, there is a fixed cost of f_b units of labor. With increasing returns in the financial sector, like Williamson [1986] and Jungblut [2004], it is assumed that banks engage in Cournot competition. Like Salinger [1986], when there are two stages of production, a bank does not view it can influence the price of a manufactured good and a manufacturing firm does not view it can influence the interest rate charged by a bank.

For the manufactured good ϖ, there are $m(\varpi)$ identical firms producing it. To produce manufactured goods, as capital is frequently associated with machines and buildings, capital is specified as the fixed cost of production. The marginal cost of production is determined by labor costs. To produce each manufactured good, like Zhou [2004; 2007; 2009], it is assumed that there is a continuum of technologies indexed by a positive number n. A higher n indicates a more advanced technology. For technology n, the fixed cost is $f(n)$ units of capital and the marginal cost is $\beta(n)$ units of labor. To capture the substitution between capital and labor in

[3] This utility function is specific. Yu [2005] contains a discussion of the implications of a more general utility function.

production, it is assumed that the fixed cost increases with the level of technology and the marginal cost decreases with the level of technology: $f'(n) > 0$ and $\beta'(n) < 0$.[4] To facilitate the study of the financial sector, for ψ, θ, g, and h denoting positive constants, the cost functions are specified as[5]

(1a) $$f(n) = \psi n^{\theta},$$

(1b) $$\beta(n) = g n^{-h}.$$

The price of a manufactured good is p, which is determined by output of all firms producing this good. The interest rate charged by a bank to a manufacturing firm for a unit of capital is R, which is determined by all banks serving the same industry. For a manufacturing firm with output level x, this firm's total revenue is px, and its cost of capital is fR and the cost of labor is $\beta x w$. Thus its profit is $\pi = px - fR - \beta x w$. Since there are an infinite number of manufacturing firms demanding labor, a manufacturing firm takes the wage rate as given. A manufacturing firm also takes the interest rate charged by a bank as given. It chooses its level of output and its technology to maximize its profit. A manufacturing firm's optimal choice of output requires that $p + x\partial p / \partial x - \beta w = 0$. Combining this equation with the result that the absolute value of a consumer's elasticity of demand for a manufactured good is one leads to the following relationship between a manufacturing firm's price and its marginal cost:

(2) $$p\left(1 - \frac{1}{m}\right) = \beta w.$$

The first order condition for a manufacturing firm's optimal choice of technology leads to[6]

(3) $$f' R + \beta' x w = 0.$$

Plugging equations (1a) and (1b) into equation (3), it can be shown that

[4] Levinson [2006] provides an example of the choice of technology in the transportation sector. Before the introduction of containers in the 1950s, cargos were handled by longshoremen and were labor intensive. With high wage rates, the marginal cost was high. The usage of containers led to a sharp rise of the fixed cost of production in the transportation sector because costly containerships and container ports must be built. With containerization, the marginal cost of loading and unloading decreases sharply. If the volume of transportation is high, the adoption of costly containerships and container ports becomes profitable because the high fixed costs of containerization can be spread to a high level of output and the average cost decreases.

[5] The only usage of equations (1a) and (1b) is to ensure constant elasticity of demand for the financial sector. Otherwise, this special function form is unnecessary.

[6] The second order condition is assumed to be satisfied and is used later for comparative statics.

$$f = \psi^{\frac{h}{\theta+h}} \left(\frac{ghxw}{\psi\theta} \right)^{\frac{\theta}{\theta+h}} R^{-\frac{\theta}{\theta+h}}.$$

Partial differentiation of f with respect to R leads to

$$\frac{\partial f}{\partial R}\frac{R}{f} = -\frac{\theta}{\theta+h}.$$

Free entry and exit in the production of manufactured goods leads to zero profit in equilibrium for a manufacturing firm:

(4) $$\pi = p\,x - f\,R - \beta\,x\,w = 0.$$ [7]

For each manufactured good, the number of identical banks providing financial services is m_b. The interest rate offered by a bank to depositors is r. For a bank attracting x_b units of deposit, this bank's revenue is Rx_b. Since its fixed cost is $f_b w$ and its marginal cost is rx_b, its profit is $\pi_b = R\,x_b - f_b w - r\,x_b$. Since there are an infinite number of banks competing for deposits, a bank takes the interest rate paid to depositors as given. A bank chooses the level of output or quantity of deposits optimally to maximize its profit. The first order condition for a bank's optimal output choice requires that $R + x_b \partial R / \partial x_b - r = 0$.

Free entry and exit in the banking sector leads to zero profit for a bank:

(5) $$\pi_b = R\,x_b - f_b w - r\,x_b = 0.$$

Each bank supplies x_b units of capital and the total amount of capital supplied by all banks is $m_b x_b$. The total demand for capital for a manufacturing good is $m\,f$. In equilibrium, the supply of capital should be equal to the demand of capital:

(6) $$m_b x_b = m\,f\ .$$

For a given bank with output x_b, let x_{-b} denote the sum of output of other banks. Clearance of the market for capital requires that $x_b + x_{-b} = mf$. In a Cournot equilibrium, when a firm chooses its level of output, it takes the output of other firms as given. With this in mind, partial differentiating $x_b + x_{-b} = mf$ with respect to R and using $\frac{\partial f}{\partial R}\frac{R}{f} = -\frac{\theta}{\theta+h}$ yield

[7] For the sake of simplicity, it is assumed that the number of manufacturing firms and the number of banks are real numbers, rather than restricted to be integer numbers.

$$\frac{\partial x_b}{\partial R}\frac{R}{x_b}=\frac{R}{x_b}m\frac{\partial f}{\partial R}$$

$$=\frac{R}{x_b}m\left(\frac{\partial f}{\partial R}\frac{R}{f}\right)\frac{f}{R}=-\frac{\theta m_b}{\theta+h}.$$

Combining this result with the condition for a bank's optimal choice of output $R+x_b\partial R/\partial x_b-r=0$, the relationship between a bank's marginal cost and the interest rate it charges is given by

(7) $$R\left(1-\frac{\theta+h}{\theta m_b}\right)=r.$$

In equilibrium, the amount of capital in the financial sector $\int_0^1 m_b x_b d\varpi$ should be equal to the supply of capital K from individuals:

(8) $$\int_0^1 m_b x_b d\varpi=K.$$

The demand for labor is the sum of the demand from the financial sector $\int_0^1 m_b f_b d\varpi$ and the demand from the manufacturing sector $\int_0^1 m\beta x d\varpi$. The total supply of labor is L. Labor market clearance requires that demand equals supply:

(9) $$\int_0^1 (m_b f_b+m\beta x)d\varpi=L.$$

Total value of final output is the value of output from the manufacturing sector $\int_0^1 m p x d\varpi$. Total income is the sum of labor income wL and capital income rK. For the economy as a whole, total value of final output should be equal to total income:

(10) $$\int_0^1 m p x d\varpi=wL+rK.$$

We focus on a symmetric equilibrium in which the levels of output, prices, and consumption for all manufactured goods are the same. In a symmetric equilibrium, equations (2)-(10) form a system of nine equations defining nine variables w, r, m, m_b, p, n, R, x, and x_b. An equilibrium in a closed economy is a tuple (w, r, m, m_b, p, n, R, x, x_b) satisfying equations (2)-(10). For the remaining of the paper, the price of a manufactured good is normalized to one: $p \equiv 1$.

To proceed, we simplify the system of nine equations to a manageable number of equations. From equations (6) and (8), the number of manufacturing firms producing the same good is

(11) $$m = \frac{K}{f}.$$

From equations (7) and (8), the number of banks can be expressed as

(12) $$m_b = \frac{K(R-r)}{f_b w}.$$

Plugging the value of m_b from equation (12) into equation (7), it can be shown that

$$R^2 - \left(2r + \frac{(\theta+h) f_b w}{\theta K}\right) R + r^2 = 0.$$

There are two roots for this equation. One of the roots leads to $R < r$ and is discarded because it means that the interest rate charged by banks is lower than the interest rate paid to depositors. The other root is kept and is shown as

(13) $$R = r + \frac{(\theta+h) f_b w}{2\theta K} + \sqrt{\frac{(\theta+h) f_b r w}{\theta K} + \frac{(\theta+h)^2 f_b^{\,2} w^2}{4\theta^2 K^2}}$$

With some manipulation, we get the following system of three equations defining three variables n, w, and r as functions of exogenous parameters:[8]

(14a) $V_1 \equiv K(1-\beta w) - f = 0$,

(14b) $V_2 \equiv f'(1-\beta w) + \beta' f w = 0$,

(14c) $$V_3 \equiv K^2 \left[\sqrt{\frac{(\theta+h)^2 f_b^{\,2} w^2}{4\theta^2 K^2} + \frac{(\theta+h) f_b r w}{\theta K}} + \frac{(\theta+h) f_b w}{2\theta K} + r \right] - f(wL + rK) = 0.$$

Differentiation of the above system of equations with respect to w, n, r, L, and K leads to[9]

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[8] Equations (14a)-(14c) are derived as follows. Plugging the value of m from equation (11) into equation (2) yields equation (14a). Plugging the value of x from equation (4) into equation (3) yields equation (14b). Plugging the value of R from equation (13) into equation (4) yields the value of x. Plugging this value of x and the value of m from equation (11) into equation (9) yields equation (14c).

[9] By using equations (14a) and (14b), it can be shown that the derivative of V_1 with respect to n is zero.

$$\begin{pmatrix} \frac{\partial V_1}{\partial w} & 0 & 0 \\ \frac{\partial V_2}{\partial w} & \frac{\partial V_2}{\partial n} & 0 \\ \frac{\partial V_3}{\partial w} & \frac{\partial V_3}{\partial n} & \frac{\partial V_3}{\partial r} \end{pmatrix} \begin{pmatrix} dw \\ dn \\ dr \end{pmatrix} = -\begin{pmatrix} 0 \\ 0 \\ \partial V_3 / \partial L \end{pmatrix} dL - \begin{pmatrix} \partial V_1 / \partial K \\ 0 \\ \partial V_3 / \partial K \end{pmatrix} dK .$$

Let Δ denote the determinant of the above coefficient matrix. Since $\partial V_1 / \partial w < 0$, $\partial V_2 / \partial n > 0$, $\partial V_3 / \partial r > 0$, it is clear that

$$\Delta = \frac{\partial V_1}{\partial w}\frac{\partial V_2}{\partial n}\frac{\partial V_3}{\partial r} < 0 .$$

To facilitate interpretation of results under financial liberation and product market liberalization, the following proposition studies the impact of labor endowment on the return to capital in a closed economy.

Proposition 1: The level of technology and the wage rate are not affected by the labor endowment. The interest rate paid to depositors increases with the labor endowment.

Proof: An application of Cramer's rule to the system V_1, V_2, and V_3 leads to $dn / dL = 0$, $dw / dL = 0$, and

$$\frac{dr}{dL} = -\frac{\partial V_1}{\partial w}\frac{\partial V_2}{\partial n}\frac{\partial V_3}{\partial L} / \Delta > 0 . \qquad \square$$

Interestingly, the level of technology and the wage rate are not affected by changes in the labor endowment. With the price of final goods normalized to one, the wage rate is the ratio of the wage rate and the price of final goods. Consider a situation in which a worker can produce a fixed amount of a final good and there is no fixed cost of production. It is clear that in this situation the wage rate is constant and is independent of the amount of labor. In this model, the situation is a little more complicated because a manufacturing firm is able to choose the level of technology (the amount of final good a worker is able to produce) and there is a fixed cost in the manufacturing sector (the price is a markup over marginal cost), thus the ratio of the wage rate depends on the level of technology and the markup factor as shown in equation (2). If the markup factor and the level of technology are not affected by the labor endowment, then the wage rate will not be affected by the labor endowment. The markup factor is determined by the number of firms or the degree of competition in the manufacturing sector. Form equation (11), the number of firms in the manufacturing sector depends on the amount of capital, not the labor endowment. Thus, the labor endowment does not show up in equation (14a). Equation (14b) is the condition for a firm's optimal choice of technology. From equation (14b), a firm's choice of technology is affected by the wage rate alone. Thus equations (14a) and (14b) form a system of two equations determining the level of technology and the wage rate independent of the level of labor endowment. As a result, the level of technology and thus the wage rate are not affected by the level of labor endowment.

To understand the rest of Proposition 1, with an increase of the labor endowment, other things equal, the demand for manufactured goods increases. As the revenue in the manufacturing sector is larger, the payment to capital used in the manufacturing sector increases, since manufacturing firms earn zero profit in equilibrium. From equation (13), when the wage rate does not change, the interest rate received by depositors increases with the interest rate charged by a bank. Thus, the return to interest earners increases when the level of labor endowment increases.

The following proposition studies the impact of capital endowment on the level of technology and the wage rate in a closed economy.

Proposition 2: An increase of capital endowment increases the level of technology and the wage rate.

Proof: An application of Cramer's rule to the system V_1, V_2, and V_3 leads to

$$\frac{dn}{dK} = \frac{\partial V_1}{\partial K}\frac{\partial V_2}{\partial w}\frac{\partial V_3}{\partial r} / \Delta > 0 ,$$

$$\frac{dw}{dK} = -\frac{\partial V_1}{\partial K}\frac{\partial V_2}{\partial n}\frac{\partial V_3}{\partial r} / \Delta > 0 . \qquad \square$$

Proposition 2 shows that an increase in the capital endowment is beneficial to wage earners. When the amount of capital increases, other things equal, the number of firms producing the same manufactured good increases. Because the degree of competition in the manufacturing sector increases, a manufacturing firm's price as a markup over its marginal cost decreases. As the profit margin per unit of output decreases, a manufacturing firm must produce more to break even. This leads manufacturing firms to adopt more advanced technologies, because the higher fixed cost can be distributed to a higher level of output. A more advanced technology leads to a lower average cost. As the average cost is lower, this is reflected in the higher wage rate because the price of a manufactured good is normalized to one.

Like the proof of Proposition 2, it can be shown that an increase of the fixed cost in the financial sector decreases the interest rate paid to depositors. The reason is that f_b is composed of labor. In this model, because the supply of capital is inelastic, the interest rate paid to depositors is determined by the relative demand for capital. When the relative demand for capital decreases, the interest rate paid to depositors decreases. Other things equal, an increase of f_b increases the relative demand for labor compared with capital. Thus the relative return to labor compared with capital increases or the interest rate paid to depositors decreases. When the interest rate paid to depositors decreases, the interest rate charged by banks also decreases. From equation (13), it is clear that when f_b increases while the wage rate does not change, $R-r$ increases. This ensures that a bank can break even when f_b increases.[10]

In the following, we study financial integration and product market integration between the two countries. The analysis can be easily extended to the case with multiple identical countries. To facilitate comparison of results, we first study financial integration, then study product market integration, finally study joint integration.

3. FINANCIAL INTEGRATION

In this section, we study the impact of financial integration without product market integration between the two countries. Foreign consumers are assumed to have the same preferences as domestic consumers. Foreign variables are denoted with an asterisk. Variables associated with the financial integration scenario are generally indicated by a subscript f. However, sometimes this subscript is suppressed, and the meaning of a variable is not explained if there is no confusion from doing this.

With financial integration, the separate financial markets of the two countries are unified. We assume there is no additional cost if a bank attracts deposit from the other country or

[10] Also, it can be shown that an increase of the fixed cost in the financial sector does not change the level of technology and the wage rate in the manufacturing sector. The intuition is like that in the illustration of Proposition 1.

provides loans to manufacturing firms in the other country. Since markets for capital in the two countries are integrated, the number of banks providing capital is the sum of banks in the two countries $m_b + m_b *$.[11] Thus with financial liberalization, equation (7) is replaced with[12]

$$R\left(1-\frac{\theta x_b}{(\theta+h)(m_b x_b + m_b * x_b *)}\right) = r, \tag{15}$$

$$R\left(1-\frac{\theta x_b *}{(\theta+h)(m_b x_b + m_b * x_b *)}\right) = r. \tag{15*}$$

As markets for capital in the two countries are integrated, equation (6) is replaced with

$$\int_0^1 (m f + m * f *) d\varpi = \int_0^1 (m_b x_b + m_b * x_b *) d\varpi . \tag{16}$$

With financial integration, equation (8) is replaced with

$$\int_0^1 (m_b x_b + m_b * x_b *) d\varpi = K + K *. \tag{17}$$

With financial integration, equations (2)-(5) and (9)-(10) are still valid. The following equations corresponding to foreign country are also valid:

$$p *\left(1-\frac{1}{m *}\right) = \beta * w *. \tag{2*}$$

$$f *' R + \beta *' x * w* = 0. \tag{3*}$$

$$\pi * = p* x * - f* R - \beta * x * w* = 0. \tag{4*}$$

$$\pi_b * = R x_b * - f_b w * - r x_b * = 0. \tag{5*}$$

$$\int_0^1 (m_b * f_b + m * \beta * x*) d\varpi = L *. \tag{9*}$$

$$\int_0^1 m* p * x * d\varpi = w * L * + r K *. \tag{10*}$$

Equations (2)-(5), (2*)-(5*), (9)-(10), (9)-(10*), and (15), (15*), (16), and (17) form a system of sixteen equations defining sixteen variables w, $w*$ r, m, $m*$, m_b, m_b*, p, $p*$, n, $n*$, R, x, $x*$, x_b and x_b* for the equilibrium with financial integration. We focus on a

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[11] The number of banks under financial integration is not necessarily the same as the sum of the number of banks for countries in autarky. That is, financial integration can cause a change of the number of banks in a country. To avoid clutter of notations, here we use $m_b + m_b *$ instead of the more precise one $m_{bf} + m_{bf} *$. This explanation also applies to the notations for product market integration and for joint integration.

[12] If the levels of output for banks are the same in the two countries, equations (15) and (15*) degenerate to equations similar to (7).

symmetric equilibrium in which the numbers of banks, the sizes of banks, the wage rates, the price levels of manufactured goods, and the levels of technology in the manufacturing sector are the same in the two countries. In a symmetric equilibrium, from the above set of equations, we can derive the following system of three equations defining three variables w, n, and r under financial integration:

(18a) $$V_{1f} \equiv K(1-\beta w) - f = 0,$$

(18b) $$V_{2f} \equiv f'(1-\beta w) + \beta' f w = 0,$$

(18c) $$V_{3f} \equiv K^2\left[\sqrt{\frac{(\theta+h)^2 f_b{}^2 w^2}{4\theta^2(2K)^2} + \frac{(\theta+h) f_b r w}{\theta K}} + \frac{(\theta+h) f_b w}{2\theta(2K)} + r\right] - f(wL+rK) = 0.$$

If we replace the coefficient 2 in the bracketed term $2K$ in V_{3f} with τ, a comparison of the system (14a)-(14c) with the system (18a)-(18c) reveals that starting from autarky, the impact of financial integration is similar to an increase of τ:

$$V_{3f} \equiv K^2\left[\sqrt{\frac{(\theta+h)^2 f_b{}^2 w^2}{4\theta^2(\tau K)^2} + \frac{(\theta+h) f_b r w}{\theta K}} + \frac{(\theta+h) f_b w}{2\theta(\tau K)} + r\right] - f(wL+rK) = 0.$$

An increase of τ captures an increase of the degree of competition in the financial market and τ can be viewed as the number of countries engaging in financial integration if the number of countries is not restricted to be an integer number. The impact of an increase of τ is different from that of an increase of capital for a closed economy. The can be seen that the amount of capital in equation (18a) and parts of equation (18c) do not change when τ changes.

Differentiation of the system of equations (18a)-(18c) with respect to w, n, R, and τ leads to

$$\begin{pmatrix} \frac{\partial V_{1f}}{\partial w} & 0 & 0 \\ \frac{\partial V_{2f}}{\partial w} & \frac{\partial V_{2f}}{\partial n} & 0 \\ \frac{\partial V_{3f}}{\partial w} & \frac{\partial V_{3f}}{\partial n} & \frac{\partial V_{3f}}{\partial r} \end{pmatrix} \begin{pmatrix} dw \\ dn \\ dr \end{pmatrix} = -\begin{pmatrix} 0 \\ 0 \\ \partial V_{3f} / \partial \tau \end{pmatrix} d\tau .$$

The following proposition studies the impact of financial integration on the financial sector.

Proposition 3: With financial integration, the interest rate paid to depositors increases.

Proof: An application of Cramer's rule to the system of equations V_{1f}, V_{2f}, and V_{3f} leads to

$$\frac{dr}{d\tau} = -\frac{\partial V_{1f}}{\partial w}\frac{\partial V_{2f}}{\partial n}\frac{\partial V_{3f}}{\partial \tau} / \Delta_f > 0. \qquad \square$$

With financial integration, the degree of competition in the financial sector increases. Since the supply of deposits is totally inelastic, this increased degree of competition in the financial sector leads to a higher interest rate paid to depositors. This increase in the interest rate paid to depositors leads to an increase of the interest rate charged by banks for manufacturing firms. Since an increase of the degree of competition in the financial sector decreases the difference between the interest rate charged by a bank and the interest rate paid to depositors, to break even, the size of a bank increases.

That financial integration can increase the degree of competition in the financial sector is reflected in Lin et al. [2003, Ch. 7]. Lin et al. argue that state banks in China paid low interest rates to depositors. With the liberalization of the financial sector as China becomes more integrated with the world economy, competition from foreign banks is expected to increase the interest rate paid to depositors.

The following proposition studies the impact of financial integration on the manufacturing sector.

Proposition 4: With financial integration, the level of technology and the wage rate do not change. The degree of competition in the product market does not change.

Proof: An application of Cramer's rule to the system of equations V_{1f}, V_{2f}, and V_{3f} leads to $dn / d\tau = 0$, and $dw / d\tau = 0$.

From equation (11), the number of manufacturing firms producing the same good m is equal to K / f. Since $dn / d\tau = 0$, the level of fixed cost f does not change with financial integration. As a result, m does not change with financial integration. □

Proposition 4 shows that an increase of the degree of competition in the financial sector does not necessarily increase the degree of competition in the product market. Similar to the intuition behind Proposition 1, the wage rate and the level of technology under financial integration are determined by equations (18a) and (18b). As equations (18a) and (18b) are the same as equations (14a) and (14b), the wage rate and the level of technology do not change under financial integration.

For a manufacturing firm, one question is how to accommodate an increase of the interest rate charged by banks if the wage rate and the level of technology do not change. From equation (4), $x = fR/(p - \beta w)$: a manufacturing firm's equilibrium level of output x increases with the interest rate charged by a bank R. As financial integration increases the interest rate charged by a bank, it also increases the level of output of a manufacturing firm. Plugging the value of x into the condition for a manufacturing firm's optimal choice of technology $f'R + \beta' x w = 0$ leads to $f'R + \beta' wfR/(p - \beta w) = 0$. Since R appears on both terms in the left-hand side of the equation, R will cancel out. As the impact of financial integration is absorbed by a change of the level of output of a manufacturing firm, it is possible that the wage rate and a manufacturing firm's level of technology do not change.

With financial integration, the wage rate does not change, the interest rate paid to depositors increases, and total disposable income increases. Since the price of a final good is normalized to one, an increase of disposable income means that the levels of consumption of final goods increase. Thus, financial integration increases the welfare of a country.

4. PRODUCT MARKET INTEGRATION

In this section, we study the impact of product market integration without financial integration. Variables associated with the equilibrium with product market integration usually carries a subscript t, to indicate trade of manufactured goods.

It is assumed that there is no transportation cost between different countries. With product market integration, markets for manufactured goods in the two countries become integrated. Since markets for manufactured goods in the two countries are integrated, the number of firms producing the same manufactured good in the integrated world market is the sum of domestic and foreign manufacturing firms $m + m^*$. Thus, with product market integration, equation (2) is replaced with[13]

[13] If the levels of output for manufacturing firms in the two countries are the same, equations (19) and (19*) degenerate to equations similar to equation (2).

(19) $$p\left(1-\frac{x}{mx+m^*x^*}\right)=\beta w,$$

(19*) $$p\left(1-\frac{x}{mx+m^*x^*}\right)=\beta w.$$

With product market integration, equation (10) is replaced with

(20) $$\int_0^1 (m\,p\,x+m^*\,p\,x^*)d\varpi = wL+rK+w^*L^*+r^*K^*.$$

With product market integration, equations (3)-(9) are still valid. In addition to equations (3*)-(5*), the following equations corresponding to the foreign country are valid:

(6*) $$\int_0^1 m_b{}^*x_b{}^*d\varpi=\int_0^1 m^* f d\varpi,$$

(7*) $$R^*\left(1-\frac{\theta+h}{\theta m_b{}^*}\right)=r^*,$$

(8*) $$\int_0^1 m_b{}^*x_b{}^*d\varpi=K^*,$$

(9*) $$\int_0^1 (m_b{}^*f_b+m^*\beta^*x^*)d\varpi=L^*.$$

Equations (3)-(9), (3*)-(9*), (19), and (20) form a system of sixteen equations defining sixteen variables w, w^*, r, r^*, m, m^*, m_b, $m_b{}^*$, p, n, n^*, R, x, x^*, x_b, and $x_b{}^*$ for the equilibrium with product market integration. We focus on a symmetric equilibrium in which the levels of output and prices for final goods in the two countries are the same.[14] From this system of equations, we can derive the following system of three equations defining three variables w, n, and r under product market integration:

(21a) $V_{1t}\equiv 2K(1-\beta w)-f=0,$

(21b) $V_{2t}\equiv f'(1-\beta w)+\beta' f w=0,$

(21c) $$V_{3t}\equiv K^2\left[\sqrt{\frac{(\theta+h)^2 f_b{}^2 w^2}{4\theta^2K^2}+\frac{(\theta+h)f_b rw}{\theta K}}+\frac{(\theta+h)f_b w}{2\theta K}+r\right]-f(wL+rK)=0.$$

[14] In this case, the trade between the two countries can be zero. The impact of product market integration comes solely from an increase of product market competition.

If we replace the coefficient 2 before K in V_{1t} with ρ, a comparison of the system (14a)-(14c) with the system (21a)-(21c) reveals that starting from autarky, the impact of trade integration is similar to an increase of ρ:

$V_{1t} \equiv \rho K(1-\beta w) - f = 0$.

An increase of ρ captures an increase of the degree of competition in the product market and ρ can be viewed as the number of countries engaging in product market integration. Differentiation of the system of equations (21a)-(21c) with respect to w, n, r, and ρ leads to

$$\begin{pmatrix} \frac{\partial V_{1t}}{\partial w} & 0 & 0 \\ \frac{\partial V_{2t}}{\partial w} & \frac{\partial V_{2t}}{\partial n} & 0 \\ \frac{\partial V_{3t}}{\partial w} & \frac{\partial V_{3t}}{\partial n} & \frac{\partial V_{3t}}{\partial r} \end{pmatrix} \begin{pmatrix} dw \\ dn \\ dr \end{pmatrix} = - \begin{pmatrix} \partial V_{1t} / \partial \rho \\ 0 \\ 0 \end{pmatrix} d\rho .$$

The following proposition studies the impact of product market integration.

Proposition 5: With product market integration, the level of technology, the wage rate, and the interest rate paid to depositors increase.

Proof: An application of Cramer's rule to the system V_{1t}, V_{2t}, and V_{3t} leads to

$$\frac{dn}{d\rho} = \frac{\partial V_{1t}}{\partial \rho} \frac{\partial V_{2t}}{\partial w} \frac{\partial V_{3t}}{\partial r} / \Delta_t > 0,$$

$$\frac{dw}{d\rho} = -\frac{\partial V_{1t}}{\partial \rho} \frac{\partial V_{2t}}{\partial n} \frac{\partial V_{3t}}{\partial r} / \Delta_t > 0,$$

$$\frac{dr}{d\rho} = \frac{\partial V_{1t}}{\partial \rho} \left(\frac{\partial V_{2t}}{\partial n} \frac{\partial V_{3t}}{\partial w} - \frac{\partial V_{2t}}{\partial w} \frac{\partial V_{3t}}{\partial n} \right) / \Delta_t > 0. \qquad \square$$

With product market integration, the degree of competition in the manufactured product market increases. For a manufacturing firm, since its price as a markup over marginal cost decreases, to break even, its level of output increases. This makes the adoption of more advanced technologies profitable and leads to a lower average cost of production in the manufacturing sector. As a manufacturing firm makes a profit of zero, this lower average cost is reflected in the higher wage rate. Thus, product market integration is beneficial to wage earners. Since firms choose more advanced technologies, the demand for capital increases. As a result, the interest rate charged by a bank increases. This leads to an increase of the interest rate paid to depositors.

Proposition 5 is consistent with empirical evidence that product market integration leads firms to adopt more advanced technologies. For example, studying historical data for the United States, Engerman and Sokoloff [1997] show that manufacturing firms adopted more advanced and specialized technologies with trade integration resulting from declining transportation costs.

With product market integration, the wage rate increases, and the interest rate paid to depositors increases. As disposable income increases and the price of a manufactured good is normalized to one, product market integration increases the welfare of a country.

5. FINANCIAL INTEGRATION AND PRODUCT MARKET INTEGRATION

In this section, we study the impact of joint integration: a combination of financial integration and product market integration. Variables associated with the equilibrium with a combination of financial and product market integration usually carries a subscript ft.

With joint integration, both markets for capital and markets for manufactured goods in the two countries are integrated. With joint integration, equations (3)-(5), (3*)-(5)*, (9), and (9*) are valid. Also, equations (15), (15*), (16), (17), (19), (19*), and (20) are valid. Those equations form a system of fifteen equations defining fifteen variables w, $w*$, r, m, $m*$, m_b, m_b*, p, n, $n*$, R, x, $x*$, x_b, and x_b* for the equilibrium with joint integration. We focus on a symmetric equilibrium in which there are the same number of manufacturing firms and the same number of banks in the two countries. From this system of equations, we get the following system of three equations defining three variables w, n, and r:

(22a) $$V_{1ft} \equiv 2K(1-\beta w) - f = 0,$$

(22b) $$V_{2ft} \equiv f'(1-\beta w) + \beta' f w = 0,$$

(22c) $$V_{3ft} \equiv K^2\left[\sqrt{\frac{(\theta+h)^2 f_b{}^2 w^2}{4\theta^2(2K)^2} + \frac{(\theta+h) f_b r w}{\theta K}} + \frac{(\theta+h) f_b w}{2\theta(2K)} + r\right] - f(wL+rK) = 0.$$

If we replace the coefficients 2 before K in V_{1ft} and before w in V_{3ft} with δ, a comparison of the system (14a)-(14c) with the system (22a)-(22c) reveals that starting from autarky, the impact of joint integration is similar to that of an increase of δ:

$$V_{1ft} \equiv \delta K(1-\beta w) - f = 0,$$

$$V_{3ft} \equiv K^2\left[\sqrt{\frac{(\theta+h)^2 f_b{}^2 w^2}{4\theta^2(\delta K)^2} + \frac{(\theta+h) f_b rw}{\theta K}} + \frac{(\theta+h) f_b w}{2\theta(\delta K)} + r\right] - f(wL+rK) = 0.$$

An increase of δ means an increase of the degree of competition in both the financial market and the product market and δ can be interpreted as the number of countries engaging in joint integration. Differentiation of the above system of equations with respect to w, n, r, and δ leads to

$$\begin{pmatrix} \frac{\partial V_{1ft}}{\partial w} & 0 & 0 \\ \frac{\partial V_{2ft}}{\partial w} & \frac{\partial V_{2ft}}{\partial n} & 0 \\ \frac{\partial V_{3ft}}{\partial w} & \frac{\partial V_{3ft}}{\partial n} & \frac{\partial V_{3ft}}{\partial r} \end{pmatrix} \begin{pmatrix} dw \\ dn \\ dr \end{pmatrix} = -\begin{pmatrix} \partial V_{1ft}/\partial\delta \\ 0 \\ \partial V_{3ft}/\partial\delta \end{pmatrix} d\delta.$$

The following proposition studies the impact of joint integration.

Proposition 6: Starting from autarky, joint integration increases the level of technology, the wage rate, and the interest rate paid to depositors.

Proof: An application of Cramer's rule to the system V_{1ft}, V_{2ft}, and V_{3ft} leads to

$$\frac{dn}{d\delta} = \frac{\partial V_{1ft}}{\partial\delta}\frac{\partial V_{2ft}}{\partial w}\frac{\partial V_{3ft}}{\partial r} / \Delta_{ft} > 0,$$

$$\frac{dw}{d\delta} = -\frac{\partial V_{1ft}}{\partial\delta}\frac{\partial V_{2ft}}{\partial n}\frac{\partial V_{3ft}}{\partial r} / \Delta_{ft} > 0,$$

$$\frac{dr}{d\delta} = \left(\frac{\partial V_{1ft}}{\partial\delta}\frac{\partial V_{2ft}}{\partial n}\frac{\partial V_{3ft}}{\partial w} - \frac{\partial V_{1ft}}{\partial\delta}\frac{\partial V_{2ft}}{\partial w}\frac{\partial V_{3ft}}{\partial n} - \frac{\partial V_{1ft}}{\partial w}\frac{\partial V_{2ft}}{\partial n}\frac{\partial V_{3ft}}{\partial\delta}\right) / \Delta_{ft} > 0. \qquad \square$$

For two countries already established financial integration, if now they also have product market integration, it can be shown that the level of technology, the wage rate, and the interest rate paid to depositors all increase. For two countries already established product market integration, if now they also have financial integration, it can be shown that this increases the interest rate paid to depositors, while the level of technology and the wage rate will not change. Compared with product market integration alone, joint integration leads to a higher level of increase of the interest rate paid to depositors. Thus, the impact of an increase of the interest rate paid to depositors under product market integration will not be reversed under joint integration.

Starting from autarky, joint integration is beneficial to wage earners because the wage rate increases. As interest rate paid to depositors also increases with joint integration, the welfare for interest earners is also higher. Thus, joint integration increases the welfare of a country.

6. CONCLUSION

Financial markets and product markets are interrelated. In this paper, we have studied the impact of financial integration and product market integration in a unified general equilibrium model. First, for a closed economy, we show that an increase of capital leads to a more advanced technology and a higher wage rate. An increase of the level of labor endowment increases the interest rate paid to depositors. Second, as a financial integration increases the degree of competition in the financial market, the interest rate paid to depositors increases, while the degree of competition in the product market may not change. Third, as a product market integration increases the degree of competition in the product market, the level of technology, the wage rate, and the interest rate paid to depositors all increase. Even with linkages between the manufacturing sector and the financial sector, the impact of financial integration is significantly different from that of product market integration. Finally, joint integration increases the level of technology, the wage rate, and the interest rate paid to depositors. For countries that have already established product market integration, adding financial integration would increase the interest rate paid to depositors. Thus, the impact of an increase of the interest rate paid to depositors under product market integration will not be reversed under joint integration. For countries that have already established financial integration, adding product market integration would increase the level of technology, the wage rate, and the interest rate paid to depositors. Social welfare increases under all integration regimes.

To gain insights, we have made some special assumptions. There are some interesting generalizations and extensions of the model. First, in this model, firms have the same level of production technology. In reality, firms may differ in their production technologies. If firm heterogeneity in technologies is incorporated, financial or trade liberalization may lead to the exit of less efficient firms. Second, in this model, countries have identical factor endowments. If tractable, a model with different factor endowments of countries should be useful to address welfare implications for factor owners under trade and financial integration. Third, institutions such as the protection of property rights are not studied in this model. The model may be extended to incorporate different levels of protection of property rights in different countries. A country with poor protection of property rights may not necessarily gain from financial integration because financial integration may lead to the outflow of capital even though capital is relatively scarce in this country. Finally, in this model the monetary sector is not addressed. Incorporating money should be an interesting avenue for future research because policy issues related to money can be addressed. With this kind of extension, the interaction between trade policy and monetary policy can also be addressed.

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