<ARTICLE>Capital Market Imperfections, Credit Markets, and Foreign Direct Investment

Capital Market Imperfections, Credit Markets, and Foreign Direct Investment

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Abstract

We consider a two-country growth model to analyze effects of foreign direct investment (FDI) on economic growth and welfare in China. China has conducted an opening and restricted policy: FDI is accepted from other countries but capital outflows are restricted. In this paper, we denote China as a developing country and assume that another developed country exists. We also assume that any potential investor in each of both countries has no sufficient internal funds to operate his investment project; he must require external financing in their own credit market subject to a costly state verification (CSV) problem that leads credit rationing. In this environment, we find that the two countries will simultaneously converge to an identical, unique, nontrivial steady state with an identical initial capital stock. Compared to this, Boyd and Smith (1997) argued that, when the two countries open their credit markets, the two countries would respectively converge to asymmetric steady state with capital flight in less-developing country. Therefore, the opening and restricted policy in China not only makes China fester to approach the steady state, but also makes China avoid capital flight. Furthermore, compared to closed economies, the opening and restricted policy in China don't change the welfare of either of the two countries in the steady state, though Cardoso and Dornbusch (1989) and Reis (2001) argued that FDI might reduce the welfares of developing countries.

Key words: CSV; Credit Rationing; FDI; Economic Growth; Welfare
JEL classification: F21; F43; G14

1. Introduction

Many recent literatures have emphasized the role of foreign direct investment (FDI) on economic growth from the viewpoint of the transfer of technology. Romer (1993) pointed that developing countries should open their economies to foreign investment since the transfer of technology from

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developed countries into developing countries is an important channel through which developing countries have higher economic growth rates. This argument is also supported by several empirical studies. Blomström et al. (1994), Balasubramanyam et al. (1996) and Borensztein et al. (1998) showed that inward direct investment has raised the growth rate of many developing countries. Cardoso and Dornbusch (1989) and Reis (2001), however, indicated that FDI might decrease national welfare due to the transfer of capital returns to foreigners.

Many developing countries, however, are constrained not only by the technology gap, but also by capital flight. Boyd and Smith (1997) used a two-country growth model with international capital markets to analyze why less-developed economies seek to close off their financial markets. They argued that, if two countries open their credit markets to each other, capital flight would occur in a less-developed country due to the existence of multiple steady state and equilibrium cycles. They concluded that opening international credit markets tends to make poor countries poor permanently and that international borrowing and lending are a potential source of endogenous cyclical fluctuations in both real activity and in international asset flows. However, if the two economies close off their credit market, they will convergence to an identical, unique, nontrivial steady state from any given initial capital stock.

China has conducted a restricted opening policy to develop its economy. In an attempt to catch up with developed economies, China opened its economy to FDI in 1979. According to the China Statistical Yearbook (2000), the 1999 foreign investment value was about 22.5 times greater than the 1979-1983 total foreign investment value of 1802 million dollars, attaining 40319 million dollars. However, so far, China has only allowed foreign investors to utilize their own credit to operate their investments in China. Furthermore, China also restricts domestic capital outflows. In an attempt to conveniently study the effects of FDI on economic growth and welfare under the restricted opening policy, we ignore the effect of the technology gap between China and developing countries in this paper, even though the technology gap exists.

In this paper, we modify the Boyd and Smith (1997) model to study how FDI affects economic growth and social welfare under the restricted opening policy conducted in China. We denote China as a developing country and another country as a developed country. For convenience, we assume that both

countries can utilize an identical technology to produce a single good. We also assume that potential investors in both countries can only use their own credit market to operate their investment projects. In an attempt to analyze the effects of FDI on economic growth and social welfare, we assume that there are two types of potential investors in the developed country: the one type can only operate their single investment projects in the developed country; the other type can only operate their single investment projects in the developing country. On the other hand, there is only one type of potential investor in the developing country, who is only allowed to invest in the developing country. Furthermore, all potential investors in both countries do not have sufficient internal funds to operate their investment projects; they must use external financing. In addition, only the project owner can costlessly observe the realization of a single indivisible investment project; any other agents can observe the project realization only by bearing fixed costs. Therefore, the allocation of credit in both countries is complicated by the presence of the standard costly state verification (CSV) problem, which is originally considered by Townsend (1979). Moreover, the CSV problem leads to credit rationing in the manner described by Gale and Helliwig (1985) and Williamson (1986, 1987). In this environment, we find that there is an identical, unique, nontrivial steady state equilibrium to which the two countries will converge with an identical capital stock. This means that the developing country will approach the steady state faster by the restricted opening policy. Furthermore, compared to closed economies, the restricted opening policy does not change the social welfare of either of the two countries in the steady state, though Cardoso and Dornbusch (1989) and Reis (2001) argued that FDI might reduce the welfares of developing countries.

This paper is organized as follows. Section 2 presents a two-countries growth model with capital market imperfection and FDI. Section 3 studies a general equilibrium. Section 4 provides conclusions.

2. The model

The paper modifies the model presented by Boyd and Smith (1997) to study the effects of FDI on economic growth and social welfare under the restricted opening policy conducted in China.

We assume that there are two countries: one is a developed country denoted by f, and the other is a developing country denoted by h. We assume that each country is inhabited by a infinite sequence of overlapping generations that live for two periods. Furthermore, in each period a continuum of young agents with identical size and composition are born into each of two countries with unit mass. We let t denote the period, where t=0,1,2,$\cdots$.

In each period a single final good is produced with an identical technology by inputting capital and labor in both countries. Let Y_t^i, K_t^i, and L_t^i denote the output, capital and labor supply of country i, where $i=f,h$. Then the production function in each country can be given by $Y_t^i=F(K_t^i, L_t^i)$, which is assumed to satisfy constant returns to scale and Inada conditions. Therefore, by defining $k_t^i=K_t^i/L_t^i$, the incentive production function can be denoted as $y_t^i=f(K_t^i/L_t^i,1)=f(k_t^i)$, where $f'>0>f''$ holds for any k_t^i. In addition, we assume that the capital depreciates completely in production in each period.

In each period only young agents in both countries are endowed with one unit of labor. All the young agents in both countries inelastically supply the endowed one unit of labor and retire when they are old. For convenience, we let $L_t^i=1$. Furthermore, we assume that, the initial old agents in both countries are respectively endowed with the initial per capita capital stock k_0^f and k_0^h, where $k_0^f > k_0^h > 0$, and agents other than the initial old agents in each country have no endowment of capital or the final good in each period t. We also assume that all the young generation in both countries are divided into two types: a fraction, α, of the young generation are potential investors, and the remaining fraction, 1-α, of the young generation are lenders, where α is assumed to be the same in both countries. Only potential investors in both countries have access to a stochastic linear technology for converting the period t final good into the period $t+1$ capital. On the other hand, all lenders in both countries have no access to such a technology. Furthermore, potential investors in the developing country can only operate their investment projects in their own country, and they are denoted as potential developing country investors. On the other hand, potential investors in the developed country is divided into two types: one type can only operate their investment projects in their own country, and they are denoted as potential internal developed country investors; the other type can only operate their investment projects in the developing country, and they are denoted as potential developed country foreign direct investors.

The capital investment technology has the following properties. All potential borrowers in both countries have a single, indivisible investment project, which can only be operated at the scale q. The q units of the financial good invested in period t yield zq units of capital in period $t+1$. The random variable, z , is *iid* across borrowers and periods and is realized in period $t+1$. We let $G(z)$ denote the probability distribution of z and $g(z)$ denote the associated differentiable density function with support $[0,\bar{z}]$. We also let $\hat{z}$ denote the expected value of z. Additionally, we assume that all lenders in both countries face with the CSV problem: only the project owner can costlessly observe z , while any other agent can observe z only by bearing fixed costs of $\gamma>0$ units of capital in process.

Finally, we assume all agents in both countries are risk neutral, and care only about their old age consumption. Hence all young period income is invested in capital formation.

Factor markets

We assume that there are competitive rental markets for capital and labor in both countries. All the young agents in both counties are immobile between the two countries and inelastically supply one unit of labor to obtain the marginal wage, which is denoted $w(k_t^i)$. Furthermore, we denote ρ_t^i as the rental rate on capital. Then the standard marginal productivity conditions in each country can be given by

$$\rho_t^i = f'(k_t^i),\ i=f,h, \tag{1}$$

$$w_t^i = f(k_t^i) - k_t^i f'(k_t^i) = w(k_t^i),\ i=f,h, \tag{2}$$

where clearly $w'(k_t^i)>0$ holds. Furthermore, we impose $w''(k_t^i)<0$ so as to guarantee the existence of a unique steady state. This assumption can be satisfied when $f(k_t^i)$ is any CES production function with elasticity of substitution of no less than one.

Credit market

Since all lenders in both countries inelastically supply their real marginal wage, $w(k_t^i)$, in their own credit market, all credit extension is intermediated in the manner described by Williamson (1986, 1987). On the other hand, none of the potential investors in either country have sufficient young period income to operate their investment projects; they must obtain external financing. We assume that, for all relevant values of the capital stock, the following assumption holds for any period t in both countries:

$$q > w(k_t^i), \quad i=f, h. \tag{3}$$

Let b_t^i denote the amount borrowed by the operator of a funded project in period t. Then b_t^i is given by

$$b_t^i = q - w(k_t^i), \quad i=f, h. \tag{4}$$

Assume that all the potential investors in both countries wish to obtain external funding by announcing loan contracts in the manner described by Williamson (1986). A loan contract consists of the following set of objects. First, there is a set of project return realizations, A_t^i, for which verification of the project return occurs in period t. However, if $z \in B_t^i \equiv [0,z] - A_t^i$, verification of project return does not occur. Second, if $z \in A_t^i$, the contractual per unit borrowed payment can meaningfully be made contingent on the project return, which is denoted as $R_t^i(z)$. However, if $z \in B_t^i$, the loan payment cannot meaningfully depend on the project return. The only incentive compatible loan contract will offer a per unit borrowed noncontingent payment in country i for all $z \in B_t^i$, which is denoted as x_t^i.

The loan contracts offered by all potential investors are either accepted or rejected by intermediaries. We assume that any lender in either country can form an intermediary, who takes deposits, makes loans, and conducts monitoring of project return as necessary. In equilibrium, intermediaries will lend their deposits to a large number of investors, earn zero profits, and have nonstochastic return on their portfolios. Therefore, the intermediary needs not to be monitored by his depositors.

Assume that intermediaries take the gross expected market return on loans as given, which is denoted as r_{t+1}^i, and through which they can obtain any

quantity of funds. Therefore, for any developed country intermediary who lends his funds to potential internal developed country investors or any developing country intermediary who lends his funds to potential developing country investors, the following expected return constraint must be satisfied:

$$\int_{A_t^i}\left[R_t^i(z)b_t^i - \rho_{t+1}^i\gamma\right]g(z)dz + b_t^i x_t^i \int_{B_t^i} g(z)dz \geq r_{t+1}^i b_t^i, \quad i = f, h. \tag{5a}$$

For any developed country intermediary who lends his funds to potential developed country foreign direct investors, the following expected return constraint must satisfied:

$$\int_{A_t^{fh}}\left[R_t^{fh}(z)b_t^f - \rho_{t+1}^h\gamma\right]g(z)dz + b_t^f x_t^{fh} \int_{B_t^{fh}} g(z)dz \geq r_{t+1}^f b_t^f, \tag{5b}$$

where, A_t^{fh} is a set of project return realizations for which verification of the project return occurs in period t, $B_t^{fh} \equiv [0,z] - A_t^{fh}$ is a set of project return realizations for which verification of project return doesn't occur, $R_t^{fh}(z)$ is a state contingent payment if $z \in A_t^{fh}$, and x_t^{fh} is a per unit borrowed noncontingent payment for all $z \in B_t^{fh}$.

Eq. (5) declares that the expected repayments must be enough to cover the expected market return on borrowed funds and the real expected monitoring costs. On the other hand, since only the investors directly observe their project return, they must have the proper incentives to correctly reveal when a monitoring state has occurred. Therefore, for any potential internal developed country investor or any potential developing country investor, the incentive compatibility requirement is given by

$$R_t^i(z) \leq x_t^i, \quad z \in A_t^i, \; i=f, h. \tag{6a}$$

For any potential developed country foreign direct investor, the incentive compatibility requirement is given by

$$R_t^{fh}(z) \leq x_t^{fh}, \quad z \in A_t^{fh}. \tag{6b}$$

Additionally, the repayments specified by any contract must be feasible for any potential investor in either country. Therefore, for any potential internal

developed country investor or any potential developing country investor, the nonnegative conditions are given by

$$0 \le R_t^i(z) \le \frac{zq\rho_{t+1}^i}{b_t^i}, \quad z \in A_t^i, \quad i = f,h, \tag{7a}$$

$$0 \le x_t^i \le \inf_{z \in B_t^i} \left[\frac{zq\rho_{t+1}^i}{b_t^i} \right], \quad i = f,h. \tag{8a}$$

For any potential developed country foreign direct investor, the nonnegative conditions are given by

$$0 \le R_t^{fh}(z) \le \frac{zq\rho_{t+1}^h}{b_t^f}, \quad z \in A_t^{fh}, \tag{7b}$$

$$0 \le x_t^i \le \inf_{z \in B_t^{fh}} \left[\frac{zq\rho_{t+1}^h}{b_t^f} \right]. \tag{8b}$$

Eqs. (7) and (8) require that none of potential investors in either country can pay more than the real value of the capital yield from his investment, which is $zq\rho_{t+1}^i$ in state z.

All potential investors in both countries, however, must maximize their expected utility subject to the constraints described above. Any potential internal developed country investor or any potential developing country investor must maximize the following announced loan contract in period :

$$\max \left\{ q\hat{z}\rho_{t+1}^i - b_t^i \int_{A_t^i} R_t^i(z)g(z)dz - b_t^i x_t^i \int_{B_t^i} g(z)dz \right\}, \quad i = f,h, \tag{9a}$$

subject to Eqs. (5a), (6a), (7a) and (8a). Any potential developed country foreign direct investor must maximize the following announced loan contracts in period t

$$\max \left\{ q\hat{z}\rho_{t+1}^h - b_t^f \int_{A_t^{fh}} R_t^{fh}(z)g(z)dz - b_t^f x_t^{fh} \int_{B_t^{fh}} g(z)dz \right\}, \tag{9b}$$

subject to Eqs. (5b), (6b), (7b) and (8b).

By modifying a standard debt contract described by Gale and Hellwig (1985) and Williamson (1986, 1987), the solution to the contractual problem in each

country can be obtained. In particular, any potential internal developed country investor or any potential developing country investor either repays $x_t^i(i=f,h)$ or defaults; any potential developed country foreign direct investor either repays x_t^{fh} or defaults. When any type of investor defaults, all lenders in each country will verify the project return, and retain the proceeds of the project net of monitoring costs. Therefore, the standard solution to potential investors in each country can be given by the following proposition:

Proposition Suppose $q>b_t^i(i=f,h)$. For any potential internal developed country investor or any potential developing country investor, the optimal contractual loan terms satisfy

$$R_t^i(z)=\frac{zq\rho_{t+1}^i}{b_t^i},\quad i=f,h, \tag{10a}$$

$$A_t^i(z)=\left[0,\frac{x_{t+1}^i b_t^i}{q\rho_{t+1}^i}\right),\quad i=f,h, \tag{11a}$$

$$\int_{A_t^i}\left[R_t^i(z)b_t^i-\frac{\rho_{t+1}^i\gamma}{b_t^i}\right]g(z)dz+x_t^i\int_{B_t^i}g(z)dz=r_{t+1}^i,\quad i=f,h. \tag{12a}$$

Any potential developed country foreign direct investor, the optimal contractual loan terms satisfy

$$R_t^{fh}(z)=\frac{zq\rho_{t+1}^h}{b_t^f}, \tag{10b}$$

$$A_t^{fh}(z)=\left[0,\frac{x_{t+1}^{fh}b_t^f}{q\rho_{t+1}^h}\right), \tag{11b}$$

$$\int_{A_t^{fh}}\left[R_t^{fh}(z)b_t^f-\frac{\rho_{t+1}^h\gamma}{b_t^f}\right]g(z)dz+x_t^{fh}\int_{B_t^{fh}}g(z)dz=r_{t+1}^f. \tag{12b}$$

In turn, we must analyze how the expected return a lender receives under the optimal contract is determined. Without distinction of endogenous variables

in both countries, we let $\pi\,[x;b/p]$ denote the expected return a lender receives under the optimal contract. Then $\pi\,[x;b/p]$ can be given by

$$\pi\left[x;\frac{b}{\rho}\right]=x\left[1-G\left(\frac{xb}{q\rho}\right)\right]-\left(\frac{\gamma\rho}{b}\right)G\left(\frac{xb}{q\rho}\right)+\int_0^{xb/q\rho}\left(\frac{q\rho}{b}\right)zg(z)dz$$

$$=x-\frac{\gamma\rho}{b}G\left(\frac{xb}{q\rho}\right)-\frac{q\rho}{b}\int_0^{xb/q\rho}G(z)dz\,. \tag{13}$$

Eq. (13) means that, the expected return for a lender, π , is a function of the contractually specified gross interest rate, x , the degree of external finance, b , and the relative price of capital, ρ . For convenience, we assume that

$$g(z)+\frac{\gamma}{q}g'(z)\geq 0\,, \tag{14}$$

holds, and thus, $\pi_{11}<0$ holds. Therefore, Eq. (14) implies that the function described in Eq. (13), π , has the configuration depicted in Fig. 1.

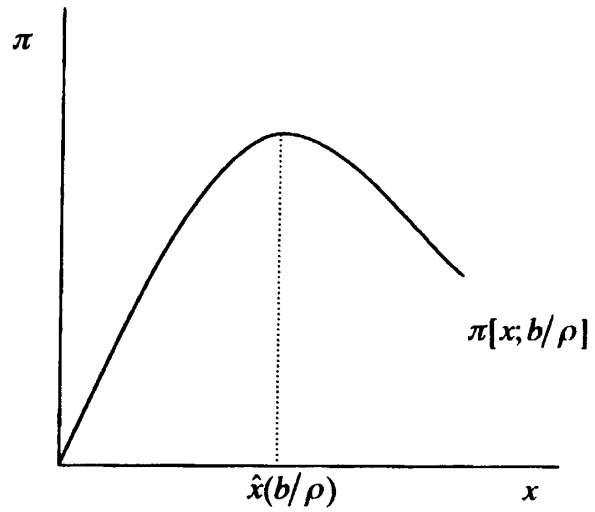

Fig. 1 The expected return function for lender

Evidently, for any lender there is a unique maximum expected return, $\hat{x}(b/p)$, which is implicitly defined by

$$\pi_1\left[\hat{x};\frac{b}{\rho}\right]=1-\frac{\gamma}{q}g\left[\hat{x}\left(\frac{b}{\rho}\right)\frac{b}{q\rho}\right]-G\left[\hat{x}\left(\frac{b}{\rho}\right)\frac{b}{q\rho}\right]=0\,. \tag{15}$$

Solving Eq. (15), we obtain

$$\hat{x}\left(\frac{b}{\rho}\right)\frac{b}{q\rho} \equiv \eta, \tag{16}$$

where η satisfies $1-[\gamma\, g(\eta)/q]-G(\eta)\equiv 0$. Therefore, the project return verification occurs iff $z\in[0,\eta]$. In addition, the assumption that monitoring uses capital implies that η is independent of any endogenous variable in both countries.

Credit Rationing

As originally noted by Gale and Hellwig (1985) and Williamson (1986, 1987), in this environment described above, unfulfilled demand for credit can easily occur in both countries. In particular, if all potential investors in each country desire to operate their projects in period t , the total per capita demand for funds in both countries is αq in period t , and the total per capita supply of funds in each country is $w(k_t^i)$ in period t . If the total per capital demand for funds exceeds the total per capita supply of funds in each country in period t , that is if

$$\alpha q > w(k_t^i), \quad i = f, h, \tag{17}$$

holds, credit must be rationed in both countries. Therefore, for any funded internal developed country investor or any funded developing country investor, the following function must hold in any period t :

$$x_t^i = \hat{x}\left(\frac{b_t^i}{\rho_{t+1}^i}\right) \equiv \hat{x}\left(\frac{q-w_t^i}{\rho_{t+1}^i}\right), \quad i = f, h. \tag{18a}$$

For any funded developed country foreign direct investor, the following function must hold in any period t :

$$x_t^{fh} = \hat{x}\left(\frac{b_t^f}{\rho_{t+1}^h}\right) \equiv \hat{x}\left(\frac{q-w_t^f}{\rho_{t+1}^h}\right). \tag{18b}$$

Eq. (18) means that all funded investors in either country offer the expected payments for maximizing a prospective lender's expected return. If rationed (unfunded) investors will obtain credit by changing loan contract terms, it will reduce the expected return received by any lender in either country. Therefore, all rationed investors in either country cannot obtain any funds.

In turn, we consider the expected payoffs received by any potential lender who is either a lender or a rationed investor and the expected utility received by a funded investor in each country. For any potential lender in the developed country who lends his funds to funded internal developed country investors or any potential lender in the developing country, the expected return under credit rationing can be obtained from Eq. (13):

$$\pi\left[\hat{x}\left(\frac{b_t^i}{\rho_{t+1}^i}\right);\frac{b_t^i}{\rho_{t+1}^i}\right]=\frac{q\rho_{t+1}^i}{b_t^i}\left[\hat{x}\left(\frac{b_t^i}{\rho_{t+1}^i}\right)\frac{b_t^i}{q\rho_{t+1}^i}-\frac{\gamma}{q}G\left(\hat{x}\left(\frac{b_t^i}{\rho_{t+1}^i}\right)\frac{b_t^i}{q\rho_{t+1}^i}\right)\right]$$

$$-\int_0^{\hat{x}(b_t^i/\rho_{t+1}^i)(b_t^i/q\rho_{t+1}^i)}G(z)dz=\frac{q\rho_{t+1}^i}{b_t^i}\left[\eta-\frac{\gamma}{q}G(\eta)-\int_0^{\eta}G(\eta)dz\right]\quad i=f,h. \tag{19a}$$

For any potential lender in the developed country who lends his funds to funded developed country foreign potential direct investors, the expected return under credit rationing can also be obtained from Eq. (13):

$$\pi\left[\hat{x}\left(\frac{b_t^f}{\rho_{t+1}^h}\right);\frac{b_t^f}{\rho_{t+1}^h}\right]=\frac{q\rho_{t+1}^h}{b_t^f}\left[\hat{x}\left(\frac{b_t^f}{\rho_{t+1}^h}\right)\frac{b_t^f}{q\rho_{t+1}^h}-\frac{\gamma}{q}G\left(\hat{x}\left(\frac{b_t^f}{\rho_{t+1}^h}\right)\frac{b_t^f}{q\rho_{t+1}^h}\right)\right]$$

$$-\int_0^{\hat{x}(b_t^f/\rho_{t+1}^h)(b_t^f/q\rho_{t+1}^h)}G(z)dz=\frac{q\rho_{t+1}^h}{b_t^f}\left[\eta-\frac{\gamma}{q}G(\eta)-\int_0^{\eta}G(\eta)dz\right]. \tag{19b}$$

Defining $\theta=\eta-\frac{\gamma}{q}G(\eta)-\int_0^{\eta}G(\eta)dz$, then Eq. (19) can be reduced as follows:

$$\pi\left[\hat{x}\left(\frac{b_t^i}{\rho_{t+1}^i}\right);\frac{b_t^i}{\rho_{t+1}^i}\right]=\frac{\theta q\rho_{t+1}^i}{b_t^i},\quad i=f,h. \tag{20a}$$

$$\pi\left[\hat{x}\left(\frac{b_t^f}{\rho_{t+1}^h}\right);\frac{b_t^f}{\rho_{t+1}^h}\right]=\frac{\theta q\rho_{t+1}^h}{b_t^f}. \tag{20b}$$

Therefore, Eq. (20) means that the expected return received by a potential lender in each country is proportional to the ratio ρ/b. On the other hand, the expected utility for a funded internal developed country investor or a funded developing country investor can be obtained from Eq. (9a) as follows:

$$q\hat{z}\rho_{t+1}^{i} - r_{t+1}^{i}b_t^{i} - \rho_{t+1}^{i}\gamma G\left[\hat{x}\left(\frac{b_t^{i}}{\rho_{t+1}^{i}}\right)\frac{b_t^{i}}{q\rho_{t+1}^{i}}\right] = q\rho_{t+1}^{i}\left[\hat{z} - \frac{\gamma}{q}G(\eta)\right] - r_{t+1}^{i}b_t^{i},\ i = f,h. \quad (21a)$$

The expected utility for a funded developed country foreign direct investor can also be obtained from (9b) as follows:

$$q\hat{z}\rho_{t+1}^{h} - r_{t+1}^{f}b_t^{f} - \rho_{t+1}^{h}\gamma G\left[\hat{x}\left(\frac{b_t^{f}}{\rho_{t+1}^{h}}\right)\frac{b_t^{f}}{q\rho_{t+1}^{h}}\right] = q\rho_{t+1}^{h}\left[\hat{z} - \frac{\gamma}{q}G(\eta)\right] - r_{t+1}^{fh}b. \quad (21b)$$

Defining $\phi = \hat{z} - (\gamma/q)G(\eta)$, then Eq. (21) can be reduced as follows:

$$q\hat{z}\rho_{t+1}^{i} - r_{t+1}^{i}b_t^{i} - \rho_{t+1}^{i}\gamma G\left[\hat{x}\left(\frac{b_t^{i}}{\rho_{t+1}^{i}}\right)\frac{b_t^{i}}{q\rho_{t+1}^{i}}\right] = \phi q\rho_{t+1}^{i} - r_{t+1}^{i}b_t^{i},\ i = f,h, \quad (22a)$$

$$q\hat{z}\rho_{t+1}^{h} - r_{t+1}^{f}b_t^{f} - \rho_{t+1}^{h}\gamma G\left[\hat{x}\left(\frac{b_t^{f}}{\rho_{t+1}^{h}}\right)\frac{b_t^{f}}{q\rho_{t+1}^{h}}\right] = \phi q\rho_{t+1}^{h} - r_{t+1}^{fh}b. \quad (22b)$$

However, if a funded developed country investor deposits his young period income with developed country intermediaries, then he will obtain the expected return $r_t^f w_t^f$ or $r_t^{fh} w_t^f$. If a funded developing country investor deposits his young period income with developing country intermediaries, then he will obtain the expected return $r_t^h w_t^h$. Therefore, any funded internal developed country investor or any funded developing country investor prefers borrowing to lending iff

$$\phi q\rho_{t+1}^{i} \geq r_{t+1}^{i}(w_t^{i} + b_t^{i}),\ i = f,h, \quad (23a)$$

holds. Any funded developed country foreign direct investor prefers borrowing to lending iff

$$\phi q\rho_{t+1}^{h} \geq r_{t+1}^{f}(w_t^{f} + b_t^{f}), \quad (23b)$$

holds. From Eq. (4), Eq. (23) can be written as follows:

$$\phi\rho_{t+1}^{i} \geq r_{t+1}^{i}, \quad i = f, h, \tag{24a}$$

$$\phi\rho_{t+1}^{h} \geq r_{t+1}^{f}. \tag{24b}$$

3. General equilibrium

In this section, we will consider equilibrium conditions of the model described in section 2 and analyze the roles of FDI on economic growth and social welfare under the restricted opening policy conducted in China.

Credit market

Let μ_t^f , μ_t^{fh} denote the fraction of funded internal developed country investors and funded developed country foreign direct investors in period t , and let μ_t^h denote the fraction of funded developing country investors in period t. Furthermore, assume that all the rationed investors in both countries deposit their income with their own country intermediaries. Therefore, equality between sources and uses of funds in each country requires that

$$\alpha\mu_t^f[q - w(k_t^f)] + \alpha\mu_t^{fh}[q - w(k_t^f)] = (1-\alpha)\alpha\mu_t^f w(k_t^f) + \alpha(1 - \mu_t^f - \mu_t^{fh})w(k_t^f), \tag{25a}$$

$$\alpha\mu_t^h[q - w(k_t^h)] = (1-\alpha)\alpha\mu_t^h w(k_t^h) + \alpha(1 - \mu_t^h)w(k_t^f), \tag{25b}$$

respectively. Eq. (25) can be reduced as follows:

$$\alpha q(\mu_t^f + \mu_t^{fh}) = w(k_t^f), \tag{26a}$$

$$\alpha q\mu_t^h = w(k_t^h). \tag{26b}$$

For both all the potential developed country lenders who lend their funds to funded internal developed country investors, and all the potential developed country lenders who lend their funds to funded developed country foreign

direct investors, the expected return in equilibrium must be identical under credit rationing. Then the following equation must hold:

$$\pi\left[\hat{x}\left(\frac{b_t^f}{\rho_{t+1}^f}\right);\frac{b_t^f}{\rho_{t+1}^f}\right]=\pi\left[\hat{x}\left(\frac{b_t^f}{\rho_{t+1}^h}\right);\frac{b_t^f}{\rho_{t+1}^h}\right]. \tag{27}$$

From Eq. (20), Eq. (27) can be written as follows:

$$f'(k_t^f)=f'(k_t^h). \tag{28}$$

Eq. (28) means that the marginal product of capital in both the developed country and the developing country must be identical in equilibrium of the credit market of the developed country under credit rationing.

Capital market

Since it is assumed in section 2 that both return on investment projects is *iid* across investors and periods, and a large number of investors exist, there is no aggregate randomness in this economy. For the developed country, the per capita capital stock is simply $\hat{z}\alpha q\mu_t^f$, which is invested by funded internal developed country investors, less capital expended on monitoring in period in the developed country, $\alpha\mu_t^f\gamma G(\eta)+\alpha\mu_t^{fh}\gamma G(\eta)$, which are the costs expended by all lenders and rationed investors in the developed country for monitoring both funded internal developed country investors and funded developed country foreign direct investors when they default. Therefore, we can obtain the capital stock of the developed country in period t+1 under credit rationing as follows:

$$k_{t+1}^f=\hat{z}\alpha q\mu_t^f-\alpha\mu_t^f\gamma G(\eta)-\alpha\mu_t^{fh}\gamma G(\eta). \tag{29a}$$

On the other hand, for the developing country, the per capita capital stock is simply $\hat{z}\alpha q\mu_t^h+\hat{z}\alpha q\mu_t^{fh}$, which is invested by both funded developing country investors and funded developed country foreign direct investors, less capital expended on monitoring in period t+1 in the developing country, $\alpha q\mu_t^h\gamma G(\eta)$, which are the costs expended by all lenders and rationed investors in the developing country for monitoring funded developing country investors when they default. Therefore, we can obtain the per capita capital stock of the

developing country in period t+1 under credit rationing as follows:

$$k_{t+1}^{h} = \hat{z}\alpha q\mu_t^{h} + \hat{z}\alpha q\mu_t^{fh} - \alpha\mu_t^{h}\gamma G(\eta)\,. \tag{29b}$$

From Eq. (26), Eq. (29) can be reduced as follows:

$$k_{t+1}^{f} = \hat{z}\alpha q\mu_t^{f} - \frac{\gamma G(\eta)}{q} w(k_t^{f}), \tag{30a}$$

$$k_{t+1}^{h} = \phi w(k_t^{f}) + \hat{z}\alpha q\mu_t^{fh}\,. \tag{30b}$$

From Eq. (30), the total capital stock available for use in production in both countries in period t+1 is given by

$$k_{t+1}^{f} + k_{t+1}^{h} = \phi[w(k_t^{f}) + w(k_t^{h})]. \tag{31}$$

Steady state

The equilibrium law of motion of the per capita capital stock in both countries can be described by Eqs. (28) and (31). Since $f(k_t^i)$ is assumed to be a concave function, Eq. (28) means that the following function must hold for any period t:

$$k_t^i = k_t^h = k_t\,. \tag{32}$$

Eq. (32) means that the capital stock in both countries must be identical for any period t. Substituting Eq. (32) into Eq. (31), we get the following equation:

$$k_{t+1} = \phi\, w(k_t), \tag{33}$$

with the initial condition $k_0^h < k_0 = (k_0^f + k_0^h)/2 < k_0^f$. Eq. (33) gives the equilibrium law of motion of the per capita capital stock for both countries. For guaranteeing the existence of a nontrivial steady state, we assume that

$$\phi\, w'(0) > 1, \tag{34}$$

holds.[1] From Eq. (33) and $w''(k_t)<0$, the equilibrium law of motion of the per capita capital stock described by Eq. (33) can be depicted in Fig. 2. Clearly there exists an identical, unique, nontrivial steady state capital stock in the two countries, which is denoted as $\bar{k}$.[2]

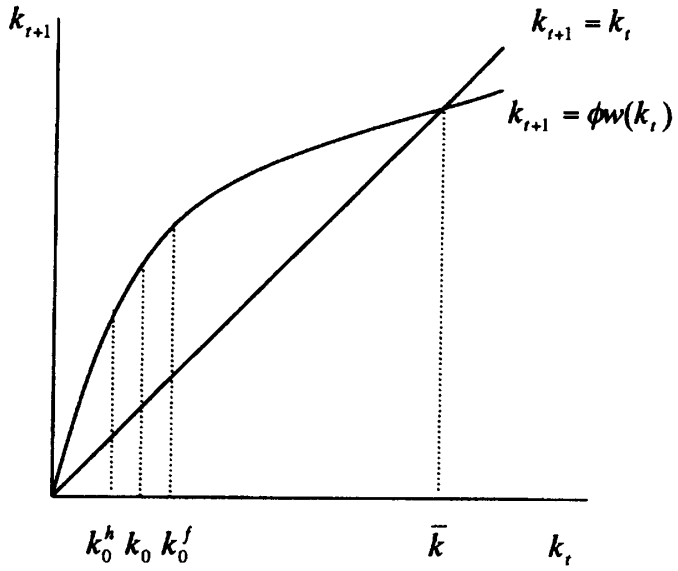

Fig. 2 The convergence of capital stock in each country

According to the discussion presented by Boyd and Smith (1997), if the two countries are closed economies, they will monotonically approach the steady state capital stock, even though they have different initial conditions k_0^f and k_0^h. On the other hand, if the two countries open their credit market to each other, perfect capital mobility across countries will yield asymmetric multiple steady states characterized by perverse capital flows from the less-developed country to the developed country. Compared to these results, when the developing country opens its economy to FDI under the restricted opening policy, the two countries will also converge to the identical steady state from an identical initial condition, k_0 . Furthermore, because of the restricted opening policy, capital flight can be avoided in the developing country since no multiple steady states occur.

In addition, we must check whether Eq. (24) holds in the steady state or not.

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[1] This is satisfied when is any CES production function with elasticity of substitution no less than one.

[2] For guaranteeing the existence of credit rationing at this steady state, $\alpha q>w(\bar{k})$ is also assumed to hold.

From Eq.(28), the following equation must hold:

$$r_{t+1}^{f} = r_{t+1}^{fh} = r_{t+1}^{h} = \frac{\theta q \rho_{t+1}}{b_t}. \tag{35}$$

Then Eq .(20) can be reduced as follows:

$$\phi[q - w(k_t)] \geq \theta q. \tag{36}$$

Eq. (36) was verified by Boyd and Smith (1997). They produced an example to show that Eq. (36) holds in the steady state.

Social welfare in steady state

Let $\bar{w}^f$ and $\bar{w}^h$ denote the social welfare of the developed country and the developing country, respectively. From Eqs. (20), (22) and (35), the social welfare of the developed country is given by

$$\bar{w}^f = (1 - \bar{u}^f - \bar{u}^{fh}) \frac{\theta q \bar{\rho}}{\bar{b}^f} w(\bar{k}) + (\bar{u}^f + \bar{u}^{fh}) q \bar{\rho} (\phi - \theta). \tag{37}$$

The first term on the right hand side of Eq. (37) is the total welfares of all lenders and all rationed investors in the developed country in the steady state; the second term on the right hand side of Eq. (37) is the total utilities of all funded internal developed country investors and all funded developed country foreign direct investors in the steady state.

On the other hand, from Eqs. (20a), (21a) and (35), the social welfare of the developing country is given by

$$\bar{w}^h = (1 - \bar{u}^h) \frac{\theta q \bar{\rho}}{\bar{b}^h} w(\bar{k}) + \bar{u}^h q \bar{\rho} (\phi - \theta). \tag{38}$$

The first term on the right hand side of Eq. (38) is the total welfares of all lenders and all rationed investors in the developing country in the steady state; the second term on the right hand side of Eq. (38) is the total utilities of all funded developing country investors in the steady state.

Even though the restricted opening policy conducted in the developing country, both the developed country and the developing country converge to

their closed steady state described by Boyd and Smith (1997). Therefore, compared to closed economies, the restricted opening policy conducted in the developing country does not change the social welfare of either of the two countries.

4. Conclusions

This paper used a two-country growth model to analyze the effects of FDI on economic growth and social welfare under the restricted opening policy conducted in China by ignoring the technology gap between China and developed country. In China, domestic capital outflows are restricted and FDI is positively accepted from other countries. In this paper, we denote China as a developing country and another country as developed country. We also assume that all potential investors in both countries must obtain external funds in their own credit market to operate their investment projects. The allocation of credit in both countries, however, is affected by the CSV problem. Consequently, credit rationing occurs easily. In order to study the effects of FDI on economic growth and welfare, we assume that there are two types of potential investors in the developed country: potential internal developed country investors and potential developed country foreign direct investors. The higher marginal product of capital in China is attractive to the potential developed country foreign direct investors to operate their investment projects in China. In this environment, the restricted opening policy conducted in China can allow China and the developed country to approach an identical, unique, nontrivial steady state with an initial condition. On the other hand, according to the discussion presented by Boyd and Smith (1997), when China opens its credit market to international credit markets, capital flight may occur since China is a less-developed country. Therefore, the restricted opening policy not only allows China to approach the steady state more quickly, but also allows China to avoid capital flight. Furthermore, compared to closed economies, the restricted opening policy does not change the social welfare of either of two countries in the steady state, though Cardoso and Dornbusch (1989) and Reis (2001) argued that FDI might reduce the social welfare of developing countries due to the transfer of capital returns to foreign investors.

On the other hand, this paper leaves several problems to study in the future.

First, the technology gap between China and developed countries is ignored. The transfer of technology should be important for the economic growth of developing countries. Second, the lending institutions in this paper are only one of the features of real-world intermediaries. For examples, potential investors in each country could operate their investment projects by financing external funds in their domestic stock markets. In addition, China is going to open its stock market to foreign direct investors in 2002. This means that foreign investors can easily obtain external funds to operate their investment projects in China. Third, for convenience, this paper depends on several unrealistic assumptions, which were pointed out by Boyd and Smith (1997). For examples, credit rationing always prevails and there are upper bounds on total investment capacity and fixed monitoring costs in both countries.

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