View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Munich Personal RePEc Archive

MPRA
Munich Personal RePEc Archive

Saving Wedge, Productivity Growth and International Capital Flows

Hung Ly-Dai

Vietnam National University

June 2015

Online at https://mpra.ub.uni-muenchen.de/90239/
MPRA Paper No. 90239, posted 27 November 2018 10:07 UTC

Saving Wedge, Productivity Growth and International Capital Flows

Hung Ly-Dai*

First draft: 06/2015. This version: 01/2018

Abstract

On one small open OLG economy, the productivity growth determines both the investment through marginal product of capital and the savings through endogenous financial friction modeled as the capital income taxation. Therefore, the over-time fluctuation of international capital flows is shaped by the changes of productivity growth. The empirical evidences on one panel sample of 180 economies over 1980-2013 confirm the endogeneity of financial friction as one mechanism underlying the impact of productivity growth on net total capital inflows. Furthermore, the combination of theory and evidences reveals that, for capital flows, the implication of Neo-Classical growth model works on the investment side, while the allocation puzzle applies on the saving side.

Keywords: International Capital Flows, Allocation Puzzle, Endogenous Financial Friction, Productivity Growth Rate.

JEL Classifications: H20, F21, F41.

*Email: hunglydai@gmail.com. Address: Faculty of International Business and Economics, VNU University of Economics and Business, office 406, E4 Building, 144 Xuan Thuy street, Cau Giay district, Ha Noi city, Viet Nam. I am grateful for helpful comments by Cuong Le Van, Jean-Bernard Chatelain, Ha Huy Thai, Ngoc-Sang Pham and participants in the economics seminars in Paris School of Economics, Ca Foscari University of Venice, Bielefeld Graduate School of Economics and Management. The author acknowledges financial support by the European Commission in the framework of the European Doctorate in Economics - Erasmus Mundus (EDEEM).

1 Introduction

There are two stylized facts on the dynamics of international capital flows across countries, illustrated in Figure (1.1). Fact 1: the net total capital inflows fluctuate over time on both advanced and developing economies. On Panel A, in United States, one advanced economy, the inflows of capital increase over 1980-1986, but decrease over 1986-1990, then raise continuously to peak at (7%) in 2006. In China, one developing economy, the capital inflows also experience the high fluctuation along the downward trend to the bottom of (-10%) in 2006, before they climb to (-2.5%), the same value in 1981. Fact 2: the net total capital inflows are highly (positively or negatively) correlated with the productivity growth over time. On Panel B, in United States, over 1990-1997, the inflows of capital raise from (0%) to (4%) while the growth rate surges from (-0.2%) to (2.4%). However, over 1998-2000, the expansion of capital inflows is accompanied by the shrinkage of growth. On Panel C, in China, from 1980 to 1985, the inflows of capital accelerate from (-1%) to (10%), while the growth rate goes up from (-3%) to (4%). However, over 2001-2007, the escalation of capital inflows comes along with the decline of productivity growth.

The observed pattern of capital inflows imposes the challenge for the past papers. On theory, the papers based on insight of Neo-Classical growth model usually focus on the long-run value of capital inflows. Therefore, it can only explain whether one economy tends to experience the inflows or outflows of capital, but not the fluctuation of capital inflows (Fact 1). On empirical ground, the papers, on the up-hill capital flows literature, usually employ the cross-section data sample to compare the pattern of capital flows across countries. Therefore, they do not capture the dynamics on the dependence of capital flows on productivity growth over time (Fact 2). Our paper aims to fill in the research gap.

We shows that the two stylized facts can be jointly explained by one general equilibrium model of open economy with endogenous financial friction. Indeed, the productivity growth can not only raises the investment as implied by Neo-Classical growth model but also accelerate the savings by lowering the rate of return on savings. When savings go up more than investment, the increase of productivity growth results in the reduction of net total capital inflows. Otherwise, the escalation of growth goes stimulates the inflows of capital. Therefore, the dependence of capital flows on growth rate (Fact 2) is accounted for by the endogeneity of financial friction. Moreover, since the productivity growth is fluctuated over time, the net total capital inflows also change over time (Fact 1). In brief, within our framework, the fluctuation of international capital flows relies on the dynamics of productivity growth over time.

The paper belongs to the literature on the pattern of international capital flows. Lucas (1990) employs one small open economy to uncover the reason why capital does not flow to the developing economies, which have scarcity of capital and high marginal product of capital. However, the author focus on the value of net total capital flows, and leaves aside their dependence on productivity growth. Gourinchas and Jeanne (2013), on one data sample of developing economies, establish the existence of allocation puzzle: one country growing faster tends to receive less capital inflows. Recently, Alfaro, KalemliOzcan, and Volosovych (2014) employ one cross-section sample of both advanced and developing economies, to show that the net total capital inflows are also increasing on the productivity growth as implied by Neo-Classical growth model. The common shortcoming on these two paper is that the cross-section data does not account for the fluctuation on the pattern of international capital flows over time.

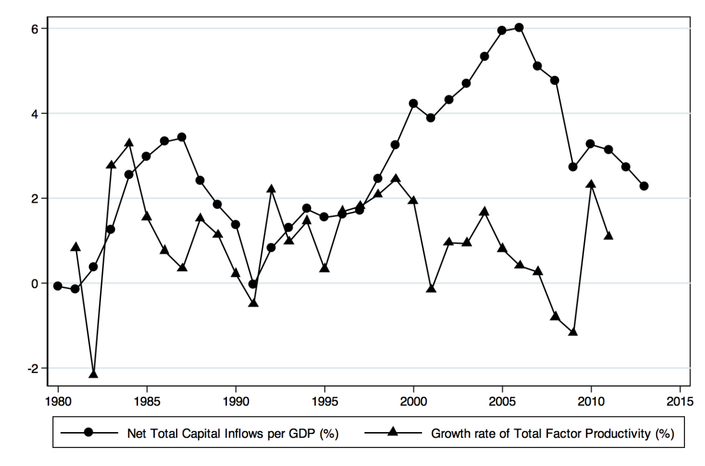
Our paper complements the main results on the aforementioned papers. Firstly, on theory, we stress the role of endogenous financial friction on shaping the pattern of capital flows. Since the productivity growth affects both savings and investment, the changes on growth rate translated into the fluctuation of net total capital inflows over time. Secondly, on evidences, we capture the dynamics of capital flows by one panel data sample of both about 180 developing and advanced economies. As a result, by combination of theory and evidences, we prove that Neo-Classical growth model explains the investment aspect of capital flows while the allocation puzzle relies on the savings side.

The paper also sheds the new light on the highly correlation between savings and growth. On Carroll, Overland and Weil (2000), since the habits make the consumers to postpone the current consumption in response to the rising interest rate, a higher growth leads to a huger savings. However, their model of closed-economy isolates the crucial role of savings from the interaction with the international capital market as on Bernanke (2005). On one open multi-country economy by Coeurdacier, Guibaud and Jin (2015), the severity of credit constraint combined with the demographic changes explain the high savings in developing economies. However, since the financial friction is exogenous, the expansion of savings is not originated from the growth. The correlation between savings and growth on the context of financial integration is characterized on Song, Storesletten and Zilibotti (2011). For one open transition economy, the movement of labor from the low-productivity to high-productivity sectors raises not only the aggregate productivity growth but also savings by boosting the households' income. However, since the reallocation of labor determines both growth and savings, there is still missing mechanism underlying the direct impact of growth on savings.

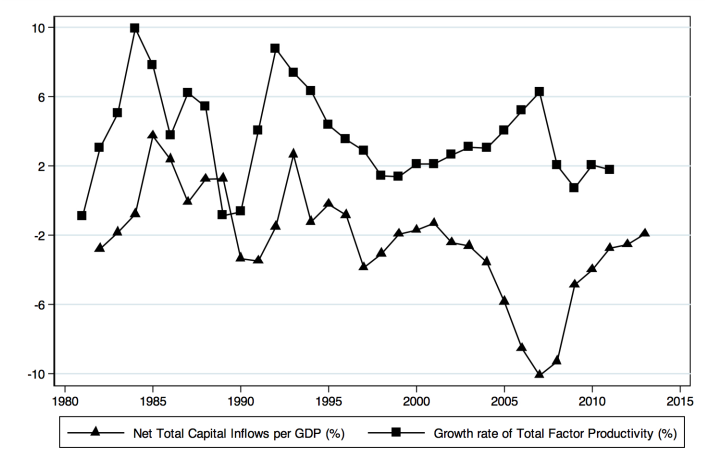
Our paper differs to the past papers by revealing the mechanism for productivity growth affects directly the savings on the financial integration context. Indeed, on our paper, an improvement of growth rate can lead to a higher savings by depressing the domestic interest rate. Since the case works on the open economy model, a higher productivity growth can result in the outflows of capital if savings are greater than investment.

The paper is organized as follows. After the introduction, section 2 develops one theory to analyze the role of saving wedge on shaping the pattern of international capital flows. Then, section 3 provides the empirical evidences to evaluate the theoretical results. Section 4 concludes.

Panel A: Net Total Capital Inflows in United States and China



Panel B: Capital Flows and Productivity Growth in United States



Panel C: Capital Flows and Productivity Growth in China

Figure 1.1: Pattern of International Capital Flows Over Time

2 Theory

2.1 Economy

The model is one small open economy which takes the interest rate as exogenous given by the world capital market. There is one homogeneous good, which is used for consumption and investment. Good is traded freely and costlessly, and capital is free mobile between the economy and the rest of world. But labor is immobile, and domestic firm is subject to changes in the productivity and labor force.

2.1.1 Production

The domestic output is produced by one representative firm which employs the capital (K_t) and labor (N_t) with the constant-return-scale technology.

$$Y_t = K_t^{\alpha}(A_t N_t)^{(1-\alpha)} g_t^{\eta}$$

whereby, the growth rates at time period t (g_t^A, g_t^N) of productivity (A_t) and labor force (N_t) are exogenous:

$$A_{t+1} = (1 + g_t^A)A_t; N_{t+1} = (1 + g_t^N)N_t$$

Following Barro and Sala-I-Martin (2002), the public expenditure (G_t) is one type of production factor, which contributes on the output through its ratio over the total effective units of labor:

$$g_t = \frac{G_t}{A_t N_t} \tag{1}$$

Let's define $k_t = \dfrac{K_t}{A_t N_t}$ as capital-effective-labor ratio. Then, output-effective-labor ratio is :

$$y_t \equiv \frac{Y_t}{A_t N_t} = k_t^{\alpha} g_t^{\eta}$$

The future capital stock (K_{t+1}) is augmented by the current investment (I_t), and by the current capital stock depreciated with the rate δ, satisfying ($0 < \delta < 1$).

$$K_{t+1} = I_t + (1 - \delta)K_t \tag{2}$$

The profit maximization problem for the firm facing the world exogenous interest rate (R^w) and the wage rate (w_t) is as following:

$$\Pi_t = K_t^{\alpha}(A_t N_t)^{(1-\alpha)} g_t^{\eta} - R^w K_t - w_t N_t$$

With the perfect market for factors of production, the interest rate equals to the marginal product of capital and the real wage equals to the marginal product of labor.

$$R^w = \alpha k_t^{(\alpha-1)} g_t^{\eta} \tag{3}$$

$$w_t = (1 - \alpha)A_t(\frac{\alpha}{R^w})^{\alpha/(1-\alpha)} {g_t}^{\eta/(1-\alpha)} \tag{4}$$

By (3), we get the capital-effective-labor ratio. Then, the corresponding capital stock and output for the small open economy take the forms:

$$k_t = (\frac{\alpha}{R^w})^{1/(1-\alpha)} g_t{}^{\eta/(1-\alpha)} \tag{5}$$

$$K_t = A_t N_t k_t = A_t N_t (\frac{\alpha}{R^w})^{1/(1-\alpha)} g_t{}^{\eta/(1-\alpha)} \tag{6}$$

$$Y_t = A_t N_t k_t^{\alpha} g_t^{\eta} = A_t N_t (\frac{\alpha}{R^w})^{\alpha/(1-\alpha)} g_t{}^{\eta/(1-\alpha)} \tag{7}$$

2.1.2 Consumption

There are N_t newborn agents at t, each supplies one unit of labor at young and retires at old. Let denote (c_t^y, s_t^y) as the consumption and saving by the young agent at t and (c_{t+1}^o) as the consumption by that agent at old at $(t+1)$.

The utility maximization problem for one newborn agent at (t) is as following:

$$\begin{aligned} max_{(c_t^y, c_{t+1}^o, s_t^y)} u(c_t^y) &+ \beta u(c_{t+1}^o) \\ c_t^y + s_t^y &= w_t \\ c_{t+1}^o &= (1-\tau_{t+1}) R^w s_t^y \end{aligned}$$

The young agent born at t earns the wage as income, then allocates it between consumption and saving. At old, she receives the interest rate on saving, covers the capital taxation, then consumes the rest of income. The tax rate (τ_{t+1}) is levied by the government with the residence principle. Therefore, the tax is based on where the agents live, no matter whether the source of income is from the domestic or foreign markets.

The utility function $u(c) = \dfrac{c^{1-1/\sigma}}{1-1/\sigma}$ is standard with the inter-temporal elasticity of substitution coefficient (σ) and the discount factor satisfying $(0 < \beta < 1)$. We focus on the case of $(0 < \sigma < 1)$, so that the income effect dominates the substitution effect for the impact of interest rate on savings. This range of value is consistent with literature on asset pricing (Guvenen (2006)) and some other empirical papers (Hall (1988)) which estimate the coefficient of substitution below 1.

The Euler equation is:

$$u'(c_t^y) = \beta R^w (1-\tau_{t+1}) u'(c_{t+1}^o)$$

Therefore, the future capital taxation affects the savings by the current young agent through the marginal saving rate, defined by $\varphi^s(\tau_{t+1})$.

$$s_t^y = \varphi^s(\tau_{t+1}) w_t \equiv \frac{1}{1 + \beta^{-\sigma}[R^w(1-\tau_{t+1})]^{(1-\sigma)}} w_t \tag{8}$$

For $(0 < \sigma < 1)$, the marginal saving rate is increasing on taxation $(\partial\varphi(\tau_{t+1})/\partial\tau_{t+1} > 0)$ since a higher tax rate reduces the rate of return on the savings, then raises the marginal saving rate through the income effect.

2.1.3 Government

As on Barro and Sala-I-Martin (2002), the government demands for the public good such that its marginal product of expenditure ($\partial Y_t/\partial G_t$) equals to its price, which is 1.

$$\frac{\partial Y_t}{\partial G_t} = 1 \Rightarrow G_t = \eta Y_t \tag{9}$$

The government collects the taxation income, given by ($\tau_t R^w N_{t-1} s^y_{t-1}$), to finance the public expenditure. We assume that the government always keeps the balanced budget. The assumption differs our theory to the literature on international taxation where government involves in debt and has to issue the bond and increase tax to finance public debt (Frenkel, Razin and Sadka (1991)).

$$\tau_t R^w N_{t-1} s^y_{t-1} = \eta Y_t \tag{10}$$

Replacing (4) into (8), and the result into (10), we get an equation determining the endogenous capital taxation:

$$\tau_t R^w \varphi^s(\tau_t) = \frac{\eta}{(1-\alpha)} \frac{Y_t}{Y_{t-1}} \tag{11}$$

Therefore, by the implicit function theorem, the capital taxation is increasing on the output growth rate.

$$\frac{\partial \tau_t}{\partial (Y_t/Y_{t-1})} > 0 \tag{12}$$

Since the public expenditure is complementary to the private output, a higher output growth rate raises the demand for public expenditure. To balance the public budget, the government needs to raise the tax rate.

2.1.4 Equilibrium

The equilibrium output is found by plugging the public expenditure (9) into (7), taking into account (1):

$$Y_t = (\frac{\alpha}{R^w})^{\alpha/(1-(\alpha+\eta))} \eta^{\eta/(1-(\alpha+\eta))} A_t N_t \tag{13}$$

Therefore, by (9) and (1), the public expenditure per effective units of labor is constant.

$$g = (\frac{\alpha}{R^w})^{\alpha/(1-(\alpha+\eta))} \eta^{(1-\alpha)/(1-(\alpha+\eta))} \tag{14}$$

Plugging (14) into (5) and (6), the equilibrium capital-effective-labor ratio and the corresponding capital stock are as following:

$$\begin{aligned} k &= (\frac{\alpha}{R^w})^{(1-\eta)/(1-(\alpha+\eta))} \eta^{\eta/(1-(\alpha+\eta))} \\ K_t &= A_t N_t k \end{aligned}$$

Replacing (14) into (4), the equilibrium wage rate is a constant fraction of productivity level.

$$w_t = (1-\alpha)(\frac{\alpha}{R^w})^{\alpha/(1-(\alpha+\eta))} \eta^{\eta/(1-(\alpha+\eta))} A_t$$

2.2 International Capital Flows

Let denote S_t^y as the stock of aggregate savings by the young agents at the end of period t. By using (8) and the share of labor income ($w_tN_t = (1-\alpha)Y_t$), we have:

$$S_t^y \equiv N_t s_t^y = \varphi^s(\tau_{t+1})w_tN_t = (1-\alpha)\varphi^s(\tau_{t+1})Y_t \tag{15}$$

As on Obstfeld and Rogoff (1996), the saving of the young has two components, the net foreign assets (B_{t+1}) and the capital stock that will be used in the production in the next period.

$$S_t^y = B_{t+1} + K_{t+1} \tag{16}$$

Dividing both side of previous equation by the next-period output, we have:

$$\frac{B_{t+1}}{Y_{t+1}} = \frac{S_t^y}{Y_t}\frac{Y_t}{Y_{t+1}} - \frac{K_{t+1}}{Y_{t+1}} \tag{17}$$

By (13), the growth rate of output is determined by the exogenous growth rates of productivity and labor force.

$$\frac{Y_{t+1}}{Y_t} = (1+g_t^A)(1+g_t^N) \tag{18}$$

Replacing (15), (18) into 17, taking into account the share of capital income ($K_t = \alpha Y_t, \forall t$), we get the ratio of net stock of foreign assets over output as:

$$\frac{B_{t+1}}{Y_{t+1}} = \frac{S_t^y}{Y_t}\frac{Y_t}{Y_{t+1}} - \frac{K_{t+1}}{Y_{t+1}} = \frac{(1-\alpha)\varphi^s(\tau_{t+1})}{(1+g_{t+1}^A)(1+g_{t+1}^N)} - \frac{\alpha}{R^w}$$

At steady state with constant growth rate of productivity and labor force ($g_t^A = g^A, g_t^N = g^N, \forall t$), the output growth rate is constant, then by (11),the capital tax rate is constant ($\tau_t = \tau_{t+1} = \tau$). Therefore, the steady-state net foreign assets at the beginning of period is also constant.

$$\overline{\frac{B}{Y}} = \frac{(1-\alpha)\varphi^s(\tau)}{(1+g^A)(1+g^N)} - \frac{\alpha}{R^w} \tag{19}$$

The current account is the changes in the net stock of foreign assets, i.e, ($CA_t = B_{t+1} - B_t$).

$$\frac{CA_t}{Y_t} = \frac{B_{t+1}}{Y_{t+1}}\frac{Y_{t+1}}{Y_t} - \frac{B_t}{Y_t} \tag{20}$$

Replacing (19) into (20), the steady-state current account to finance the net foreign assets is as following.

$$\overline{\frac{CA}{Y}} = (g^A + g^N + g^Ag^N)\overline{\frac{B}{Y}} = (g^A + g^N + g^Ag^N)\left(\frac{(1-\alpha)\varphi^s(\tau)}{(1+g^A)(1+g^N)} - \frac{\alpha}{R^w}\right)$$

To analyze the impact of productivity growth on net total capital inflows (measured by the negative value of current account), we assume that the economy has an initial zero net foreign assets position at the initial productivity growth rate, denoted by ($g^{A,*}$).

That is $\overline{CA/Y}(g^{A,*}) = \overline{B/Y}(g^{A,*}) = 0$. Then, we carry out the Taylor expansion to get the net total capital inflows for an increase of growth rate from $g^{A,*}$ to g^A.

$$-\frac{\overline{CA}}{Y}(g^A) \approx \frac{\partial(-\overline{CA/Y})}{\partial g^A} |_{g^{A,*}} (g^A - g^{A,*}) \tag{21}$$

By taking into account the dependence of the marginal saving rate on the productivity growth rate through the capital taxation, the change of the net total capital inflows is:

$$\frac{\partial(-\overline{CA/Y})}{\partial g^A} |_{g^{A,*}} = (g^{A,*} + g^N + g^{A,*}g^N) \frac{\partial(-\overline{B/Y})}{\partial g^A} |_{g^{A,*}} \tag{22}$$

Therefore, all the changes in the net total capital inflows are from the change in the net foreign asset stock. Moreover, we have:

$$\frac{\partial\overline{(-B/Y)}}{\partial g^A} |_{g^{A,*}} \quad = \quad \frac{(1-\alpha)}{(1+g^{A,*})(1+g^N)} \frac{\varphi^s}{g^{A,*}} \left(\frac{g^{A,*}}{1+g^{A,*}} - \epsilon^{\varphi}_{g^{A,*}}\right) \tag{23}$$

Where we define the elasticity coefficient of the marginal saving rate by the young agent w.r.t the growth rate as: $\epsilon^{\varphi}_{g^{A,*}} \equiv \frac{\partial \varphi^s}{\partial g^{A,*}} \frac{g^{A,*}}{\varphi^s}$. For $0 < \sigma < 1$, $\frac{\partial \varphi^s}{\partial g^{A,*}} > 0$ and therefore, $\epsilon^{\varphi}_{g^{A,*}} > 0$.

Placing (23) into (22), then the result into 21, we end up with:

$$-\frac{\overline{CA}}{Y}(g^A) = \frac{(g^{A,*} + g^N + g^{A,*}g^N)}{(1+g^{A,*})(1+g^N)} \frac{(1-\alpha)\varphi^s}{g^{A,*}} \left(\frac{g^{A,*}}{1+g^{A,*}} - \epsilon^{\varphi}_{g^{A,*}}\right)(g^A - g^{A,*}) \tag{24}$$

Therefore, the impact of productivity growth rate on the net total capital inflows depends on the adjustment of marginal saving rate by young agent. We summarize the result on the following proposition.

Proposition 2.1. *Suppose that the net foreign assets is zero at the initial productivity growth rate ($g^{A,*}$). At a higher productivity growth ($g^A > g^{A,*}$), the net total capital inflows is positive if $\epsilon^{\varphi}_{g^{A,*}} < \frac{g^{A,*}}{(1+g^{A,*})}$ and negative if $\epsilon^{\varphi}_{g^{A,*}} > \frac{g^{A,*}}{(1+g^{A,*})}$.*

Proof. The result is implied directly by the equation (24). ■

For an increase of productivity growth rate, there are two different effects which tend to offset each other. For the traditional channel, a higher growth rate leads to a higher investment to keep the marginal product of capital to be equal to the world interest rate. Given that domestic saving is unaffected by productivity growth, the country needs to borrow from the rest of world to finance the expansion of investment. We label this effect as the *Neo-Classical growth effect*, which implies that one country growing faster would experience the surge of net total capital inflows to finance domestic investment. Note that the effect is deduced from the equation (24): given ($\epsilon^{\varphi}_{g^{A,*}} = 0$), $-\overline{CA/Y}(g^A) > 0$ for $g^{A,*}/(1+g^{A,*}) > 0$.

One new channel emerges within our model with the endogenous saving wedge. A higher growth rate can raise the savings-output ratio. Indeed, since the public expenditure is complementary to the private output, a higher growth rate requires the government to raise the capital taxation to finance huger expenditure. A higher tax rate, in turn, depresses the domestic interest rate and raises the marginal saving rate when the income effect dominates the substitution effect. Therefore, the savings by the young agents goes up. Given the investment, the country lends the capital, which is due to the increase of savings, to the rest of world. We label this effect as the *saving-wedge effect*. Note that on Proposition (2.1), the effect is expressed as: given ($g^{A,*} > 0$), $-\overline{CA/Y}(g^A) < 0$ for $\epsilon^{\varphi}_{g^{A,*}} > g^{A,*}/(1+g^{A,*})$.

The impact of productivity growth on the capital inflows depends on the intensity that the saving rate by the young agent responds to the growth rate. If the increase of saving is weak, the Neo-Classical growth effect wins the saving-wedge effect. Therefore, the net total capital inflows are positive and the improvement of growth raises the inflows of capital. If the increase of saving is strong enough, the saving-wedge effect holds the dominant position. Then, the net total capital inflows are negative and a higher growth rate results in the outflows of capital. In brief, the endogenous saving wedge can generate the various dependence patterns of capital flows on the productivity growth.

Note that the net total capital inflows are also equal to the difference between investment and saving. Indeed, by definition on (16), the current account is:

$$CA_t \equiv B_{t+1} - B_t = (S^y_t - S^y_{t-1}) - (K_{t+1} - K_t) \tag{25}$$

Let denote (S^o_t) as the stock of aggregate savings by the old agents at the end of time period t. Indeed, the old agent does not save but only consumes her saving at youth. By (15),

$$S^o_t = N_{t-1}(-s^y_{t-1}) = -S^y_{t-1}$$

Therefore, the stock of savings at the end of time t, denoted by (S_t) is as following:

$$S_t \equiv S^y_t + S^o_t = S^y_t - S^y_{t-1} \tag{26}$$

Moreover, the investment is defined by the law of capital accumulation (2), which implies that:

$$I_t - \delta K_t = K_{t+1} - K_t \tag{27}$$

Replacing (26) and (27) into (25), then scaling by output, we have:

$$-\frac{CA_t}{Y_t} = \frac{I_t}{Y_t} - \frac{S_t}{Y_t} - \frac{\delta K_t}{Y_t} \tag{28}$$

Therefore, the net total capital inflows are used to fill the gap between investment and saving, taking into the depreciation of last-period capital stock. The decomposition of capital inflows into saving and investment is convenient for the empirical analysis on the next section.

3 Empirical Evidences

3.1 Data and Methodology

3.1.1 Data Description

The dataset is one panel sample covering about 160 economies from 1980 to 2013. The dependent variable is the net total capital inflows. The independent variables include the saving wedge and productivity growth rate.

The international capital flows are measured by the negative value of annual current account divided by gross national product (GDP) on percentage, denoted by ($negCA2y$) or divided by total population on USD, denoted by ($negCApc$). Scaling by output or population rules out the country-size effect on the measurement of net total capital inflows. The data is extracted from the updated and extended version of dataset of net private and public capital flows constructed by Alfaro, KalemliOzcan, and Volosovych (2014). The dataset is one panel sample on the international capital flows, covering a wide range of countries, both developing and advanced economies, for a long time period, from 1980 to 2013.

For the investigation on the role of saving wedge, we also decompose the net total capital inflows into saving and investment. The idea is to check the impact of productivity growth on the net total capital inflows through the saving-wedge effect revealed by Proposition (2.1). By the current account identity (28) for the case of zero depreciation rate, the capital inflows are the gap between investment (I/Y) and savings (S/Y). In details, the savings are measured by two alternative ratios: the first one is the gross savings over GDP on percentage ($S2y$) and the second one is the gross savings per capita on USD. The different measures of savings are used for the robustness check on the impact of independent variables. Furthermore, the investment ($I2y$) is the ratio of gross capital formation over GDP on percentage. Both data on savings and investment are explored from the World Development Indicators.

The saving wedge, denoted by ($Wedge^j$), is defined by Gourinchas and Jeanne (2013) as the difference between the domestic interest rate (R^j) and world interest rate (R^w) which is exogenous for one small open economy j. In details,

$$R^j = (1 - Wedge^j)R^w$$

We employ a strategy which is different to theirs. Indeed, the authors calibrate the wedge such that the pattern of net total capital flows predicted by the theoretical model fits the cross-section data sample of Non-OECD countries. However, we compute the saving wedge directly on the data, and use it as one independent variable to explain the pattern of international capital flows. In short, we use one empirical wedge which differs the theoretical one on the past literature.

On computation, the wedge can be one type of financial friction that creates the gap between the rental of capital for domestic firms (which equals to world interest rate for one small open economy) and the rate of return on savings for households. Since there does not exist one common world rental rate of capital across countries, we can not compute the exact measure of saving wedge by data. In fact, we can only observe the deposit interest rate ($R_t^{d,j}$) which is the rate of return on saving and the lending interest rate ($R_t^{l,j}$) which is the rental rate of capital in one country j at time t. Both deposit and lending rate are from the World Development Indicators. Then, we compute the wedge on percentage as following:

$$Wedge_t^j = \frac{R_t^{l,j} - R_t^{d,j}}{R_t^{l,j}}.100$$

The productivity growth rate on percentage, denoted by ($TFPgrowth$), is computed using the productivity level at constant 2005 USD, which is explored from the Penn World Table 8.1 (2015). On this updated version, the productivity level is computed with three novelty. First, the share of factor income is different across countries and across time. Second, the physical capital stock is decomposed by type of assets, each of which has one specific depreciation rate. Then, they are combined with the human capital index which takes into account average year of schooling to result in total factor productivity (TFP). Third, the production employed in PWT 8.1 is Harrod-neutral production function, which is also the one we use in the theoretical model.

Moreover, we also use two other measures of productivity growth. The first one is the output per capita growth rate on percentage, denoted by ($GDPpcgrowth$). As on literature on economic growth (Solow (1956), Swan (1956)), at the long-run equilibrium, the growth rate of output per capita is determined by the growth rate of productivity. Recently, Alfaro, KalemliOzcan, and Volosovych (2014) use this variable, in stead of TFP growth rate, on explaining the pattern of capital flows across countries. The second one is the growth rate of output on percentage, denoted by ($GDPgrowth$). The variable, which measures the growth rate of both productivity and labor force, is also useful for the robustness check on the regression of net total capital inflows. For data, the output is real gross national product at constant national 2005 price and the population is the number of people engaged. Both of them are from Penn World Table 8.1.

Table 3.1 provides summary statistics on the panel sample of 160 countries from 1980 to 2013. There is considerable variation for each variable. The net total capital inflows per output ratio has a mean of -3.75% with a standard deviation of about 13.5%. Compared with the net total capital inflows, both saving ($S2y$) and investment rate ($I2y$) have the higher means and greater deviations. The net total capital inflows per capita exhibits a mean of -91 USD with standard deviation of 1661 USD. The savings per capita has a much higher mean (6534 USD) and deviation (9915 USD) than the capital inflows per capita. Furthermore, the saving wedge has a mean of 0.47, with about 0.29 of standard deviation. Similarly, the productivity growth rate exhibits quite large deviation, with means of 0.1% and standard deviation of 0.53%. In comparison with the productivity growth, the growth rate of output per capita has a higher mean at (1.46%) and a more deviation at (6.60%). The output growth rate has the highest mean at (3.57%) with largest deviation at (6.61%). In brief, the dataset offers the rich variation for exploring the relationship between productivity growth and net total capital inflows.

3.1.2 Specification of Empirical model

The empirical analysis on the panel data is consistent to the theoretical modeling, on both the time and country dimensions. In particular, the time dimension, which spans over 1980-2013, allows us to study the dynamics on the dependence pattern of capital flows on the productivity growth. The changes over time on the pattern of capital flows are also the focal point on the theory, in particular, on the Proposition (2.1). Indeed, the theory focuses on the deviation of capital inflows from the steady state, which is

Table 3.1: Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Net Total Capital Inflows per GDP (%) (*negCA2y*)	4973	3.751759	13.55661	-304.0221	240.4958
Net Total Capital Inflows per Capita (USD) (*negCApc*)	5100	-91.29572	1661.487	-28141.84	16484.09
Gross Savings per GDP (%) (*S2y*)	4697	20.05024	15.76129	-233.9462	342.1523
Gross Savings per Capita (USD) (*Spc*)	3988	6534.043	9915.786	-127697.6	154381.7
Gross Capital Formation per GDP (%) (*I2y*)	5382	23.57126	10.80658	-2.424358	219.0694
Saving Wedge (%) (*Wedge*)	4198	47.68908	29.2787	-1149.206	99.8
Productivity Growth Rate (%) (*TFPgrowth*)	3259	.1053784	5.34612	-66.07364	52.59184
Output per Capita Growth Rate (%) (*GDPpcgrowth*)	4772	1.46388	6.60297	-69.22271	91.79552
Output Growth Rate (%) (*GDPgrowth*)	4875	3.57206	6.61251	-66.11992	106.2798

induced by the change of productivity growth. And on the panel sample, each time point can be considered as the steady state, and the changes of net total capital inflows are the deviation from the steady state.

Moreover, the cross-section dimension, which covers about 160 economies, helps us to capture the common pattern of capital flows across the different types of economies, both advanced and developing. The coverage of many economies, even the large ones, is also the implication by the model based on small open economy. Indeed, the analysis of one large open economy is in the middle between one closed economy (which fully affect the world equilibrium) and one small open economy (which can not affect the world equilibrium). Therefore, using one small open economy to analyze the case of large economy will miss the partial effect of that economy on the world equilibrium. The advantage, however, is one tractable framework which helps us to focus on the other endogenous variables rather than the equilibrium interest rate. This approach is employed by Song, Storesletten and Zilibotti (2011) for one small open economy version of China. In brief, the combination of yearly time series for many countries on the panel sample is appropriate to investigate the empirical evidences for the theoretical implications.

3.2 Evidences

We will examine the pattern of international capital flows. Then, we investigate the role of saving wedge on shaping the dependence of capital inflows on productivity growth. Finally, we run the robustness checks on the regression results.

3.2.1 Pattern of International Capital Flows

Table (3.2) reports the regression of net total capital inflows and their components on the productivity growth rate. The common result is that the growth rate has the negative impact on the net total capital inflows. On Column 1, the increase of 1% on the Total Factor Productivity (TFP) growth will result in the reduction of 0.266% on the net total capital inflows per output ratio. On Column 4, 1% increase of Output per capita (GDPpc) growth reduces the capital inflows per output by 0.111%. On Column 7, raising the Output (GDP) by 1% will lower the capital inflows per output by 0.114%.

In brief, a higher growth rate of total factor productivity reduces the net total capital capital inflows.

The regression provides one new evidence for the discussion on the pattern of international capital flows. The Neo-Classical growth model predicts that one economy with a higher growth rate would receive more inflows of capital. Recently, this implication is supported by the empirical evidence on Alfaro, KalemliOzcan, and Volosovych (2014) for a cross-section sample of both developing and advanced economies. However, for one cross-section sample of Non-OECD economies, Gourinchas and Jeanne (2013) find the evidence that one economy growing faster tends to receive less capital inflows. The authors postulate the result as the allocation puzzle. Therefore, our regression results can be considered as the extension of the allocation puzzle to the panel data sample. On other words, on average across countries, an increase over time of productivity growth rate reduces the net total capital inflows. In short, we support the existence of allocation puzzle on one panel sample of about 180 economies from 1980 to 2013.

On Table (3.2), we also examine the channels through which the growth rate shapes the pattern of capital flows. On Column 2, 1% increase on TFP growth raises the saving by 0.3%. This surging can be the reason for the reduction of 0.2% on the inflows of capital on Column 1, since the inflows of capital equal the investment minus saving. On Column 3, the regression on the investment has no significant. However, for other two alternative measures of growth, the regressions shows that a higher growth rate exerts the negative effect on the inflows of capital by raising the saving more than the investment. In details, on Column 5 and 6, 1% increase on GDPpc growth raises the saving by 0.3%, which is higher than the surge on investment by 0.2%. The difference between two numbers is 0.104%, which is closely to 0.111% as the impact of GDPpc growth on the net total capital inflows. On Column 7, the GDP growth rate raising by 1% reduces the net total capital inflows by 0.114%, which is nearly difference between the increase on the saving by 0.415% on Column 8 and on the investment by 0.279% on Column 9. In brief, the impact of growth on capital inflows relies on its greater effect on the saving than on the investment.

The regressions of growth on saving and investment reveals that the saving is also important channel for the growth rate drives the pattern of international capital flows. Indeed, one economy growing faster would invest more and receives more inflows of capital as implied by the Neo-Classical growth model. However, that economy also raises the saving over time. And since the impact of growth on saving is stronger than its impact on investment, the net total capital inflows are decreasing on the productivity growth rate. In sum, the solution for allocation puzzle on the pattern of capital flows needs to account for impact of growth on saving.

Table (3.3) investigates the role of saving wedge on shaping the pattern of international capital flows. On Column 1, the saving wedge has the positive impact on the saving-output ratio. In particular, the increase of wedge by 1% boosts the saving by 0.042%. On Column 2, the increase of saving wedge reduces the net total capital inflows. Indeed, if the wedge raises by 1%, the inflows of capital shrinks by 0.042%, which is exactly the surging on the saving induced by the wedge. In brief, the regression results confirms that the saving wedge affects negatively the net total capital inflows, through its impact on the saving-output ratio.

Table 3.2: Fixed-Effect Estimation Results of Net Total Capital Inflows ($negCA2y$) and Their Decomposition (Savings ($S2y$) and Investment ($I2y$)) on Productivity Growth: 1980-2013.

VARIABLES	(1) negCA2y	(2) S2y	(3) I2y	(4) negCA2y	(5) S2y	(6) I2y	(7) negCA2y	(8) S2y	(9) I2y
Productivity Growth	-0.266***	0.301***	-0.00852						
($TFPgrowth$)	(0.0346)	(0.0362)	(0.0204)						
Output-per-Capita Growth				-0.111***	0.320***	0.216***			
($GDPpcgrowth$)				(0.0275)	(0.0301)	(0.0201)			
Output Growth							-0.114***	0.415***	0.279***
($GDPgrowth$)							(0.0284)	(0.0306)	(0.0200)
Constant	2.078***	21.32***	23.11***	3.598***	19.47***	22.80***	4.133***	18.39***	22.29***
	(0.142)	(0.152)	(0.0945)	(0.138)	(0.151)	(0.116)	(0.167)	(0.180)	(0.132)
Observations	2,934	2,867	3,076	4,098	3,888	4,335	4,193	3,979	4,431
R-squared	0.021	0.024	0.000	0.004	0.029	0.027	0.004	0.046	0.044
Number of Countries	109	109	109	161	161	161	162	162	162

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3.3: Fixed-Effect Estimation Results of Net Total Capital Inflows ($negCA2y$) and Savings ($S2y$) on Saving Wedge: 1980-2013.

VARIABLES	(1) S2y	(2) negCA2y
Saving Wedge	0.0420***	-0.0421***
($Wedge$)	(0.00809)	(0.00742)
Constant	18.76***	5.494***
	(0.407)	(0.374)
Observations	3,491	3,697
R-squared	0.008	0.009
Number of Countries	164	168

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The evidences on Table (3.3) are in line with the mechanism on the theoretical model. Indeed, by (8), the saving wedge has the positive impact on the marginal saving rate. The reason is that at the given world interest rate, a higher wedge curtails the rate of return on saving. This curtailment, in turn, scales up the the marginal saving rate by the income effect on the case of low coefficient of inter-temporal substitution. Next, by (19), the increase of marginal saving rate raises the saving-output ratio, which drains the inflows of capitals. In short, both theory and evidences supports the negative impact of saving wedge on the net total capital inflows.

On the next step, given the impact of saving wedge on the net total capital inflows, we will use the wedge as one potential candidate to explain the dependence pattern of capital inflows on productivity growth.

3.2.2 Saving Wedge, International Capital Flows and Productivity Growth

Table (3.4) illustrates the regression results of productivity growth on the saving wedge. On Column 1, the TFP growth rate has the positive impact on the wedge. In details, 1% increase of growth elevates the wedge by 0.528%. The same pattern applies for the alternative measures of growth as the GDPpc growth on Column 2 and the GDP growth on Column 3. However, comparing the magnitude of impact on wedge across three growth rates, the TFP growth makes the greatest effect on the wedge. In brief, the saving wedge is increasing on productivity growth.

The regression results lay the empirical ground for the theoretical model. Indeed, by (12), the wedge, modeled as the capital taxation, is positively dependent on the growth rate. The reason relies on the endogenous taxation: for a higher growth rate, the government needs to raise the tax rate, or the wedge, to finance a more massive public expenditure to complement a higher growth of private output. Furthermore, the dependence of wedge on the productivity growth reveals the clue to understand the mechanism underlying the pattern of capital flows. In particular, given the evidences Table (3.3) that the wedge leverages the saving, a higher growth rate can raises the saving through the wedge. And through the saving channel, an improvement of growth rate results in the reduction on the inflows of capital. In short, the theory is consistent to the empirical evidences. Both of them suggest the addition of wedge to explain the dependence pattern of capital flows on growth.

On Table (3.5), we add the wedge and growth together on the regressions of capital inflows and saving-output ratio. As Alfaro, KalemliOzcan, and Volosovych (2008), the strategy is to add one variable on the regression of capital inflows on the growth. If the coefficient of growth rate turns to be insignificant, the evidences proves that the added variable can account for the dependence of capital inflows on the growth. On Column 1, adding the saving wedge makes the coefficient of TFP growth to be insignificant. The same pattern applies on Column 2, in which the coefficient of TFP growth on the saving has no significance when adding the wedge. In sum, the first two columns confirms the saving wedge as the crucial channel through which the productivity growth exerts the negative impact on the net total capital inflows.

Column 3 to 6 on Table (3.5) presents the regression results of capital inflows and saving on the other measures of growth. The common pattern is that the addition of saving wedge reduces the magnitude of the coefficient on growth. However, the evidences also support the central role of wedge on shaping the pattern of international capital flows. In details, for the GDPpc growth rate, on Column 3, the coefficient on the regression of net total capital inflows is 0.05, a half of value recorded on Column 4 on Table (3.2) for the case without wedge. On Column 4, the coefficient on the regression of saving is 0.103, which is far lower than the value of 0.320 shown on Column 5 on Table (3.2). For the GDP growth, the values of coefficients on the regression of capital inflows and saving also reduces substantially. In short, the regression with other measures of productivity growth proves the wedge as one decisive determinant of capital inflows.

Table 3.4: Fixed-Effect Estimation Results of Saving Wedge ($Wedge$) on Productivity Growth: 1980-2013.

VARIABLES	(1) Wedge	(2) Wedge	(3) Wedge
Productivity Growth	0.528***		
($TFPgrowth$)	(0.154)		
Output-per-Capita Growth		0.245***	
($GDPpcgrowth$)		(0.0839)	
Output Growth			0.226***
$GDPgrowth$)			(0.0838)
Constant	44.34***	45.28***	45.05***
	(0.634)	(0.495)	(0.569)
Observations	2,387	3,359	3,454
R-squared	0.005	0.003	0.002
Number of Countries	104	151	152

Note: Standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1

Table 3.5: Fixed-Effect Estimation Results of Net Total Capital Inflows ($negCA2y$) and Savings ($S2y$) on Saving Wedge and Productivity Growth: 1980-2013.

VARIABLES	(1) negCA2y	(2) S2y	(3) negCA2y	(4) S2y	(5) negCA2y	(6) S2y
Saving Wedge	-0.0599***	0.0287***	-0.0503***	0.0252***	-0.0465***	0.0226***
($Wedge$)	(0.00692)	(0.00749)	(0.00775)	(0.00847)	(0.00775)	(0.00843)
Productivity Growth	-0.00990	0.0438				
($TFPgrowth$)	(0.0326)	(0.0338)				
Output-per-Capita Growth			0.0504*	0.103***		
($GDPpcgrowth$)			(0.0292)	(0.0314)		
Output Growth					0.0769**	0.189***
($GDPgrowth$)					(0.0307)	(0.0326)
Constant	4.082***	20.93***	5.228***	19.50***	5.258***	18.94***
	(0.332)	(0.359)	(0.377)	(0.412)	(0.390)	(0.422)
Observations	2,219	2,174	3,060	2,905	3,155	2,995
R-squared	0.035	0.009	0.015	0.008	0.013	0.015
Number of Countries	103	103	150	148	151	149

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Another considerable evidence on Table (3.5) is on the coefficient of saving wedge. Firstly, on controlling for the growth rates, a higher wedge curtails the inflows of capital by raises the domestic savings. For example, by accounting for the productivity growth rate, for the wedge raise by 1%, the saving goes up by 0.029% on Column 2, and the inflows of capital lower by 0.059%. This evidence implies the same pattern proved on Table (3.3) on the impact of wedge on the net total capital inflows and on saving. Secondly, the value of coefficient on wedge on the capital inflows is quite similar, closely to -0.05%, across different controlling variables, from the TFP growth on Column 1 to the GDP growth on Column 5. On the regression of saving, the coefficient of wedge is also the same when we use different controlling variables. In short, on controlling for different measures of growth, the saving wedge has the positive effect on the saving, and then, affects negatively the net total capital inflows.

The evidences on Table (3.5) confirm the theoretical mechanism, implied by Proposition (2.1), for the growth rate affects the net total capital inflows. Indeed, the theory postulates that, by the saving-wedge effect, a higher growth rate raises the savings, then impedes the inflows of capital. The evidences on Table (3.5) reveal the existence of that effect, by establishing the role of wedge on accounting the dependence pattern of capital inflows on productivity growth. As a result, the combination of theory and evidences offer a clear answer for the allocation puzzle recorded on Table (3.2). In brief, the endogenous saving wedge is the key to explain the pattern of international capital flows.

The paper, based on the synthesis of theory and evidences, verifies the consistency between the prediction by Neo-Classical growth model and the allocation puzzle. On one hand, over time, one economy growing faster tends to invest more, and receives the inflows of capital to finance the domestic investment. This pattern is true within the framework of Neo-Classical growth model, and is grounded by evidences on Column 6 and 9 on Table (3.2). On other hand, over time, one economy growing faster also experiences a higher saving wedge, which in turn raises the domestic savings, and leads to the outflows of capital. This pattern, recorded as allocation puzzle, is explained by Proposition (2.1) for the case of high elasticity of marginal saving rate w.r.t growth. In brief, the implication by Neo-Classical growth model works for the investment side of capital flows while the Allocation puzzle relies on theirs saving side.

In summary, the empirical analysis provides the evidences supporting the theory. Firstly, the analysis on Table (3.4) confirms that the saving wedge is increasing on the productivity growth rate. This evidence proves the adequacy of endogenous capital taxation on the theoretical model construction. Secondly, on Table (3.5), the saving wedge is one key channel for the productivity growth drives the pattern of international capital flows. Indeed, both theory and evidence shows that an improvement of growth raises the saving, then reduces the inflows of capital.

On the next step, we would carry out the robustness checks on the empirical model for more evidences on the role of saving wedge.

3.2.3 Robustness Checks

Table (3.6) shows the regression results of net total capital inflows per capita and savings per capita on the independent variables. Firstly, the net total capital inflows are decreasing on the growth rate, for all three alternative measures of growth: TFP growth (Column 1), GDPpc growth (Column 5), and GDP growth (Column 9). These evidences confirms the existence of allocation puzzle recorded on Table (3.2). Secondly, the saving wedge can account for the dependence pattern of capital flows on the growth. Indeed, the addition of wedge makes the coefficient of growth to be insignificant, for all three alternative measures of growth rates: TFP growth (Column 2), GDPpc growth (Column 6), and GDP growth (Column 10). Therefore, the regression confirms the role of saving wedge established by Table (3.5) for the net total capital inflows per GDP. Thirdly, for all three measures of growth rates, the savings are increasing on growth on Columns (3,7,11), and they are also increasing on the wedge, on controlling for the growth rates on Columns (4,8,12). In brief, for the alternative measures of net total capital inflows and savings, the evidences confirms the role of saving wedge as the key driver of international capital flows patterns.

Table 3.6: Fixed-Effect Estimation Results of Net Total Capital Inflows per Capita ($negCApc$) and Savings per Capita (Spc) on Saving Wedge and Productivity Growth: 1980-2013.

VARIABLES	(1) negCApc	(2) negCApc	(3) Spc	(4) Spc	(5) negCApc	(6) negCApc	(7) Spc	(8) Spc	(9) negCApc	(10) negCApc	(11) Spc	(12) Spc
Saving Wedge		-7.356***		41.87***		-6.037***		33.28***		-5.418***		32.35***
($Wedge$)		(1.199)		(4.411)		(0.945)		(3.685)		(0.932)		(3.692)
Productivity Growth	-26.35***	-0.709	107.9***	-102.2***								
($TFPgrowth$)	(4.932)	(5.812)	(22.77)	(19.92)								
Output-per-Capita Growth					-12.82***	0.503	75.16***	-50.81***				
($GDPpcgrowth$)					(3.164)	(3.646)	(15.25)	(13.65)				
Output Growth									-15.87***	-1.410	132.5***	-7.006
($GDPgrowth$)									(3.196)	(3.734)	(15.71)	(14.42)
Constant	-155.4***	93.92	7,760***	6,126***	-74.29***	132.7***	6,374***	5,333***	-12.75	145.3***	6,003***	5,302***
	(20.45)	(57.55)	(95.44)	(211.3)	(15.84)	(45.84)	(76.34)	(178.9)	(18.83)	(46.56)	(92.23)	(183.9)
Observations	2,959	2,229	2,867	2,174	4,142	3,077	3,888	2,905	4,237	3,172	3,891	2,908
R-squared	0.010	0.018	0.008	0.049	0.004	0.014	0.006	0.032	0.006	0.011	0.019	0.027
Number of Countries	109	103	109	103	161	150	161	148	162	151	161	148

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table (3.7) reports the regression results of net total capital inflows and saving on the growth and wedges for the sample of Non-OECD economies. The idea is to investigate our main results for the developing economies, which are at the center of the literature on international capital flows, motivated by Lucas (1990), Gourinchas and Jeanne (2013). Firstly, the negative impact of growth on the capital inflows (on Table (3.2)) is confirm for all three measures of growth: TFP growth (Column 1), GDPpc growth (Column 5) and GDP growth (Column 9). Secondly, as on Table (3.5), adding the wedge makes the coefficient of TFP growth on the capital inflows (Column 2) and on the savings (Column 4) to be insignificant. On the other columns, for two other measures of growth, the adding of wedge only reduces the magnitude on the impact of growth on the inflows of capital and savings. However, the common result is that the wedge has the positive impact on savings, then negative impact on capital inflows as proved on Table (3.3). In brief, for Non-OECD economies, the saving wedge continues to play an important role on shaping the dependence pattern of capital inflows on the growth rates.

Table 3.7: Fixed-Effect Estimation Results of Net Total Capital Inflows ($negCA2y$) and Savings ($S2y$) on Saving Wedge and Productivity Growth: Non-OECD Economics, 1980-2013.

VARIABLES	(1) negCA2y	(2) negCA2y	(3) S2y	(4) S2y	(5) negCA2y	(6) negCA2y	(7) S2y	(8) S2y	(9) negCA2y	(10) negCA2y	(11) S2y	(12) S2y
Saving Wedge		-0.0684***		0.0405***		-0.0537***		0.03292***		-0.0486***		0.0302***
($Wedge$)		(0.00888)		(0.00988)		(0.00943)		(0.0105)		(0.00937)		(0.0104)
Productivity Growth	-0.266***	0.00182	0.304***	0.0420								
($TFPgrowth$)	(0.0392)	(0.0364)	(0.0414)	(0.0381)								
Output-per-Capita Growth					-0.111***	0.0532*	0.325***	0.106***				
($GDPpcgrowth$)					(0.0299)	(0.0316)	(0.0331)	(0.0343)				
Output Growth									-0.113***	0.0834**	0.410***	0.181***
($GDPgrowth$)									(0.0312)	(0.0334)	(0.0339)	(0.0359)
Constant	2.545***	4.921***	20.76***	19.84***	4.184***	5.997***	18.78***	18.48***	4.779***	5.978***	17.63***	17.92***
	(0.179)	(0.423)	(0.193)	(0.469)	(0.162)	(0.456)	(0.178)	(0.508)	(0.197)	(0.469)	(0.214)	(0.519)
Observations	2,274	1,749	2,209	1,705	3,438	2,590	3,230	2,436	3,533	2,685	3,321	2,526
R-squared	0.021	0.035	0.025	0.012	0.004	0.014	0.030	0.009	0.004	0.012	0.044	0.015
Number of Countries	87	82	87	82	139	129	139	127	140	130	140	128

Note: Standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1

4 Conclusion

The paper, by combining both theory and evidences, provides one unified framework, to explain the pattern of international capital inflows. On theory, a higher growth rate can raise the savings by pushing up the saving wedge, which is modeled as the capital income taxation. Moreover, it also leas to more investment to meet the world exogenous marginal product of capital. Therefore, if the savings increase more than the investment, the increase of growth reduces the inflows of capital. On evidences, the panel sample of about 180 economies over 1980-2013 confirms the role of saving wedge as the channel for the growth rate to elevate the savings. And a higher growth dwindles the capital inflows, even though it expands the investment. In brief, both theory and evidences proves the endogenous saving wedge as the mechanism underlying the dynamical dependence of capital inflows on the productivity growth.

There are two main implications emerged from the paper. For theory, the paper implies the parallel existence of the prediction by Neo-Classical growth model and the allocation puzzle. On one hand, the improvement of productivity growth raises the investment, and attracts more inflows of capital: a positive relationship as on the Neo-Classical growth model. On other hand, a higher growth rate also raises the savings which, in turn, tends to discourage the inflows of capitals: a negative relationship recorded as Allocation puzzle. In short, the existence of puzzle relies on the positive impact of growth on savings while the prediction of Neo-Classical growth model is based on the positive effect of growth on investment.

For policy discussion, the public expenditure should be based more on other types of taxation rather than the capital income one. The reason is that, if the public expenditure is complementary for the private output (such as the building of public infrastructure), the increase of capital tax rate to finance the economic growth can lead to the over-accumulation of domestic savings. The leverage of savings can, in turn, leads to the outflows of capital. In short, the tax base should be restructured from the capital income to other source of income.

The paper can be extended by various ways on the future research avenue. Firstly, the theoretical model can be extended to analyze the public and private capital flows. On current model, the government is assumed to keep the balanced public budget. However, in reality, the government usually runs the deficit or surplus budget, and issues the public debt to smooth the public expenditure over time. Therefore, adding the public debt would enrich the model to capture the dynamics of public capital flows induced by government. Another extension can take into account the impact of capital control policy. On our model, the capital is free mobile between the economy and the rest of world. Therefore, a higher savings can result on the outflows of capital. However, in reality, some economies tends to impose the capital control, which limit the movement of capitals. And the analysis of capital control in the connection with the economic growth will be an important extension for the current paper.

References

Alfaro, Laura, Sebnem Kalemli-Ozcan, and Vadym Volosovych. "Why doesn't capital flow from rich to poor countries? An empirical investigation." The Review of Economics and Statistics 90.2 (2008): 347-368.

Alfaro, Laura, Sebnem Kalemli-Ozcan, and Vadym Volosovych. "Sovereigns, upstream capital flows, and global imbalances." Journal of the European Economic Association 12.5 (2014): 1240-1284.

Barro, Robert J. and Sala-I-Martin, X. "Economic Growth." Second edition, (2002).

Bernanke, Ben S. The global saving glut and the US current account deficit. No. 77. 2005.

Carroll, Christopher D., Jody Overland, and David N. Weil. "Saving and growth with habit formation." American Economic Review (2000): 341-355.

Coeurdacier, Nicolas, Stphane Guibaud, and Keyu Jin. "Credit constraints and growth in a global economy." The American Economic Review 105.9 (2015): 2838-2881.

Frenkel, Jacob A., Assaf Razin, and Efraim Sadka. International taxation in an integrated world. MIT press, 1991.

Gourinchas, Pierre-Olivier, and Olivier Jeanne. "Capital flows to developing countries: The allocation puzzle." The Review of Economic Studies (2013).

Guvenen, Fatih. "Reconciling conflicting evidence on the elasticity of intertemporal substitution: A macroeconomic perspective." Journal of Monetary Economics 53.7 (2006): 1451-1472.

Hall, Robert E. "Intertemporal Substitution in Consumption." Journal of Political Economy 96.2 (1988): 339-357.

Lucas, Robert E. "Why doesn't capital flow from rich to poor countries?." The American Economic Review 80.2 (1990): 92-96.

Obstfeld, Maurice, and Kenneth S. Rogoff. Foundations of international macroeconomics. Vol. 30. Cambridge, MA: MIT press, 1996.

Ogaki, Masao, and Carmen M. Reinhart. "Measuring intertemporal substitution: The role of durable goods." Journal of Political Economy 106.5 (1998): 1078-1098.

Solow, Robert M. "A contribution to the theory of economic growth." The Quarterly Journal of Economics 70.1 (1956): 65-94.

Swan, Trevor W. "Economic growth and capital accumulation." Economic Record 32.2 (1956): 334-361.

Song, Zheng, Kjetil Storesletten, and Fabrizio Zilibotti. "Growing like china." The American Economic Review 101.1 (2011): 196-233.