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The Basic Equation of Capital Flight

Wenjun Lu[1], Ke Chen[2] and Yirong Ying[3]

Abstract

This paper theoretically analyses the measurement of capital flight scale, and the factors that affect capital flight. Then the basic equation of capital flight is improved by introducing three lemmas.

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[1] College of Economics, Shanghai University, e-mail: lwj@shu.edu.cn
[2] College of Finance and Economics, Chongqing Jiaotong University, e-mail: ckbest@163.com
[3] College of Economics, Shanghai University, e-mail: yrying@staff.shu.edu.cn

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1 Introduction

Broto et al. (2011) analyzes the determinants of the volatility of the various types of capital inflows into emerging countries. After calculating a proxy of the volatility of FDI, portfolio and bank inflows, they use a panel data model to study their relationship with a broad set of explanatory variables. His results highlight the difficulties policy-makers face in stabilizing capital flows. Thus, he showed that since 2000 global factors beyond the control of emerging economies have become increasingly significant relative to country specific drivers. However, he identified some domestic macroeconomic and financial factors that appear to reduce the volatility of certain capital flows without increasing that of others.

The role and consequences of capital controls continues to be a subject of controversy for many developing countries. Governments that under normal circumstances advocate financial integration with global markets are often tempted to resort to capital controls in the face of economic crisis.

Cross-listed shares may confound government efforts to control capital outflows by providing a legal means through which investors can transfer their wealth outside the country. Sebastian (2006) studied the recent experience of investors who while subject to capital controls, were able to purchase cross-listed shares using local currency, convert them into dollar-denominated shares, re-sell them abroad, and deposit the dollar proceeds in foreign bank accounts.

Quan and Zak (2006) contributes to the capital flight literature in three ways.

First, from a theoretical perspective, they modeled capital flight as a portfolio choice dependent upon rate of return differentials, economic risks, and several sources of political risks. Their model departed from theirs by decomposing the factors that affect the risk of investment, rather than looking at level effects.

Second, from an empirical perspective, we departed from Lensink et al. (2000) and many other empirical studies by developing a broader set of political risk measures, producing some surprising findings, while maintaining the theoretically specified control variables in each regression equation.

Third, from a statistical perspective, we utilized pooled cross-sectional time-series analysis. Previous studies have concentrated on either time-series or cross-sectional analysis. Panel data allowed us to better examine the effects of economic and political variables on capital flight as these values changed rapidly over time and cross countries.

2 Measures of Capital Flight

Capital flight is a kind of underground economic activity, with a strong hidden type and complexity. Therefore, no matter what the definition of capital flight used, it is difficult for estimating the scale of capital flight correctly. However, a rough estimate of capital flight is always underway. According to literature both in abroad and domestic, there are mainly three methods as follows.

(i) The direct method (The balance of payments method)
The direct method is that estimate capital flight through one or more short-term capital outflows programs directly which response rapidly to domestic abnormal risk. This approach gains data from international balance of payments directly, so it is also known as the international balance of payments method. Cuddington (1986) use this method first, to estimate the capital flight scale of Latin America between 1974-1982 in the mid-1980s (Argentina, Brazil, Chile, Korea, Mexico, Peru, Uruguay, and Venezuela). In his estimation method, capital flight is equal to the other short-term items of other departments in the balance of payments, if necessary, with “errors and omissions” item.
(ii) Indirect method (the World Bank Residual Approach)
Indirect method was first used in “World Development Report” by the World Bank in 1985, the World Bank used the indirect method covers net increase of foreign debt of all private and public sectors, and do not emphasize the motivation of capital flight. It is also known as “The World Bank Residual Approach”. The basic idea of indirect method is using the residual between “capital sources” and “capital uses” to estimate the capital flight scale. It estimates the capital flight through the residual of the four items in the balance of payments, so it is also called “residual.” The four items are: the increase of external debt, the net FDI, official reserves increased and the current account deficit. For a country, the first two items are “capital sources”, the latter two are “capital uses”. If the capital source is larger than the capital uses, the capital flight happened.
(iii) Dooley method
This method, proposed by Dooley (1986), a mixture of direct method and indirect method, also named hybrid calculation method. He viewed capital flight as a debt which a resident to non-residents, so it can sum the identify part of capital flight first, then get a country’s total external debt (excluding foreign direct investments), and then subtracted from the “normal” changes in the stock of external debt, the number we got is capital flight.

3 Lemmas

Let $\mu = x / yz$, $x = E(r_t - r^f)$, $y = Y_t$, $z = VAR(r_t)$.
For discussing conveniently, we introduce three lemmas as following.

Lemma 3.1 If $0 < \mu < 1$, then exists a approximate formula,

$$\ln(1 - \frac{\lambda}{\theta}\mu) \approx \ln D - \ln \mu \tag{1}$$

where $D = \mu_0(1 - \frac{\lambda}{\theta}\mu_0)$, $\mu_0 = x_0 / y_0 z_0$.

Proof. Let $\mu_0 = x_0 / y_0 z_0$

and if $D = \mu_0(1-\frac{\lambda}{\theta}\mu_0)$, we can determine at point $\mu = \mu_0$,

$$\ln(1-\frac{\lambda}{\theta}\mu)|_{\mu_0} = \ln D - \ln\mu|_{\mu=\mu_0}$$

If $u_0 = \frac{\theta}{2}$, we also know

$$\left.\frac{\partial \ln(1-\frac{\lambda}{\theta}\mu)}{\partial\mu}\right|_{\mu=\mu_0} = \frac{\partial}{\partial\mu}(\ln D - \ln\mu)\Big|_{\mu=\mu_0} \qquad \square$$

Lemma 3.1 shows the approximate formula (1) has more precision than the one discussed in Quan and Zak's (2006) paper.

Lemma 3.2 Let variable x, y both are infinitesimals of the same order, that is $rank(x) = rank(y)$, if $\alpha+\beta=1$, then

$$\ln(x^2+y^2) \cong \alpha\ln x^2 + \beta\ln y^2 \qquad (2)$$

where rank notes the order of infinitesimals.

Proof. Not losing generality, let $y = k_1 x, k_1 = const$, and then

$$\ln(x^2+y^2) = \ln(1+k_1^2) + \ln x^2$$

$$\alpha\ln x^2 + \beta\ln y^2 = (\alpha+\beta)\ln x^2 + \beta\ln k_1^2$$

Obviously if $\alpha+\beta=1$, and $\beta = \frac{\ln(1+k_1^2)}{\ln k_1^2}$, so

$$\ln(x^2+y^2) \cong \alpha\ln x^2 + \beta\ln y^2$$

So $\ln(x^2+y^2)$ and $\alpha\ln x^2+\beta\ln y^2$ are infinitesimals of the same order. $\square$

Lemma 3.3 If $rank(y) > rank(x)$, as $y = x^m (m>1)$, and then

$$\ln(x^2+y^2) \cong \ln x^2 + \frac{y^2}{x^2} \qquad (3)$$

Proof. Let $y = x^m (m>1)$, a infinitesimal of higher order, and then

$$\begin{aligned}\ln(x^2+y^2) &= \ln(x^2+x^{2m})\\ &= \ln x^2 + ln(1+x^{2(m-1)})\\ &= \ln x^2 + x^{2(m-1)} + O(x^{2(m-1)})\\ &= \ln x^2 + \frac{y^2}{x^2} + O(x^{2(m-1)})\end{aligned}$$

So, the result of Lemma 3.3 is true. $\square$

4 Basic Equation of Capital Flight

Let at denote assets invested in the domestic market at time t that earn rate of return rt. Investments in the domestic market are risky, rwN(m,s2). By assumption, the domestic country has an immature financial market in which a domestic risk-free return is unavailable. Agents also invest aft in the foreign country, earning a risk-free time-invariant rate of return r^f. The risk-free return can be considered to be U.S. T-Bills.4

Quan and Zak(2006) proposed the basic equation of capital flight at time t as follows:

$$\frac{A_t^f}{K_t} = 1 - \frac{E(r_t - r^f)}{\theta K_t VAR(r_t)} \tag{4}$$

where

A defines net capital flight in the developing country,

K is aggregate capital invested in the domestic country.

However, there is a problem in the Quan and Zak's basic equation, that is, only when the second term in the right side of equation nearly is zero, the basic equation is rather accurate. In the general case, consider at the time $t=0$, in the light of Taylor formula, in the neighbor of point $p(x_0, y_0, z_0)$, denote that

$$u = A_t^f / K_t, x = E(r_t - r^f), y = Y_t, z = VAR(r_t).$$

Then we expand an approximate form of equation (1) after introducing a linear production function:

$$Y_t = \lambda K_t, \lambda > 0.$$

First general form of Capital flight equation is deduced.

Let $x = E(r_t - r^f)$, $y = Y_t$, $z = VAR(r_t)$, $v = 1 - \frac{x}{\theta yz}$, $x_0 = E(r_0 - r^f)$, $y_0 = Y_0$, $z_0 = VAR(r_0)$.

Employing a first-order Taylor series expansion of equation (1) at point $w_0 = (x_0, y_0, z_0)$, we can get the first basic equation about capital flight:

$$\ln(\frac{A_t^f}{Y_t}) \approx S_0 + P(x - x_0) + Q(y - y_0) + R(z - z_0) \tag{5}$$

where

$$S_0 = \ln(1 - \frac{x_0}{\theta y_0 z_0})$$

$$P = \left.\frac{\partial \ln v}{\partial x}\right|_{w_0} = \left.\frac{\partial \ln(1 - \frac{x}{\theta yz})}{\partial x}\right|_{w_0}$$

$$Q = \left.\frac{\partial \ln v}{\partial y}\right|_{w_0} = \left.\frac{\partial \ln(1 - \frac{x}{\theta yz})}{\partial y}\right|_{w_0}$$

$$R = \left.\frac{\partial \ln v}{\partial z}\right|_{w_0} = \left.\frac{\partial \ln(1 - \frac{x}{\theta yz})}{\partial z}\right|_{w_0}$$

We deduce the second basic equation about capital flight as below.
Apply Lemma 3.1 into formula (4), and then

$$\ln(\frac{A_t^f}{Y_t}) \approx \ln D - \ln E(r_t - r^f) + \ln Y_t + \ln(\sigma_e^2 + \sigma_p^2 + \sigma_t^2) \tag{6}$$

where, there are three familiar forms in the last item of formula (5). We can describe them using three theorems.

Theorem 4.1 If $rank(\sigma_e^2) = rank(\sigma_p^2) + rank(\sigma_t^2)$, Then there exist constant α, β, γ, and $\alpha + \beta + \gamma = 1$, so that

$$\ln(\sigma_e^2 + \sigma_p^2 + \sigma_t^2) = \alpha \ln \sigma_e^2 + \beta \ln \sigma_p^2 + \gamma \ln \sigma_t^2 \tag{7}$$

Proof. Apply Lemma 3.2, extend to the three dimensions to get it. □

Theorem 4.2 If $rank(\sigma_e^2) = rank(\sigma_p^2), rank(\sigma_t^2) > rank(\sigma_e^2)$, Then there exist constant α, β, which $\alpha + \beta = 1$, such that

$$\ln(\sigma_e^2 + \sigma_p^2 + \sigma_t^2) = \alpha \ln \sigma_e^2 + \beta \ln \sigma_p^2 + \frac{\sigma_t^2}{\sigma_e^2} \tag{8}$$

Proof. Using Lemma 3.3, one can get a simple proof. □

Theorem 4.3 If $rank(\sigma_t^2) > rank(\sigma_p^2) > rank(\sigma_e^2)$. Then

$$\ln(\sigma_e^2 + \sigma_p^2 + \sigma_t^2) = \ln \sigma_e^2 + \frac{\sigma_p^2 + \sigma_t^2}{\sigma_e^2} \tag{9}$$

Proof. Applying Lemma 3.3, one can also get the proof. □

5 Conclusion

We expanded the basic equation of capital flight by proposed by Quan and Zak (2006) to a general form, and introduced three lemmas to develop three theorems. In fact, it is easy to find a sample to show that the two basic forms about capital flight are more practice than the equation 2 in Quan and Zak's (2006) paper.

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