**Review of Economics & Finance**
**Submitted on 28/11/2014**
**Article ID: 1923-7529-2015-02-81-19**
**Weiping Li, Guotai Chi, and Lan Wu**

# Empirical Study on Saving and Investment Relation in China: 1952—2011[1]

***Weiping Li*** (Correspondence author)
University Chair Professor, Southwest Jiaotong University,
Chengdu, Sichuan Providence, 610031, P. R. China;
and Watson Faculty Fellow of Finance and Professor of Mathematics,
Oklahoma State University, Stillwater, Oklahoma 74078-0613, U.S.A.
Tel: 405-744-5852 E-mail: w.li@okstate.edu

***Guotai Chi***
Professor of Finance, School of Business Management,
Dalian University of Technology, Dalian, Liaoning 116024, P. R. China,
Tel: 86-411-8470-7374, E-mail: chigt@dlut.edu.cn

***Lan Wu***
School of Business Management,
Dalian University of Technology, Dalian, Liaoning 116024, P. R. China,
Tel: 86-411-8470-7374, E-mail: bota3@sina.com

**Abstract:** This paper empirically studies the relation between the domestic saving and the domestic investment with respect to the GDP national income for China during the 60-year period, 1952--2011. We adapt the method in Feldstein and Horioka (1980) for developed OECD countries to the developing country China, and analyze the change on the relation of national investment proportion and national saving proportion from three different sub-periods according to the national policy changes. We show that the saving proportion series and the investment proportion series in China during 1952--2011 under the first order difference are steady and co-integrated of order one. Due to economic reform in China since 1978, the nonlinear (square-root) cross-section regression is presented from empirical analysis. Furthermore, we specify the openness of the economy, the household saving, corporate and government saving to see the relation change.

**Keywords**: Nonlinear cross-section regression; Domestic saving; Gross domestic investment; Gross domestic product; Household saving; Corporate saving; Government saving

**JEL Classifications:** E21, E22, F36, O16

[1] This research is supported by the National Natural Science Foundation of China 71171031 and 71471027, and by the Ministry of Education of China as Science and Technology Research Project 2011-10, as well as by the Postal Savings Bank of China as credit rating and loan pricing systems for microcredit of farmers and Peddlers 2009-07.

## 1. Introduction

Feldstein and Horioka (1980) analyze the degree of cross-country capital mobility by estimating the correlation between domestic saving and domestic investment based on cross-sectional data of OECD countries, and argue that a country's domestic investment must be financed exclusively by the country domestic saving, resulting in a perfect correlation between domestic saving and investment. Their results implies low capital mobility and contradicts a general consensus that capital is highly mobile among the OECD countries. Coakley, et al. (1998) conclude that the Feldstein and Horioka (1980) results of a high saving-investment association has remained remarkably robust in OECD cross-sections and may not be informative about capital mobility since a range of theoretical models can generate high saving-investment correlation even under perfect capital mobility. Despite some theoretic doubts about the interpretation of the Feldstein-Horioka puzzle (the cross-section coefficient close to unity has been referred as the FH puzzle), the FH puzzle have been repeatedly confirmed for OECD cross-sections (see Dooley, et al. (1987)). Coakley, et al. (1996) argue that the FH coefficient is not a puzzle, but a statistical artifact of the cross-section regression. Onafowara, et al. (2011) examine the relationship between saving and investment in eight advanced economies of the European Union by testing cointegration, causality and dynamic effects of shocks to saving and investment.

In this paper we analyze the nonlinear relation and correlation between the saving proportion and investment proportion for the developing country China during the period 1952--2011 by adapting the method of Feldstein and Horioka (1980) on the developed countries to understand the international capital flows and the relation between domestic saving and domestic investment under the domestic policy change. After 1978 economic reform experimented along the coastal areas of China, China's economy grew rapidly in the period of 1979--1999. The Chinese central government in 2000 initiates a developing the West program to promote further economic growth across China. We illustrate the nonlinear relation and correlation between the saving proportion and investment proportion relative to the GDP national income for the typical three sub-periods 1952--1978, 1979--1999 and 2000--2011. The advantage of adapting the Feldstein and Horioka (1980) framework to examine the domestic saving and investment in China is not only the understanding the capital mobility in China but also the understanding of Chinese economy through different government policy, market openness and the ratio of export to import. The global financial crisis in 2007--2009 leads to another incentive for China to intend more domestic demand for the economic growth in the sub-period 2000-2011. Our empirical results would add a component to the nation's optimal rate of saving and the maximize investors net-of-tax return.

As Coakley, et al. (1998) noticed that using the Feldstein and Horioka regression for policy purposes is questionable, we adapt the ADF statistic test to verify that the saving proportion series and the investment proportion series under the first order difference are steady for Chinese saving and investment proportions in 1952--2011. Narayan (2005) estimates the saving investment correlation for China over the periods 1952--1998 and 1952--1994, the latter culminating in a period of fixed exchange rate regime, and finds that saving and investment are correlated for China for both the period of the fixed exchange rate and the entire sample period. This has been further confirmed in this paper from Table 6. Unlike Chan, et al. (2011) focusing on the regional capital mobility in China, we emphasize the nonlinear relation of domestic saving proportion and investment proportion through the government policy and the statistically significant series. We confirmed that saving and investment rates for China in the period 1952--2011 are co-integrated of order one, i.e., stationary after being differenced once. However the solvency constraint requires that the balance of payments as share of GDP national income be stationary since debt cannot explode. We use three different measures for the GDP calculation during the period of 1952--2011, and the fixed investment over the production GDP in Table 5.3 leads the best adjusted $R^2$ value.

Chan, et al. (2011) use the Feldstein and Horioka (1980) OECD structural cross-section regression into the China cross-region regression to track how the degree of mobility has been changed over time. Ma, et al. (2013) analyze domestic and external imbalances from two perspectives: the saving-investment balance and the effective Renminbi exchange rate. We take the FH method to analyze the saving and investment relation and correlation in China during three different sub-periods according to the Chinese policy changes. The household saving rate coefficient increases through the three sub-periods (see Table 5.3), and indicates the higher household consumption spending. Prasad (2009) concludes that the economic growth of China has not been driven mainly by consumption, but by investment. Our empirical result shows the evidence of increasing household spending in the sub-period 2000--2011.

Mamingi (1994) studies the FH regression using time series estimation for 58 developing countries, and shows that the saving-investment coefficients are much weaker for developing countries than the corresponding coefficients in studies of OECD countries. Our results in this paper show that this is not the case for China, especially not for the periods after the Chinese economic reform. On the other hand, our result is consistent to what Mamingi (1994) and Dooley, et al. (1987) argue, since China is no longer small open economy after the 1979. The mix-behavior of the saving-investment of China under different fiscal policy and economic reform is illustrated as a nonlinear (square-root nonlinear) cross-section regression from the empirical results in Table 2 and Table 3. Vamvakidis and Wacziarg (1998) show that the positive strong correlation between domestic saving proportion and domestic investment proportion is no longer true among developed and developing countries included low and middle income countries. Dooley, et al. (1987) find a coefficient of $\beta$=0.455 for the period 1960--1973 and $\beta$=0.610 for the period 1974--1984 among 48 developing countries. Our empirical results in Table 6 indicates the higher correlation between the domestic saving proportion and domestic investment proportion and higher $\beta$ value in Table 1 for similar periods from 1952--1978 and 1979--1999.

Obstfeld (1986) argues there are positive correlation between saving and investment, and Tobin (1983) discusses that population growth, productivity shocks and fiscal policies rebalance current account. Arndt (2013) shows both that the rate of economic growth is a function of the rate of investment back to Adam Smith in the Harrod-Domar equation, and that a country's rate of investment is constrained by its domestic saving rate which depend upon the level of per capita income, are mainly two assumptions to a high saving rate in developing countries for long dominated economic thought. Ramakrishna and Venkateshwar Rao (2012) find evidence that suggests that there is no causation between savings and investment in Ethiopia by using cointegration method. We leave the other related economic factors in a future study to understand the relation and correlation of domestic saving proportion and domestic investment proportion.

This paper is structured as follows. First we setup a basic relation between the saving and investment as Feldstein and Horioka (1980) investigate in Section 2. Next, we adapt the basic model to analyze the linear and nonlinear regressions over the period 1952--2011 from the openness of the economy to the policy from household saving, corporate saving and government saving in Section 3. Section 4 devotes the empirical results from our econometric models, and cointegration analysis on the saving proportion series and investment proportion series is done in Section 5. Finally we conclude in last Section 6.

## 2. A basic setup on the saving and investment background

Feldstein and Horioka (1980) use data on those major industrial countries to the extent that a higher domestic saving rate in a country is associated with a higher rate of domestic investment. In a perfect world capital mobility, saving in a country responds to the worldwide opportunity for investment which investment in a country is financed by the worldwide pool of capital. Hence one does not expect to see the relation between domestic saving and domestic investment. They analyze the cross section regressions of domestic investment and domestic saving as shares of GDP across 16 OECD countries for the 1960--1974 period to claim that capital is relatively immobile since domestic investment and domestic saving would be perfectly correlated in a closed economy and unrelated in an open economy. The Feldstein--Horioka puzzle is the low capital mobility against the high capital mobility supposed form the most exchange rate and open-economy macroeconomic models since the 1970s.

Let the following be the relation between the national investment proportion I/Y and the national saving proportion S/Y for those countries.

$$(\frac{I}{Y})_i = \alpha + \beta(\frac{S}{Y})_i + \varepsilon_i, \qquad i = 1,2, \dots \dots, N, \qquad (2.1)$$

where $I$ is national investment (public and private) by country $i$, $S$ is national saving and $Y$ is the GDP national income. (2.1) is the relationship between domestic saving and domestic investment shares of GDP, and $\alpha$ is the first difference and $\beta$ is the FH coefficient or the saving--investment association (an index of capital mobility). Their results for 16 OECD countries for the 1960--1974 period indicated a very high saving-investment association and they could not reject the null hypothesis of $\beta$=1 or 0 capital mobility.

Feldstein and Horioka (1980) discuss that an increase in the saving rate in a country would cause an increase in investment in all countries under a perfect world capital mobility[2] and the distribution of the incremental capital among countries would vary positively with each country's initial capital stock and inversely with the elasticity of the country's marginal product of capital schedule. The value $\beta$ would be zero by perfect world capital mobility when the country is infinitesimally small relative to the world economy. The value $\beta$ would be close to one when most of the incremental saving in each country has remained there. The identification of the value $\beta$ as a measure of international capital mobility has been widely challenged since structural parameters are not obvious to measure what supposed to measure (see Coakley, et al. (1998)). Testing $\beta$=1 is equivalent to testing the hypothesis that the international capital flows do not depend on domestic saving rates.

The Feldstein and Horioka equation (2.1) can be re-parametrized by the current account B=S-I,

$$(\frac{B}{Y})_i = -\alpha + (1-\beta)\left(\frac{S}{Y}\right)_i + \varepsilon_i, \qquad (2.2)$$

Feldstein and Horioka (1980) interpret that changing in saving is reflected in changing in investment and has no effect on the current account with zero world capital mobility. This conflicts

[2] Assumption on perfect capital mobility is inconsistent with the traditional Keynesian interpretation that exogenous changes in the level of investment cause income to vary until the resulting saving level equals investment.

with the tradition of exchange rate and open economy models. The Feldstein and Horioka puzzle is further exacerbated by the high degree of capital mobility.

Chan, et al. (2011) adapt the Feldstein and Horioka equation (2.1) to analyze capital in China during the period of 1978-- 2006, with subscript *i* for province or region. Chinese provinces are subject to common policy shocks from the central government and other nationwide shocks that may not have the same impact across them. They argue that provinces are also subject to idiosyncratic shocks that arise from provinces' own policies, and show that there was a significant improvement in capital mobility over time in China during this period. They also find evidence of increasing private capital mobility within China over 1978--2006, and significant regional differences in the level of private capital market integration.

In this paper, we use Feldstein and Horioka equation (2.1) to continue analyze the saving and investment in China from 1952 to 2011 with respect to various economic policies developed in three different periods. The results are further extended from linear regressions to nonlinear regressions. Various saving and investment relations are analyzed.

## 3. Econometric models

We study the Feldstein and Horioka equation (2.1) for overall period from 1952 to 2011 and three subperiods from 1952 to 1978 (national planned economy period), from 1979 to 1999 (initial economic reform period) and from 2000 to 2011 (stimulating and further reform period). Due to the economic reform since 1978, the saving and investment relation changes rapidly comparing with the earlier period form 1952 to 1978. We propose some nonlinear regressions to reflect the changing economic environment in China.

We first verify the convex nonlinear regression in the following.

$$(\frac{I}{Y})_i = \alpha + \beta(\frac{S}{Y})_i + \gamma(\frac{S}{Y})_i^2 + \varepsilon_i, \qquad i = 1,2, \dots \dots, N, \qquad (3.1)$$

where *I* is the national investment (public and private) of China in year i, S is the national saving and Y is the GDP national income in year i. (3.1) is a nonlinear relation between the domestic saving and the domestic investment in China during the period N we consider. We also verify the different concave nonlinear regression in the following.

$$\left(\frac{I}{Y}\right)_i = \alpha + \beta\left(\frac{S}{Y}\right)_i + \gamma\left(\frac{S}{Y}\right)_i^{\frac{1}{2}} + \varepsilon_i, \qquad i = 1,2, \dots \dots, N, \qquad (3.2)$$

The concave down nonlinear regression (3.2) shows slower investment rate with respect to the domestic saving change than the concave up nonlinear regression (3.1) has. The result reflects the faster growth on investment in (3.1) as the rapid development in China on both domestic saving and domestic investment.

We also examine the possibilities that the link between domestic investment and domestic saving varies with the degree of openness of the economy. The value β is extended to the measure of the openness of the economy as β= $\beta_0 + \beta_1 X_i$ in

$$(\frac{I}{Y})_i = \alpha + (\beta_0 + \beta_1 X_i)\left(\frac{S}{Y}\right)_i + \varepsilon_i, \qquad i = 1,2, \dots \dots, N, \qquad (3.3)$$

where $X_i$ stands for the openness or closeness of the Chinese economy in the year *i*. The openness is measured by the share of trade in GDP as measured by the sum of exports and imports per RMB of

GDP. The estimate of $\beta_1$ is positive during the subperiod of 1952--1978, and negative on both subperiods of 1979--1999 and 2000--2011. The positive number $\beta_1$ during the subperiod of 1952--1978 is very significant to distinguish the economic reform and economic developing periods. Our result of negative $\beta_1$on both subperiods of 1979--1999 and 2000—2011 are quite large in the size comparing with the negative $\beta_1$ for developed countries. This might be a special feature on the Chinese economic developing pattern, since the negative $\beta_1$for developed countries are similar for each individual subperiod and are not significant different from zero as observed in Feldstein and Horioka (1980).

The total domestic saving consists of three components from household saving, corporate saving and the government saving. This disaggregation is important to see if the domestic investment is equally responsive to all different types of savings. The sensitivity of total investment to the different types of saving is relevant for policies that are adjusted to increase/decrease domestic investment by stimulating forms of saving. As the monetary policy of People's Bank of China varies, the domestic investment will response to the policy from household saving, corporate saving and the government saving.

$$(\frac{I}{Y})_i = \alpha + \beta_H(\frac{SH}{Y})_i + \beta_C(\frac{SC}{Y})_i + \beta_G(\frac{SG}{Y})_i\,\varepsilon_i, \qquad i = 1,2,\dots\dots,N, \tag{3.4}$$

where SH is the household saving, SC is corporate saving and SG is government saving. Relations between the components of savings and the domestic investment are given in Table 5. The government saving FH coefficient $\beta_G$ is gradually decreasing from all three different statistical methods.

## 4. Empirical results

This paper uses the data from National Bureau of Statistics of China. We collect the investment, the saving and related information from The Annual Report of Chinese Statistics which is available since 1952. The subperiod of 1952--1978 before the economic reform is the time of non-marketing economics in China and planning the growth and development of Chinese economy. The period of 1979--1999 is the initial stage of marketing economics in China after its economic reform. Although the official time for China to join the WTO is on December 11, 2001, Chinese Government started the marketing reform and various international contracts a few years ago. We split this subperiod from 2000 to 2011. The foreign direct investment (FDI) to China started in the earlier economic reform time, the related data can be collected only after 1985. In the investment part, we also consider the domestic investment and foreign investment based on the data. The foreign investment data comes from Chinese International Revenue Balance Sheet in State Administration of Foreign Exchange.

The data on three different subperiods from 1952--1978, 1979--1999 and 2000--2011 is provided in Appendix Table. The value Y as the gross domestic product (GDP) is counted in one hundred million RMB unit, the value $I$ as the national domestic investment is also in one hundred million RMB unit, the value $X_i$ is the ratio of the import with export. Due to the inconsistency on the investment, there are actually three types of investment data. We will estimate three different measures with respect to the three types of investment evaluations. The national domestic investment, the capital total as investment and the foreign direct investment are specified.

Table 1 below presents the linear regression results for three different subperiods for the domestic investment evaluated as the national domestic investment. The adjusted $R^2$ is given in the last column of Table 1. The parameter $\alpha$ is estimated as negative for overall period and two

subperiods after the economic reform. This is different from the OECD countries which are between 0.029 and 0.039 in Table 2 of Feldstein and Horioka (1980). The estimate β for the entire 60 years is 0.571 when gross saving and investment are used. The value β increases from the three different subperiods, from 0.804, 1.117 to 1.963 to indicate the increasing of the index of capital mobility. But the saving rate coefficients based on the net flows are higher than the corresponding coefficients based on gross flows from all three subperiods and the overall period.

**Table 1**. Results of linear regression for parameters in Eq.(2.1)

| (1) period | (2) name | (3) constant | (4) *S/Y* | (5) $R^2$ |
|---|---|---|---|---|
| 1952-1978 | parameter value | 0.052 | 0.804 | 0.907 |
| | p value | 0.056 | 0 | |
| 1979-1999 | parameter value | -0.096 | 1.117 | 0.804 |
| | p value | 0.529 | 0.015 | |
| 2000-2011 | parameter value | -0.412 | 1.963 | 0.864 |
| | p value | 0.005 | 0 | |
| 1952-2011 | parameter value | -0.149 | 0.571 | 0.966 |
| | p value | 0.537 | 0 | |

Parameters in (2.1) from three different periods and the overall period are given in the third column and the fourth column. All three sub-periods integral part's R-squared are higher than 0.8 to indicate the fitting effect is good. The overall period has an R-squared value of 0.966, which indicates an excellent least square linear fitting.

**Table 2**. Results of first non-linear regression for parameters in Eq. (3.1)

| (1) period | (2) name | (3) constant | (4) *S/Y* | (5) $(S/Y)^2$ | (6) $R^2$ |
|---|---|---|---|---|---|
| 1952-1978 | parameter value | 0.102 | 0.430 | 0.653 | 0.910 |
| | p-value | 0.135 | 00363 | 0.419 | |
| 1979-1999 | parameter value | -0.383 | 2.465 | -1.572 | 0.820 |
| | p-value | 0.112 | 0.065 | 0.404 | |
| 2000-2011 | parameter value | 1.414 | -6.160 | 8.893 | 0.919 |
| | p-value | 0.090 | 0.094 | 0.035 | |
| 1952-2011 | parameter value | -0.195 | 1.279 | -1.185 | 0.967 |
| | p-value | 0.149 | 0.003 | 0.086 | |

Parameters in (3.1) from three different periods and the overall period are given in the third column, the fourth column and the fifth column. All three sub-periods integral part's R-squared are higher than 0.8 to indicate the fitting effect is good. The overall period has an R-squared value of 0.967, which indicates an excellent least square non-linear fitting.

Table 2 above illustrates the nonlinear (quadratic) regression results for three different subperiods for the domestic saving and domestic investment. The investment part is measured by

the total national fixed capital investment amount divided by the GDP. The constant parameter $\alpha$ for the subperiod 2000--2011 is 1.414 a significantly positive number, and the linear coefficient $\beta$ is -6.16 way negative in saving perspective as well the nonlinear coefficient $\gamma$ is 8.893 in (3.1). This indicates the highly investment period with strongly nonlinear effect from saving for China in the subperiod 2000-2011. The investment proportion reaches its minimum $\gamma$- $\beta^2/(4\alpha)$ at the saving proportion $-\beta/(2\alpha)$.

**Table 3.** Results of second non-linear regression for parameters in Eq. (3.2)

| (1) period | (2) name | (3) constant | (4) *S/Y* | (5) $(S/Y)^{0.5}$ | (6) $R^2$ |
|---|---|---|---|---|---|
| 1952-1978 | parameter value | 0.343 | 1.822 | -1.100 | 0.888 |
| | p-value | 0.138 | 0.038 | 0.218 | |
| 1979-1999 | parameter value | 0.109 | 2.256 | -1.035 | 0.817 |
| | p-value | 0.835 | 0.097 | 0.520 | |
| 2000-2011 | parameter value | -2.030 | -1.704 | 4.885 | 0.873 |
| | p-value | 0.319 | 0.705 | 0.422 | |
| 1952-2011 | parameter value | 1.418 | 6.717 | -5.966 | 0.847 |
| | p-value | 0 | 0 | 0 | |

Parameters in (3.2) from three different periods and the overall period are given in the third column, the fourth column and the fifth column. All three sub-periods integral part's R-squared are higher than 0.8 to indicate the fitting effect is good.

Table 3 above presents the different nonlinear (square root) regression results of (3.2) for three different subperiods. As Feldstein and Horioka (1980) pointed that the linear approximation of (2.1) is clearly simplification. It is possible that the link between domestic saving and domestic investment become nonlinear as the saving rate varies. The overall nonlinear regression with the best $R^2$ value 0.967 is the quadratic regression in Table 2 for overall period 1952--2011.

**Table 4.** Results of third non-linear regression for parameters in Eq. (3.3)

| (1) period | (2) name | (3) constant | (4) *S/Y* | (5) $X_i$*(*S/Y*) | (6) $R^2$ |
|---|---|---|---|---|---|
| 1952-1978 | parameter value | -0.256 | 1.015 | 0.222 | 0.996 |
| | p-value | 0 | 0 | 0.219 | |
| 1979-1999 | parameter value | -0.502 | 2.441 | -0.686 | 0.837 |
| | p-value | 0.041 | 0.006 | 0.168 | |
| 2000-2011 | parameter value | -0.540 | 2.731 | -0.938 | 0.932 |
| | p-value | 0 | 0 | 0.015 | |
| 1952-2011 | parameter value | -0.055 | 0.647 | 1.036 | 0.893 |
| | p-value | 0.139 | 0 | 0 | |

Parameters in (3.3) from three different periods and the overall period are given in the third column, the fourth column and the fifth column. All three sub-periods integral part's R-squared are higher than 0.8 to indicate the fitting effect is good. The 1952-1978 period has an R-squared value of 0.996, which indicates an excellent least square non-linear fitting.

For various degrees of openness of the Chinese economy, we examine the share of trade in GDP as measured by the sum of exports and imports per RMB of GDP in (3.3). The measure of $\beta_1$ is negative since the Chinese economic reform started in 1979, and the values are -0.686 and -0.938 respectively for 1979--1999 subperiod and 2000-2011 subperiod in Table 4. Those significantly negative values different from zero shows that the difference between China and the other OECD countries in Feldstein and Horioka (1980). The results for subperiods are not similar between the subperiod before the economic reform and the subperiod after the reform. The $\beta_0$ in Table 4 are all positive, only for the subperiod 1952--1978 the estimate of $\beta_0$ is close to 1 (clearly the incremental saving in this subperiod remains in China), and for other two subperiods the $\beta_0$ is more than double of the one (irrationally development through the openness of the economy). At least this shows that the domestic investment proportion relative to GDP is more than the domestic saving proportion since 1979.

**Table 5.1.** Results of fourth non-linear regression for parameters in Eq. (3.4) (gross capital formation / expenditure method GDP)

| (1) period | (2) name | (3) constant | (4) *SH/Y* | (5) *SG/Y* | (6) *SC/Y* | (7) $R^2$ |
|---|---|---|---|---|---|---|
| 1952-1978 | parameter value | 0.033 | -0.835 | 0.883 | 0.889 | 0.911 |
| | p-value | 0.270 | 0.344 | 0 | 0 | |
| 1979-1999 | parameter value | 0.200 | 0.655 | 0.464 | 0.426 | 0.623 |
| | p-value | 0.125 | 0.183 | 0.421 | 0.242 | |
| 2000-2011 | parameter value | 0.190 | 0.628 | 0.960 | 0.390 | 0.828 |
| | p-value | 0.362 | 0.240 | 0.019 | 0.425 | |
| 1952-2011 | parameter value | 0.088 | 0.777 | 0.713 | 0.727 | 0.917 |
| | p-value | 0 | 0 | 0 | 0 | |

Parameters in Table 5.1 from three different periods and the overall period are given in the third column to the sixth column. The 1979-1999 period has an R-squared value of 0.623 which provides a bad fitting result.

**Table 5.2.** Results of fourth non-linear regression for parameters in Eq. (3.4) (gross capital formation / production method GDP)

| (1) period | (2) name | (3) constant | (4) *SH/Y* | (5) *SG/Y* | (6) *SC/Y* | (7) $R^2$ |
|---|---|---|---|---|---|---|
| 1952-1978 | parameter value | 0.025 | -0.647 | 0.995 | 0.819 | 0.893 |
| | p-value | 0.384 | 0.490 | 0 | 0 | |
| 1979-1999 | parameter value | 0.080 | 0.863 | 0.929 | 0.799 | 0.615 |
| | p-value | 0.525 | 0.135 | 0.051 | 0.037 | |
| 2000-2011 | parameter value | 0.237 | 0.534 | 1.326 | 0.215 | 0.935 |
| | p-value | 0.243 | 0.371 | 0.009 | 0.638 | |
| 1952-2011 | parameter value | 0.078 | 0.905 | 0.754 | 0.722 | 0.908 |
| | p-value | 0.004 | 0 | 0 | 0 | |

Parameters in table 5.2 from three different periods and the overall period are given in the third column to the sixth column. The 1979-1999 period has an R-squared value of 0.615 which provides a bad fitting result.

Table (5.1), (5.2) and (5.3) examine the parameters in (3.4) for three different subperiods and overall period for three different measurements of the domestic investment respectively. The corresponding results based on aggregate saving for these periods are presented for comparison for three different ways to measure the investment. The estimates of $\beta_G$ in the subperiod of 2000-2011 in Table (5.1)--(5.3) are significant biggest on the gross government investment. The pattern is the same for three tables, and the relative roles in (3.4) are same for each $\beta_G$ ,$\beta_H$ and $\beta_C$. The coefficient of the aggregate rate is 0.571 in Table 1 for the overall period 1952--2011; the coefficients of household, government and corporate saving are slightly higher than this in previous two methods in Table (5.1) and Table 5.2; while the third way to measure the investment provides both coefficients of household and corporate savings is slightly lower (0.496, 0.442) with $R^2$=0.967 in Table 5.3.

**Table 5.3.** Results of fourth non-linear regression for parameters in Eq. (3.4) (fixed investments / production method GDP)

| (1)period | (2)name | (3)constant | (4)*SH/Y* | (5)*SG/Y* | (6)*SC/Y* | (7) $R^2$ |
|---|---|---|---|---|---|---|
| 1952-1978 | parameter value | -0.027 | -0.157 | 0.798 | 0.383 | 0.827 |
| | p-value | 0.371 | 0.855 | 0 | 0.007 | |
| 1979-1999 | parameter value | -0.016 | 0.323 | 0.638 | 1.077 | 0.850 |
| | p-value | 0.908 | 0.489 | 0.195 | 0.017 | |
| 2000-2011 | parameter value | -0.050 | 1.530 | 3.239 | 0.815 | 0.940 |
| | p-value | 0.920 | 0.311 | 0.007 | 0.477 | |
| 1952-2011 | parameter value | -0.187 | 0.496 | 0.656 | 0.442 | 0.967 |
| | p-value | 0.563 | 0.023 | 0 | 0 | |

Parameters in table 5.3 from three different periods and the overall period are given in the third column to the sixth column. All three sub-periods integral part's R-squared are higher than 0.8 to indicate the fitting effect is good. The overall period has an R-squared value of 0.967 which indicates a best least square non-linear fitting. So we choose the table 5.3 as the final result.

We compute the correlation between the domestic saving and domestic investment in Table 6 for three different subperiods and the overall period. It is a positive correlated relationship for the Chinese domestic investment and domestic saving. We study extensively on the correlation between Chinese domestic saving and investment in another paper.

**Table 6.** Results of correlation analysis for savings ratio and investment proportion

| (1) period | (2) correlation coefficient | (3) *p*-value |
|---|---|---|
| 1952-1978 | 0.780 | 0 |
| 1979-1999 | 0.702 | 0 |
| 2000-2011 | 0.929 | 0 |
| 1952-2011 | 0.874 | 0 |

Results of correlation analysis in section 2 and section 3 from three different periods and the overall period are given in the second column. The 2000-2011 and the overall period's correlation coefficient

are higher than 0.8 to indicate this two periods of savings ratio and investment proportion has a high correlation.

**Table 7.** Results of improved linear regression for parameters in Eq. (2.1)

| (1) period | (2) name | (3) constant | (4) *S/Y* | (5) $R^2$ |
|---|---|---|---|---|
| 1985-2011 | parameter value | -0.367 | 1.884 | 0.939 |
| | p-value | 0 | 0 | |

Parameters in table 7 from 1985-2011 period are given in the third column and the fourth column. The overall period has an R-squared value of 0.939 which indicates a good least square linear fitting.

**Table 8**. Results of first improved non-linear regression for parameters in Eq. (3.1)

| (1) period | (2) name | (3) constant | (4) *S/Y* | (5) $(S/Y)^2$ | (6) $R^2$ |
|---|---|---|---|---|---|
| 1985-2011 | parameter value | -0.092 | 0.578 | 1.507 | 0.939 |
| | p-value | 0.893 | 0.856 | 0.678 | |

Parameters in table 8 from 1985-2011 period are given in the third column to the fifth column. The overall period has an R-squared value 0.939 which indicates a good least square non-linear fitting.

**Table 9.** Results of second improved non-linear regression for parameters in Eq. (3.2)

| (1) period | (2) name | (3) constant | (4) *S/Y* | (5) $(S/Y)^{0.5}$ | (6) $R^2$ |
|---|---|---|---|---|---|
| 1985-2011 | parameter value | 2.64 | 8.97 | -9.265 | 0.931 |
| | p-value | 0.141 | 0.037 | 0.095 | |

Parameters in table 9 from 1985-2011 period are given in the third column to the fifth column. The overall period has an R-squared value 0.931 which indicates a good least square non-linear fitting.

**Table 10.** Results of third improved non-linear regression for parameters in Eq. (3.3)

| (1) period | (2) name | (3) constant | (4) *S/Y* | (5) $X_i$*(*S/Y*) | (6) $R^2$ |
|---|---|---|---|---|---|
| 1985-2011 | parameter value | -0.611 | 2.816 | -0.803 | 0.954 |
| | p-value | 0 | 0 | 0 | |

Parameters in table 10 from 1985-2011 period are given in the third column to the fifth column. The overall period has an R-squared value 0.954 which indicates a good least square non-linear fitting.

**Table 11.** Results of third improved non-linear regression for parameters in Eq. (3.4)

| (1) period | (2) name | (3) constant | (4) *SH/Y* | (5) *SG/Y* | (6) *SC/Y* | (7) $R^2$ |
|---|---|---|---|---|---|---|
| 1985-2011 | parameter value | -0.317 | 1.964 | 1.905 | 1.696 | 0.937 |
| | p-value | 0.01 | 0 | 0 | 0 | |

Parameters in table 11 from 1985-2011 period are given in the third column to the fifth column. The overall period has an R-squared value 0.937 which indicates a good least square non-linear fitting.

The Chinese investment splits into the domestic investment and the foreign direct investment based on the data from Chinese International Revenue Balance Sheet in State Administration of Foreign Exchange. Adapting the national total investment measurement for the investment, we estimate the parameters in Equations (2.1), (3.1)--(3.4) by replacing the left hand $(\frac{I}{Y})_i$ by $(\frac{I}{Y})_i$ $+(\frac{I'}{Y})_i$, where $I'$ represents the foreign direct investment. We summarize our results in Table 7--11 for the period 1985--2011 due to the data of $I'$ available since 1985.

Figure 1 illustrates the graphs of domestic investment proportion and domestic saving proportion since 1952. The graphs between these two ratios clearly are not linear proportion. This suggests that the nonlinear regression in (3.1) and (3.2) are studied. Figure 1 and Figure 2 show that the investment proportion, relative to the saving proportion does depends upon the measurement of the investment from the national domestic investment to the capital total as investment. Figure 3 shows that the ratio of export with respect to import, the increasing curve confirms the Chinese economic development since 1980. It is interesting to observe that the ratio of export with respect to import declines rapidly after the 2007--2008 financial crisis. Figure 4 gives three different ways to measure the domestic saving proportion as we did in Table 5.1--5.3. Figure 5 shows that the ratio of foreign direct investment with respect to GDP is increasing from the 2004 to 2008 before the financial crisis, and there is also a big hump after the Chinese economic reform to open its market during the sub-period 1979--1999.

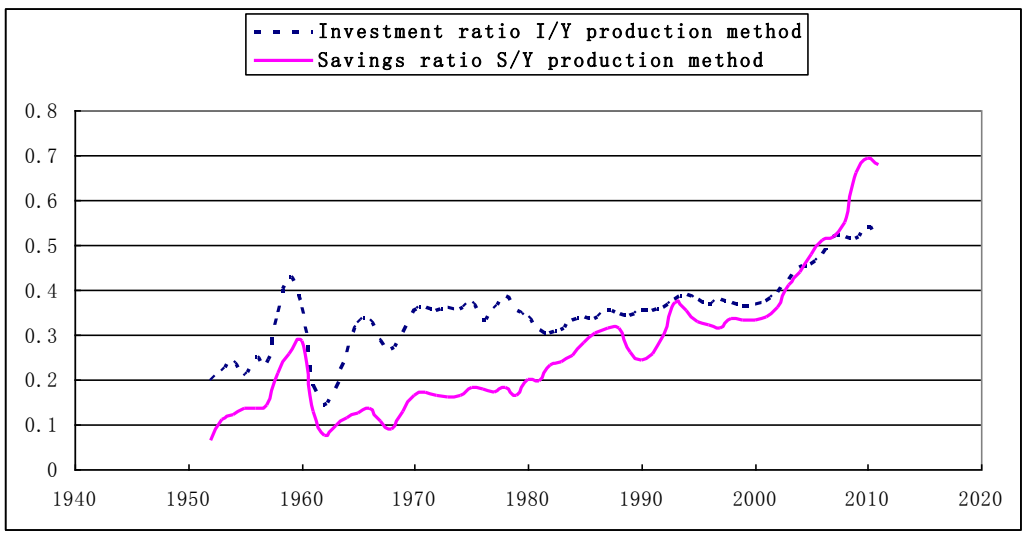


**Figure 1**. Production method of savings and investment proportion(1952~2011)

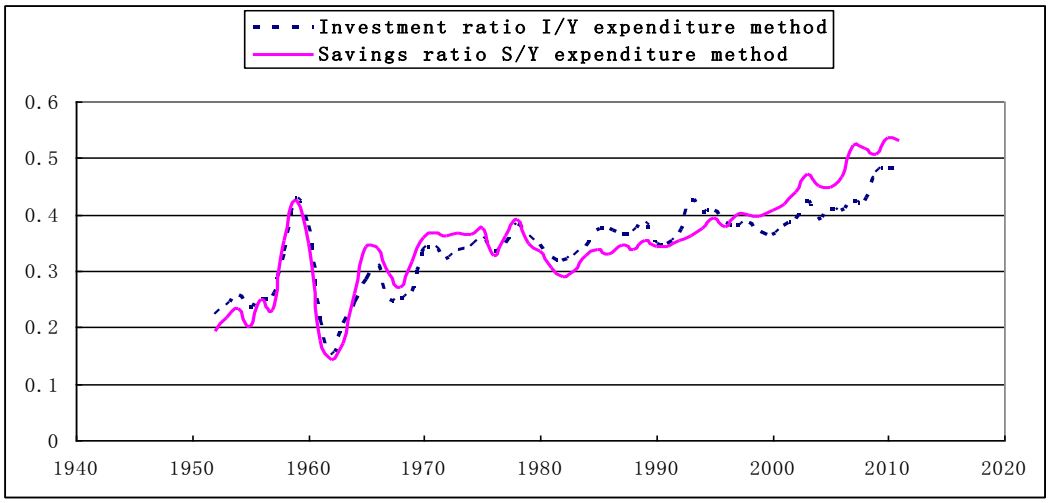


**Figure 2.** expenditure method of savings and investment proportion(1952~2011)

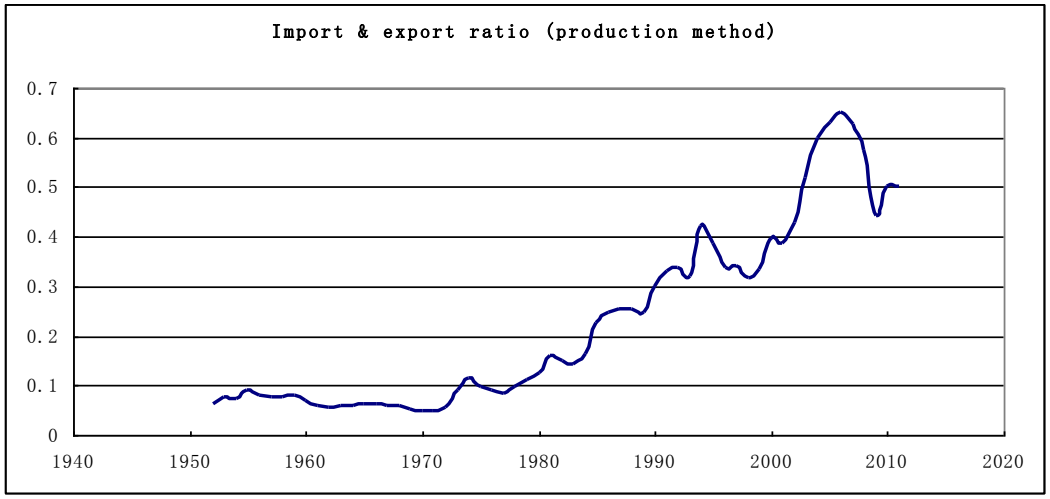


**Figure 3**. production method of import and export ratio(1952~2011)

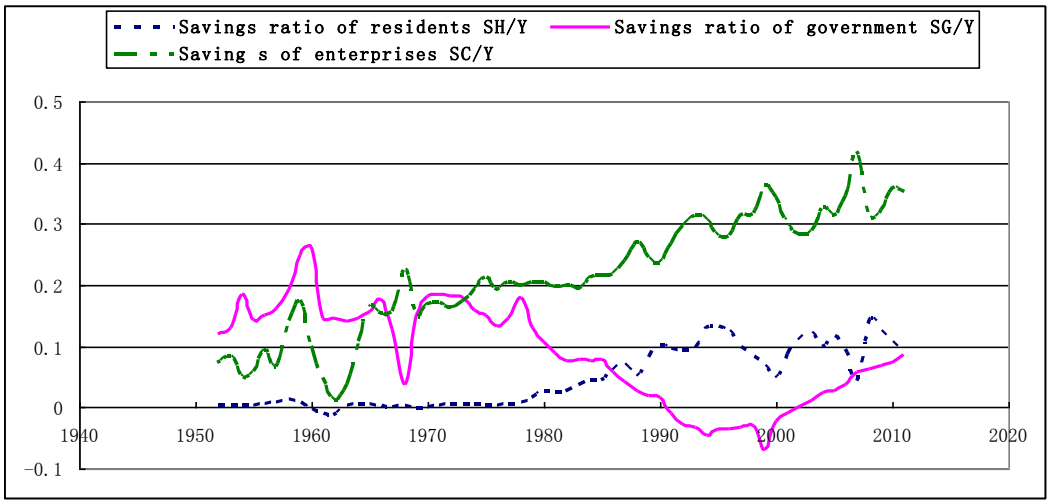


**Figure 4.** production method of three parts savings ratio(1952~2011)

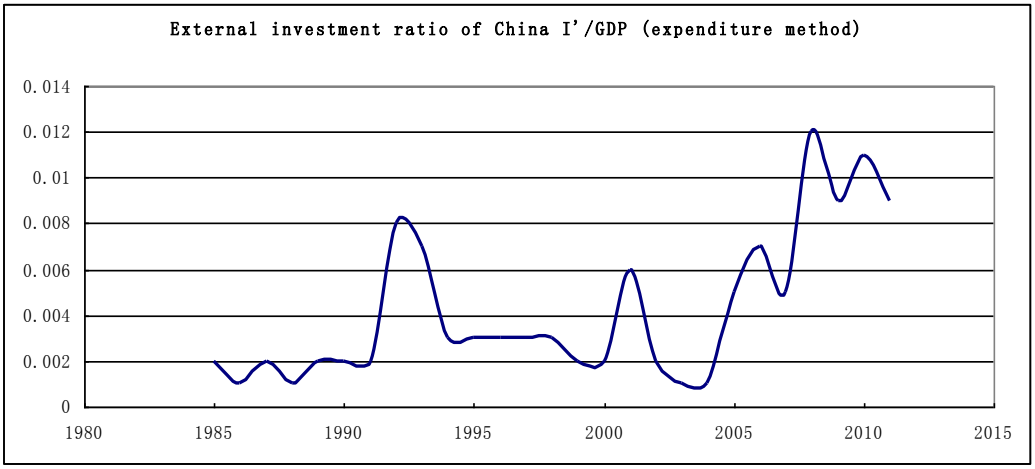


**Figure 5.** directly external investment proportion of China (1952~2011)

## 5. Co-integration analysis between domestic Investment proportion and domestic saving proportion

Co-integration analysis between domestic investment proportion and domestic saving proportion is done in Table 12 (see Bierens, Cointegration Analysis, available on website http://grizzly.la.psu.edu/~hbierens/COINT.PDF for more details). Using Eviews 6.0 software, we get the unit root test results for both domestic investment proportion series and domestic saving proportion series in Table 12, where the ADF values -3.347, -1.027 are bigger than critical value -3.49 that indicate saving and investment proportion series are not steady under 5% significance level (hence, there exists at least one unit root). Due to the non-stationary properties for both domestic investment proportion series and domestic saving proportion series, results in Table 13 are ADF test after first order difference. We get the ADF value -5.687, -5.686 respectively are smaller than critical value -2.915, -2.912 respectively for first order difference saving proportion and first order difference investment proportion that indicate saving and investment proportion series are steady under 5% significance level.

**Table 12**.Results of ADF test for savings ratio in (5.1)

| Unit root test | ADF value | Significance Level 5% | p-value | result |
|---|---|---|---|---|
| Savings ratio *S/Y* | -3.347775 | -3.490662 | 0.0690 | nonstationary |

Put savings proportion series into the Eviews6.0 software, choose unit root test and then select augmented dickey-fuller test. We get the ADF value -3.35 is bigger than critical value -3.49 that indicate s savings proportion series are not steady under 5% significance level.

We then get the saving proportion residual series $\varepsilon_t$ through estimating co-integration regression equation by OLS method.

$$\left(\frac{S}{Y}\right) = 0.216878 + 0.497602\left(\frac{I}{Y}\right) + \varepsilon_t$$

We test the property of stationary of $\varepsilon_t$ in Table 14. The ADF value -4.39 is smaller than critical value -2.91 that indicates the residual series is now steady. So the investment proportion series and saving proportion series are co-integration, i.e., there is a long-term equilibrium relationship between two variables. Table 14 has the ADF value with statistically significant level less than 5%, so that the saving proportion's residual series $\varepsilon_t$ is steady as we expected. Hence, the investment proportion series (*I/Y*) and the saving proportion series (S/Y) are co-integrated.

**Table 13.** Results of ADF test for investment proportion in (5.1)

| Unit root test | ADF value | Significance Level 5% | p-value | result |
|---|---|---|---|---|
| Investment proportion *I/Y* | -1.027285 | -3.490662 | 0.9317 | nonstationary |

We get the ADF value -1.03 is bigger than critical value -3.49 that indicate investment proportion series are not steady under 5% significance level.

**Table 14.** Results of ADF test after first order difference for savings ratio in (5.1)

| Unit root test | ADF value | Significance Level 5% | p-value | result |
|---|---|---|---|---|
| first order difference for savings proportion, $\Delta S/Y$ | -5.687090 | -2.915522 | 0.0000 | steady |

Results in table 14 are ADF test after first order difference. The ADF value -5.69 we got is smaller than critical value -2.92 that indicate savings ratio series are steady under 5% significance level.

**Table 15.** Results of ADF test after first order difference for investment proportion in (5.1)

| Unit root test | ADF value | Significance Level 5% | p-value | result |
|---|---|---|---|---|
| first difference of investment proportion, $\Delta I/Y$ | -5.686638 | -2.912631 | 0.0000 | steady |

Results in table 15, the ADF value -5.69 is smaller than critical value -2.91 that indicate investment proportion series are steady under 5% significance level.

**Table 16**. Results of unit root test for residual series in (5.2)

| Unit root test | ADF value | Significance Level 5% | p-value | result |
|---|---|---|---|---|
| Residual error sequence $\varepsilon_t$ | -4.388083 | -2.912631 | 0.0000 | steady |

Results of stationarity test are in table 16. The ADF value -4.39 is smaller than critical value -2.91 that indicate the residual series is steady. So the investment proportion sequence and savings ratio are cointegration, which has a long-term equilibrium relationship between two variables.

## 6. Conclusion

This paper consists of the innovated nonlinear (square--root) cross-section regression for the domestic investment proportion and the domestic saving proportion for China during the period 1952--2011, and the co-integration test of China saving proportion series and investment proportion series. Instead of focusing on regional capital mobility, we analyze the relation between domestic saving and domestic investment for three sub-periods (1952--1978, 1979--1999, 2000--2011) reflecting to different fiscal policies and economic reforms.

We verify that saving and investment proportion series for China in 1952--2011 period are co-integrated of order one. We also test that the saving proportion residual series through estimating co-integration regression equation given by OLS is stationary. It is important to emphasize that this conclusion is consistent with that of Coakley, et al. (1996) for 23 OECD countries. Our result for China is different from those in literatures for the developing countries among the poor developing countries, since China is no longer a small open economy after 1979. The economic reform and other fiscal policies lead to a different nonlinear behavior of the investment proportion in terms of the saving proportion, and the positive correlation between the domestic saving proportion and domestic investment proportion is statistically significant.

As Coakley, et al. (1996) argued that the Feldstein and Horioka puzzle is a statistical artifact of the cross-section regression, we mainly focus on the relation and correlation between the domestic saving and the domestic investment with respect to the GDP national income for China during the period 1952--2011. Unlike Chan, et al. (2011) focusing on the regional capital mobility by adapting the international economy method into the regional economy in China, we study three different subperiods corresponding to different fiscal policies and economic reforms.

**Acknowledgements:** We are grateful to two anonymous referees for their valuable comments and suggestions.

## References

[1] Arndt, H W. (2013). "Saving, investment and growth: recent Asian experience", *PSL Quarterly Review* 44(177): 151-163.

[2] Bai, Y., and Zhang, J. (2010). "Solving the Feldstein-Horioka puzzle with financial frictions", *Econometrica* 78(2): 603-632.

[3] Baxter, M., and Crucini, M. (1993). "Explaining Saving-Investment correlations", *The American Economic Review* 83(3): 416-436.

[4] Byrne, J., Fazio, G., and Fiess, N. (2009). "The Global side of the investment-Saving puzzle", *Journal of Money, Credit and Banking* 41(5): 1033-1040.

[5] Chan, K., Dang, V. Q. T., Lai, J. T., and Yan, I. K. M. (2011). "Regional capital mobility in China: 1978--2006", *Journal of International Money and Finance* 30(7): 1506-1515.

[6] Coakley, J., Kulasi, F., and Smith, R. (1996). Current Account Solvency and the Feldstein-Horioka puzzle, *The Economic Journal* 106(436): 620-627.

[7] Coakley, J., Kulasi, F., and Smith, R.(1998). "The Feldstein-Horioka puzzle and capital mobility: A review", *International Journal of Finance and Economics* 3(2): 169-188.

[8] Dooley, M., Frankel, J., and Mathieson, D. J. (1987). "International capital mobility: what do saving-investment correlations tell us ?", *IMF Staff Paper*, 34(3): 503-529.

[9] Feldstein, M., and Horioka, C. (1980). "Domestic saving and international capital flows", *The Economic Journal* 90(358): 314-329.

[10] Guzel, A., and Ozdemir, Z. A. (2011). "The Feldstein-Horioka puzzle in the presence of structural shifts: the case of Japan versus the USA", *Research in International Business and Finance* 25(2): 195-202.

[11] Ma, G., McCauley, R., and Lam, L. (2013). "The Roles of Saving, Investment and the Renminbi in Rebalancing the Chinese Economy", *Review of International Economics* 21(1): 72-84.

[12] Mamingi, N. (1994). "Saving-Investment correlations and capital mobility in developing countries", *The World Bank Policy Research Working Paper*, No. 1211.

[13] Narayan, P K. (2005). "The saving and investment nexus for China: evidence from cointegration tests", *Applied Economics*, 37 (17): 1979-1990.

[14] Obstfeld, M. (1986). "Capital mobility in the world economy: Theory and Measurement", *Carnegie-Rochester Conference Series on Public Policy*, 24(1): 55-103.

[15] Onafowara , O. A., Owoye, O., and Huart, F. (2011). "The temporal relationship between saving and investment: Evidence from advanced EU countries", *International Journal of Business and Social Science*, 2(2): 1-12.

[16] Prasad, E. (2009). "Rebalancing growth in Asia", *Finance and Development* 46(4): 19-22.

[17] Ramakrishna, G., and Venkateshwar Rao, S. (2012). "The Long run Relationship between Savings and Investment in Ethiopia: a Cointegration and ECM Approach", *Developing Country Studies*, 2 (4): 1-7.

[18] Sachsida, A., and Caetano, M. A. (2000). "The Feldstein-Horioka puzzle revisited", *Economics Letter* 68(1): 85-88.

[19] Tobin, J. (1983). "Domestic saving and international capital movements in the long run and the short run by M. Feldstein", *European Economic Review* 21(1-2): 153-156.

[20] Vamvakidis, A., and Wacziarg, R. (1998). "Developing countries and the Feldstein-Horioka puzzle", *IMF Working Paper*, No. 98/2.

**Appendix Table 1.** The data of China's investment and saving in 1952-2011

| (1) Year | (2) Investment proportion *I/Y*, production method | (3) Savings proportion *S/Y*, production method | (4) Investment proportion *I/Y*, expenditure method | (5) Savings proportion *S/Y*, expenditure method | (6) Savings proportion of residence *SH/Y* | (7) Savings proportion of government *SG/Y* | (8) Savings proportion of enterprises *SC/Y* | (9) Import & export ratio $X_i$ | (10) external investment proportion of China *I'/GDP* |
|---|---|---|---|---|---|---|---|---|---|
| 1952 | 0.195 | 0.064 | 0.222 | 0.192 | 0.003 | 0.119 | 0.074 | 0.064 | - |
| 1953 | 0.218 | 0.111 | 0.238 | 0.216 | 0.004 | 0.131 | 0.083 | 0.075 | - |
| 1954 | 0.239 | 0.123 | 0.258 | 0.234 | 0.004 | 0.184 | 0.051 | 0.074 | - |
| 1955 | 0.206 | 0.134 | 0.237 | 0.201 | 0.004 | 0.142 | 0.059 | 0.090 | - |
| 1956 | 0.249 | 0.136 | 0.249 | 0.248 | 0.007 | 0.150 | 0.093 | 0.081 | - |
| 1957 | 0.237 | 0.142 | 0.254 | 0.230 | 0.008 | 0.162 | 0.066 | 0.076 | - |
| 1958 | 0.349 | 0.214 | 0.335 | 0.353 | 0.015 | 0.192 | 0.141 | 0.077 | - |
| 1959 | 0.430 | 0.256 | 0.428 | 0.426 | 0.009 | 0.248 | 0.173 | 0.080 | - |
| 1960 | 0.360 | 0.286 | 0.381 | 0.348 | -0.001 | 0.262 | 0.100 | 0.068 | - |
| 1961 | 0.185 | 0.128 | 0.215 | 0.177 | -0.009 | 0.146 | 0.048 | 0.059 | - |
| 1962 | 0.144 | 0.076 | 0.151 | 0.141 | -0.012 | 0.145 | 0.012 | 0.057 | - |
| 1963 | 0.180 | 0.095 | 0.205 | 0.172 | 0.004 | 0.140 | 0.037 | 0.058 | - |
| 1964 | 0.259 | 0.114 | 0.243 | 0.261 | 0.007 | 0.145 | 0.108 | 0.059 | - |
| 1965 | 0.325 | 0.126 | 0.284 | 0.342 | 0.006 | 0.155 | 0.164 | 0.061 | - |
| 1966 | 0.333 | 0.136 | 0.312 | 0.340 | 0.004 | 0.176 | 0.153 | 0.061 | - |
| 1967 | 0.284 | 0.106 | 0.249 | 0.295 | 0.001 | 0.128 | 0.156 | 0.058 | - |
| 1968 | 0.268 | 0.088 | 0.253 | 0.270 | 0.003 | 0.038 | 0.227 | 0.058 | - |
| 1969 | 0.303 | 0.127 | 0.262 | 0.316 | -0.001 | 0.152 | 0.152 | 0.051 | - |
| 1970 | 0.352 | 0.163 | 0.338 | 0.359 | 0.002 | 0.182 | 0.168 | 0.050 | - |
| 1971 | 0.362 | 0.172 | 0.342 | 0.367 | 0.004 | 0.185 | 0.172 | 0.049 | - |
| 1972 | 0.352 | 0.164 | 0.322 | 0.361 | 0.006 | 0.181 | 0.165 | 0.056 | - |
| 1973 | 0.361 | 0.161 | 0.338 | 0.368 | 0.006 | 0.180 | 0.175 | 0.089 | - |
| 1974 | 0.356 | 0.166 | 0.342 | 0.363 | 0.005 | 0.158 | 0.193 | 0.115 | - |
| 1975 | 0.370 | 0.182 | 0.360 | 0.376 | 0.004 | 0.152 | 0.214 | 0.097 | - |
| 1976 | 0.331 | 0.178 | 0.334 | 0.328 | 0.003 | 0.134 | 0.193 | 0.090 | - |
| 1977 | 0.357 | 0.171 | 0.347 | 0.361 | 0.007 | 0.145 | 0.205 | 0.085 | - |
| 1978 | 0.386 | 0.183 | 0.382 | 0.390 | 0.008 | 0.179 | 0.199 | 0.097 | - |
| 1979 | 0.352 | 0.165 | 0.361 | 0.349 | 0.017 | 0.129 | 0.205 | 0.112 | - |
| 1980 | 0.338 | 0.200 | 0.346 | 0.335 | 0.026 | 0.106 | 0.206 | 0.125 | - |
| 1981 | 0.312 | 0.196 | 0.325 | 0.305 | 0.025 | 0.090 | 0.197 | 0.160 | - |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1982 | 0.304 | 0.231 | 0.319 | 0.289 | 0.028 | 0.075 | 0.200 | 0.150 | - |
| 1983 | 0.312 | 0.240 | 0.328 | 0.299 | 0.036 | 0.079 | 0.196 | 0.143 | - |
| 1984 | 0.333 | 0.254 | 0.342 | 0.326 | 0.045 | 0.075 | 0.213 | 0.164 | - |
| 1985 | 0.339 | 0.282 | 0.373 | 0.337 | 0.045 | 0.078 | 0.215 | 0.227 | 0.002 |
| 1986 | 0.336 | 0.304 | 0.375 | 0.329 | 0.060 | 0.059 | 0.217 | 0.248 | 0.001 |
| 1987 | 0.352 | 0.314 | 0.363 | 0.346 | 0.070 | 0.043 | 0.239 | 0.255 | 0.002 |
| 1988 | 0.346 | 0.316 | 0.370 | 0.338 | 0.049 | 0.026 | 0.271 | 0.254 | 0.001 |
| 1989 | 0.343 | 0.260 | 0.385 | 0.354 | 0.081 | 0.018 | 0.244 | 0.247 | 0.002 |
| 1990 | 0.355 | 0.242 | 0.349 | 0.343 | 0.103 | 0.016 | 0.236 | 0.298 | 0.002 |
| 1991 | 0.355 | 0.257 | 0.348 | 0.343 | 0.097 | -0.010 | 0.267 | 0.332 | 0.002 |
| 1992 | 0.362 | 0.300 | 0.366 | 0.353 | 0.094 | -0.027 | 0.295 | 0.339 | 0.008 |
| 1993 | 0.378 | 0.370 | 0.426 | 0.362 | 0.097 | -0.032 | 0.313 | 0.319 | 0.007 |
| 1994 | 0.391 | 0.354 | 0.405 | 0.376 | 0.131 | -0.045 | 0.306 | 0.423 | 0.003 |
| 1995 | 0.379 | 0.329 | 0.408 | 0.394 | 0.134 | -0.035 | 0.281 | 0.387 | 0.003 |
| 1996 | 0.368 | 0.323 | 0.387 | 0.378 | 0.124 | -0.036 | 0.280 | 0.339 | 0.003 |
| 1997 | 0.379 | 0.316 | 0.381 | 0.400 | 0.098 | -0.033 | 0.313 | 0.341 | 0.003 |
| 1998 | 0.372 | 0.337 | 0.385 | 0.398 | 0.084 | -0.029 | 0.317 | 0.318 | 0.003 |
| 1999 | 0.366 | 0.333 | 0.369 | 0.397 | 0.069 | -0.068 | 0.364 | 0.333 | 0.002 |
| 2000 | 0.368 | 0.332 | 0.364 | 0.408 | 0.047 | -0.023 | 0.343 | 0.396 | 0.002 |
| 2001 | 0.375 | 0.339 | 0.380 | 0.417 | 0.086 | -0.010 | 0.299 | 0.385 | 0.006 |
| 2002 | 0.393 | 0.361 | 0.392 | 0.438 | 0.110 | 0.001 | 0.282 | 0.427 | 0.002 |
| 2003 | 0.423 | 0.409 | 0.422 | 0.472 | 0.122 | 0.012 | 0.288 | 0.519 | 0.001 |
| 2004 | 0.451 | 0.441 | 0.392 | 0.449 | 0.100 | 0.025 | 0.326 | 0.598 | 0.001 |
| 2005 | 0.457 | 0.480 | 0.410 | 0.448 | 0.116 | 0.028 | 0.313 | 0.632 | 0.005 |
| 2006 | 0.477 | 0.509 | 0.408 | 0.467 | 0.095 | 0.038 | 0.344 | 0.652 | 0.007 |
| 2007 | 0.518 | 0.517 | 0.422 | 0.523 | 0.041 | 0.058 | 0.418 | 0.628 | 0.005 |
| 2008 | 0.519 | 0.550 | 0.424 | 0.517 | 0.144 | 0.062 | 0.312 | 0.573 | 0.012 |
| 2009 | 0.514 | 0.660 | 0.475 | 0.506 | 0.126 | 0.067 | 0.321 | 0.442 | 0.009 |
| 2010 | 0.539 | 0.693 | 0.481 | 0.537 | 0.106 | 0.074 | 0.359 | 0.502 | 0.011 |
| 2011 | 0.523 | 0.678 | 0.483 | 0.531 | 0.085 | 0.085 | 0.353 | 0.500 | 0.009 |