THE FELDSTEIN-HORIOKA PUZZLE
IN THE PRESENCE OF STRUCTURAL BREAKS: EVIDENCE FROM CHINA

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ABSTRACT

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This study explores the empirical validity of the Feldstein-Horioka puzzle for China in the presence of structural breaks. To this end, we employ the recently proposed multiple-break cointegration test of Maki (2012), along with the one-break Gregory and Hansen (1996) cointegration test. Once the existence of the cointegration between domestic savings and investment is ensured by allowing for endogenous structural breaks, Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) estimation procedures are implemented to obtain reliable inferences from the cointegrating regression. Empirical results reveal that the relationship between Chinese domestic savings and investment has changed with the regime shift towards flexible exchange rates and the 2008-2009 global financial crises. More specifically, with the introduction of managed floating exchange rate regime, a substantial reduction is observed in the almost unitary saving retention coefficient of the fixed exchange rate period. Furthermore, the correlation has experienced a slight increase since 2009, which coincides with the worldwide protectionist policies adopted in the depth of the global financial crisis.

Keywords: Feldstein-Horioka, saving, investment, structural breaks.

ÖZ

YAPISAL KIRILMALAR VARLIĞINDA FELDSTEIN-HORIOKA SORUNSALI: ÇİN ÖRNEĞİ

Orman, Ethem Erdem
Yüksek Lisans, İktisat Bölümü
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Bu çalışma yapısal kırılmalar varlığında Çin için Feldstein-Horioka sorunsalının ampirik geçerliliğini incelemektedir. Bu amaçla, tek kırılmalı Gregory ve Hansen (1996) eşbütünleşme testi ile birlikte, yakın zamanda önerilen Maki'nin (2012) çoklu kırılmalı eşbütünleşme testi uygulanmaktadır. Yurtiçi tasarruflar ve yatırımlar arasında eşbütünleşmenin varlığı içsel yapısal kırılmalar ile sağlandıktan sonra, eşbütünleşme regresyonundan güvenilir sonuçlar elde edebilmek için Tam Değiştirilmiş En Küçük Kareler (FMOLS) ve Dinamik En Küçük Kareler (DOLS) tahmin yöntemleri uygulanmaktadır. Ampirik sonuçlar, Çin'de yurtiçi tasarruflar ve yatırımlar arasındaki ilişkinin dalgalı kur sistemine doğru rejim değişikliği ve 2008-2009 küresel finans krizleri ile değiştiğini göstermektedir. Daha belirgin olarak, yönetimli dalgalı kur rejiminin başlamasıyla birlikte, sabit kur dönemindeki bire yakın olan tasarruf alıkoyma katsayısında önemli ölçüde düşüş gözlemlenmektedir. Buna ek olarak, küresel finans krizi döneminde dünya genelinde benimsenen korumacı politikalarla örtüşerek, 2009'dan itibaren bu korelasyonda hafif artış gerçekleşmiştir.

Anahtar kelimeler: Feldstein-Horioka, tasarruf, yatırım, yapısal kırılmalar.

To My Family

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LIST OF ABBREVIATIONS

ADF	: Augmented Dickey-Fuller
AIC	: Akaike Information Criterion
ARDL	: Autoregressive Distributed Lag
ARMA	: Autoregressive Moving Average
DGP	: Data Generating Process
DOLS	: Dynamic Ordinary Least Squares
EU	: European Union
FDI	: Foreign Direct Investment
FH	: Feldstein-Horioka
FMOLS	: Fully Modified Ordinary Least Squares
GDP	: Gross Domestic Product
G7	: Group of 7
OECD	: Organisation for Economic Co-operation and Development
OLS	: Ordinary Least Squares
PBOC	: People's Bank of China
PP	: Phillips-Perron
SSR	: Sum of Squared Residuals
UK	: United Kingdom
US	: United States
WDI	: World Development Indicators
WTO	: World Trade Organisation

CHAPTER 1

INTRODUCTION

The term *'puzzle'* is used by economists to define the case where empirical findings do not confirm the theoretical expectations. One of the most famous puzzles in open economy macroeconomics is the Feldstein-Horioka puzzle attributed to the pioneer study of Feldstein and Horioka (henceforth FH) in 1980. In their seminal paper, FH argue that the correlation between domestic savings and investment should be high in an isolated economy since investments can only be funded by domestic savings. In an open economy, on the other hand, there should be no relationship between domestic savings and investment since domestic savings seek for global investment opportunities with the highest returns while domestic investment can be financed by foreign savings. With this argument, FH conduct a cross-sectional analysis for 16 OECD countries by taking the sample period between 1960 and 1974. They observe that there is a strong correlation between domestic savings and investment and the relation has not weakened over time, suggesting that capital is immobile in the OECD countries. These empirical findings, however, strongly contradict with the situation of perfect capital mobility of industrialized countries, which was achieved via financial market deregulations and liberalization of capital controls, as underlined by Frankel and MacArthur (1987). This contradiction was named as the FH puzzle and has raised a great deal of attention among economists.

Since then the FH puzzle has been one of the most explored issues in international finance, with numerous studies attempting to solve the puzzle. Some of these studies, including Summers (1988), Obstfeld and Rogoff (1995), Coakley et al. (1996), and Ho (2003) refuse the idea that persistent correlation between domestic savings and investment indicates low level of capital mobility. They argue that exogenous factors like long-run current account solvency constraint, government policies targeting sustainable current account, size of countries, and domestic and global production shocks may breed a strong saving-investment link.

On the other hand, supporting the approach of FH, other studies attempt to explain the puzzling results on methodological and econometric grounds by applying cross-section, panel data or time series estimation procedures. Despite many investigations (including Frankel et al., 1986; Krol, 1996; Corbin, 2001; Kollias et al., 2008; Murthy, 2009), whether the FH puzzle is valid or not remains largely inconclusive within the cross-sectional or panel data context. Studies, adopting time series methods, mainly focus on the role of policy regime changes. Sarno and Taylor (1998), De Vita and Abbott (2002), Özmen and Parmaksız (2003a, 2003b), and Mastroyiannis (2007), amongst others, argue that policy regime changes might introduce structural breaks into the saving-investment relationship. Subsequently, they observe that accounting for those structural breaks weakens or dispels the original strong results of FH.

The objective of this thesis is to explore the FH puzzle for the case of China over the period 1970-2013. Given that China is one of the greatest economic success stories having high growth rate, it is important to examine the link between domestic savings and investment for that country. The main idea behind this study is to uncover the actual saving-investment link in the existence of breaks. In this sense, we employ the recently proposed multiple-break cointegration test of Maki (2012), along with the one-break Gregory-Hansen (1996) cointegration test. To obtain reliable statistical inferences on how the relationship between domestic savings and investment changes with observed break dates, the cointegrating regression is estimated through the FMOLS approach proposed by Phillips and Hansen (1990) and the DOLS procedure of Stock and Watson (1993).

Roughly, our empirical findings reveal a significant long-run association between China's domestic savings and investment over the study period. Allowing for endogenously-determined structural breaks, however, it is observed that the association changes with the introduction of the managed floating exchange rate system and the 2008-2009 global financial crises in a consistent way with economic and financial conditions of China.

The rest of the study is organized as follows. Chapter 2 overviews the literature on the FH puzzle, while Chapter 3 presents a brief review of the Chinese economy. Chapter 4 and 5, respectively, describe the data and econometric methodology we implement. Substantive empirical results are discussed in Chapter 6 and Chapter 7 finalizes the study.

CHAPTER 2

LITERATURE REVIEW

Given its importance in open economy macroeconomics and policy implications, the FH puzzle has initiated an enormous literature and it is growing with the availability of more sophisticated approaches.[1]

The literature on the FH puzzle has in fact developed in two directions. The first line of the literature states that the FH approach of investigating the saving-investment nexus is inappropriate for measuring the degree of capital mobility. This line of research claims that even in models with perfect capital mobility saving and investment could be correlated due to some factors that affect both saving and investment. For example, Sinn (1992), Obstfeld and Rogoff (1995), Coakley et al. (1996), Jansen (1996), and Coakley and Kulasi (1997) argue that since the current account balance equals to the difference between saving and investment, a strong correlation between these variables implies nothing but the sustainability of current account in the long-run regardless of the degree of capital mobility. Similarly, Summers (1988), Bayoumi (1989), Artis and Bayoumi (1989), Gundlach and Sinn (1991), and Levy (1995) indicate that the high level of capital mobility and persistent relationship between domestic savings and investment may coexist with the policies aiming to obtain a balanced current account. More specifically, the presence of strong correlation between domestic savings and investment is not necessarily due to imperfect capital mobility but implication of monetary and/or fiscal policies to stabilize the imbalances in current account.

According to this line of research, another reason behind the high level of correlation between domestic savings and investment in a fully integrated economy is the country-size effect. In this context, Baxter and Crucini (1993), Coakley et al. (1998),

[1] An excellent review of the FH puzzle can be found in Apergis and Tsoumas (2009).

and Ho (2003) argue that if the country is large enough to influence interest rates, any increase in national savings will reduce world interest rates and increase investment in that country. Hence, a strong correlation will be observed between domestic savings and investment despite the free movement of capital. Harberger (1980), on the other hand, proposes a different version of the country-size effect. He argues that as countries become larger they rely less on foreign savings for investment as their investment will be mainly funded by domestic savings, suggesting a high correlation between domestic savings and investment irrespective of the capital mobility degree. Subsequently, Bahmani-Oskooee and Chakrabarti (2005) provide empirical evidence for the importance of the country size, which is approximated by the income level. More specifically, in a group of 126 countries over the period between 1960 and 2000, they find that the countries with high income have a stronger correlation between saving and investment than those with low and middle incomes.

The second strand of the literature supports the approach of FH in measuring capital mobility and attempts to explain the puzzle by adopting various econometric methodologies. Following FH, earlier studies, including Feldstein (1983), Frankel et al. (1986), and Feldstein and Bacchetta (1989) examine the FH puzzle by using the cross-sectional approach. However, the strong correlation between domestic savings and investment is almost confirmed for industrial and developing countries even for longer periods. Indeed, Frankel et al. (1986) conclude that the correlation is higher for industrialized countries than for developing countries.

There are also researchers analyzing the FH puzzle within a panel context. Many of these studies, however, provide a high saving-investment correlation for developed countries which suggests low capital mobility according to the FH approach, e.g. Corbin (2001), Chakrabarti (2006), Adedeji and Thornton (2008), and Pelgrin and Schich (2008). Unlike these studies, Krol (1996) and Kollias et al. (2008) observe a low correlation between domestic savings and investment in a sample of 21 OECD countries and EU15 countries over the period 1962-1990 and 1962-2002, respectively. The empirical findings of Krol (1996), however, fall under the criticisms of Coiteux and Olivier (2000) and Jansen (2000). They argue that exclusion of Luxembourg from the sample reverses the low correlation finding of Krol (1996) and validates the FH puzzle. On the other hand, Murthy (2009), for 14 Latin American and 5 Caribbean countries, shows that during the period between 1960 and 2002 FH argument is not valid which is in conformity with the recent developments (e.g. enhanced financial integration, deregulation of banking sector, and relaxing the capital controls) that the sampling countries have witnessed. Similar to Murthy (2009), Kim et al. (2005) and Bangake and Eggoh (2011) observe a low correlation between domestic savings and investment for Asian and African countries, respectively.

Overall, in a cross-sectional or panel data context, while some researchers conclude that there is no or weak relationship between domestic savings and investment due to free movement of capital, the others fail to provide empirical evidence against the FH puzzle. According to some economists, cross-sectional and/or panel regressions in the context of FH analysis may entail some problems. For example, Hussein (1998), Athukorala and Sen (2002), and Dursun and Abasız (2014) argue that when the saving-investment relationship is modelled by these approaches misleading results may be obtained due to inclusion of economically large and financially developed countries, which can lead to sample selection bias. Furthermore, the saving-investment dynamics may vary country to country due to differences in the structure of an economy, government policies, and country-specific financial shocks. As underlined by Caporale et al. (2005), Narayan (2005b), and Mastroyiannis (2007), ignoring these differences and expecting the saving-investment nexus to be similar for the whole countries included in the analysis might lead to unreliable inferences on the main question of how much of an increase in saving is truly reflected into domestic investment.

These potential pitfalls have motivated many researchers to investigate the saving-investment link for individual countries through time series methods. Given that international capital mobility is a time-varying issue which cannot be correctly specified by one fixed coefficient, as highlighted by Ho (2000) and Telatar et al.

(2007), among others, most of these studies account for the probability that the correlation between domestic savings and investment might be exposed to various policy regime changes and structural breaks.[2] These studies have developed in two directions. While the first strand relies on exogenously-determined structural breaks and utilizes the standard Engle and Granger (1987) methodology or ARDL bounds testing approach, the second strand of the studies implements appropriate cointegration tests allowing for endogenous structural breaks. In this sense, Miller (1988), Alexakis and Apergis (1994), and De Vita and Abbott (2002), for example, examine the relationship between the US domestic saving and investment over two subperiods, corresponding to fixed and flexible exchange rate system. The results reveal that saving-investment correlation in US weakens after the introduction of the flexible exchange rate regime. Pelagidis and Mastroyiannis (2003) and Mastroyiannis (2007) consider policy regime shifts for Greece and investigate the movement of the saving-investment correlation through the exogenously-determined subperiods. Their results show that after its accession to the EU, Greece experienced a weaker relationship between domestic savings and investment due to higher level of capital market integration. These findings are also confirmed by Lemmen and Eijfinger (1995) and Sarno and Taylor (1998) for the UK when 1979 is taken as a structural break date, which coincides with abolition of exchange controls and removal of barriers to capital flows. Similarly, Payne (2005) reveals a rise in the level of capital mobility in Mexico following the 1982 debt crisis.

All of the above-mentioned studies rely on the assumption that the break date is known priori and examine saving-investment correlation over the subperiods, designed according to the imposed break date(s). Although the assigned break dates are quite reasonable in an economic perspective, such an approach may suffer from a pre-test bias, as argued by Özmen and Parmaksız (2003a, 2003b). This argument initiates the second strand of the time series studies, which utilizes cointegration testing methods allowing for structural breaks determined endogenously in the model to investigate FH puzzle.

[2] There are also some time series studies investigating the FH puzzle without considering the sensitivity of the saving-investment correlation to regime changes, e.g. Jansen and Schulze (1996), Sinha and Sinha (2004), Ang (2007, 2009), and Nasiru and Usman (2013).

In this sense, Özmen and Parmaksız (2003a, 2003b), Narayan and Narayan (2010), Verma and Saleh (2011), and Ketenci (2012) implement the Gregory-Hansen (1996) one-break cointegration test. While Özmen and Parmaksız (2003a) deduce that there is no link between saving and investment for the UK after the removal of foreign exchange controls, Narayan and Narayan (2010) and Verma and Saleh (2011) find no relationship between domestic savings and investment in G7 countries and Saudi Arabia, respectively. Their results also uncover that the capital mobility in these countries is remarkably stable. Ketenci (2012), however, confirms the presence of cointegration relationship between domestic savings and investment in all analyzed 23 EU countries, with the exceptions being Estonia and Portugal. The observed significant but low correlation is assigned to the high capital mobility. The results of Ketenci (2012) also reveal that the correlation between saving and investment could be overestimated if the structural breaks are ignored. On the other hand, considering the possibility that the saving-investment link could be exposed to more than one structural break, Dursun and Abasız (2014) employ the Hatemi-J (2008) two-break cointegration test to analyze the capital mobility in Turkey.[3] Their analysis indicates that with the allowance for two structural breaks the FH puzzle is eliminated for Turkey.

This study aims to examine the FH puzzle for China over the period 1970-2013. As aforementioned, the existing literature has largely focused on OECD and EU countries, while the saving-investment nexus for China is surprisingly under-studied. To the best of our knowledge, the only papers are Narayan (2005a) and Bordoloi and John (2011). Narayan (2005a) investigates the saving-investment correlation over 1952-1994 and 1952-1998 subperiods, the former of which culminates in period of fixed exchange rate regime. Application of the ARDL bounds test along with the one-break Gregory-Hansen (1996) cointegration test to each subperiods, indicates that domestic savings and investment are strongly correlated in China. Overall, despite a very slight reduction in the correlation during the flexible exchange rate regime, empirical findings of Narayan (2005a) validate the FH puzzle for China over

[3] There are also studies investigating the relationship between saving and investment in the existence of regime changes through nonlinear models, e.g. Telatar et al. (2007), Kejriwal (2008), and Chen and Shen (2015).

both subperiods. Bordoloi and John (2011), on the other hand, explore the saving-investment link over the period 1950-2010 by adopting ARDL bounds testing procedure without considering the possible sensitivity of the relationship to the exchange rate regime shift. According to the results, the saving and investment series are found to be cointegrated in China. They further investigate the temporal movement of the correlation by recursive estimates using the data for 1997-2009. The results point to a gradual increase in the correlation during the period 1997-2003, which is followed by a decline till 2008 and an increase afterwards with the global financial crisis of 2008-2009.

Similar to Narayan (2005a), our study aims to explore the FH puzzle in the presence of regime changes. Unlike Narayan (2005a), however, we do not impose an assumption that the break date and corresponding subperiods are precisely known. Instead, we utilize the recent multiple-break cointegration test of Maki (2012), along with the Gregory-Hansen (1996) cointegration test to specify the actual date of structural changes. Given that Chinese economy has undergone a number of dramatic changes during our sample period and the Gregory-Hansen (1996) cointegration test has some serious limitations in the presence of multiple breaks, it is important to use a cointegration test allowing for endogenously-determined multiple breaks. In this way, the temporal movement of the saving-investment correlation might be analyzed more precisely. Finally, although it is partially investigated by Bordoloi and John (2011) over the sample 1997-2009, the extension of the sample period to 2013 enables us to observe more reliable inference on how the global financial turmoil of 2008-2009 has affected the relationship between saving and investment in China.

CHAPTER 3

CHINESE ECONOMY

After the establishment under the leadership of Mao Zedong in 1949, China followed a centrally planned economy until 1979. During the period of 1949-1978, the vast majority of output in the economy was controlled by the central government via setting production targets, price controls, and resource allocation. Private enterprises and foreign investment were not accepted. Foreign trade, on the other hand, was allowed only for the goods which could not be produced in China. The main goal of the government was to achieve self-sufficient Chinese economy without the need to foreign debt and private ownership. Consequently, by 1978 the vast majority of production was undertaken by state-owned enterprises, in line with the centrally planned output targets (Morrison, 2006; Öztürk, 2011; Morrison and Labonte, 2013).

Due to under controlled price and production levels, nonexistence of competition, restricted foreign trade, and investment, the Chinese economy was considered as untenable and an overhaul of the whole system was needed by the late 1970s. Accordingly, the Chinese government decided to leave the closed and centrally managed economy in 1978. With the hope of increasing economic growth and rising living standards, China initiated its economic reforms in 1979. In this respect, the decentralization of economy was adopted by giving the governance of a variety of enterprises to local authorities. The trade barriers were eliminated and FDI inflows were attracted. Moreover, price controlling of the state on a wide range of products was removed and the Chinese people were encouraged to do their own businesses. The government gave incentives for farmers to sell their crops on the free market (Rumbaugh and Blancher, 2004; Morrison, 2006, 2014).

Together with the economic reforms that have opened up Chinese economy to competition and liberalization, its exchange rate policy has also experienced substantial changes over time. The evolution of the exchange rate regime started with the abolishment of administrative exchange rate controls and introduction of dual-exchange rate system in 1981. In the dual-exchange rate system, there were two exchange rates, namely; the official fixed exchange rate for nontrade related transactions and the exchange rate for authorized current account transactions determined in the swap market. After the implementation of the system, however, a sharp depreciation was observed in the market-determined exchange rate while the official exchange rate became relatively overvalued. Therefore, in 1994, the dual exchange rates were unified and a managed floating exchange rate regime was officially introduced. Afterwards, the exchange rate regime reform was continued further by moving from a managed floating exchange rate pegged to the US Dollar towards a basket of currencies in 2005.[4]

With the gradual implementation of economic reforms and exchange rate regime changes, China has experienced a substantial economic growth, as seen in Figure 1. While the real annual GDP growth rate was 6.7 percent on the average for the period 1953-1978, following the introduction of the reforms the growth rate increased to 9.7 percent over the period 1979-1993. In the following two decades, it is observed that the growth rate is still high but almost stable with the rates of 9.2% and 10.2% on the average.

[4] For more detailed discussion on the evolution of the exchange rate policy of China, see Guijun and Schramm (2003), Huang and Wang (2004), and Cui (2014).

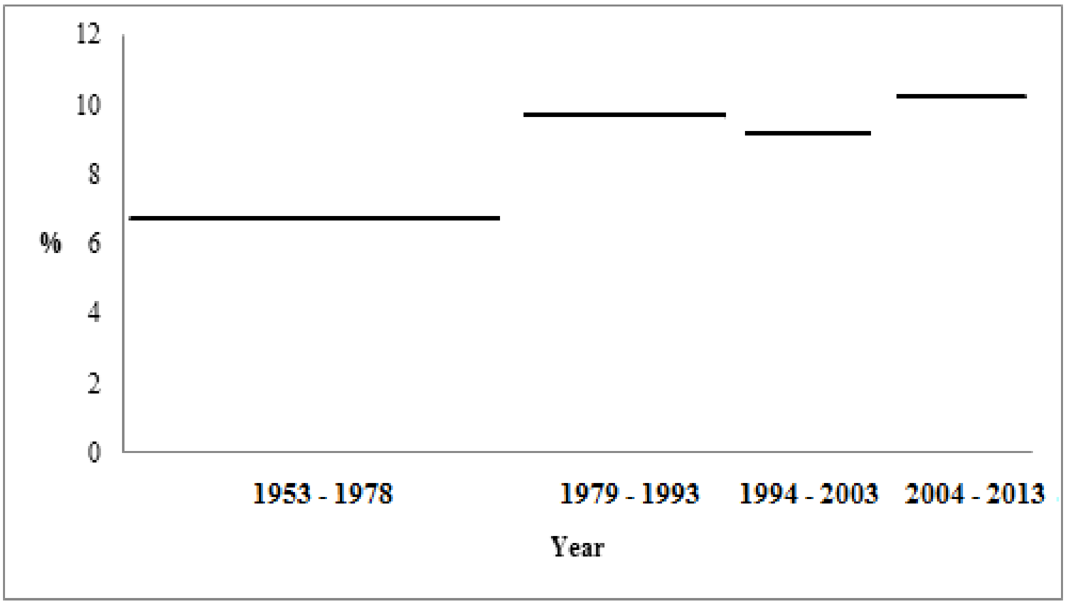

Figure 1: Chinese average real GDP growth rates over the period 1953-2013

(Source: *www.chinability.com*)

Obviously, the role of trade in promoting such an economic growth cannot be denied. By opening up the Chinese economy to the outside world, China has experienced a vast trade expansion in the 1990s (PBOC, 2008). Figure 2 clearly illustrates that since the mid-1990s, the Chinese exports have always surpassed imports and the trade surplus has become the main source of the current account surplus. Furthermore, after being a member of WTO in 2001, China's trade skyrocketed, as underlined by Liu et al. (2009).

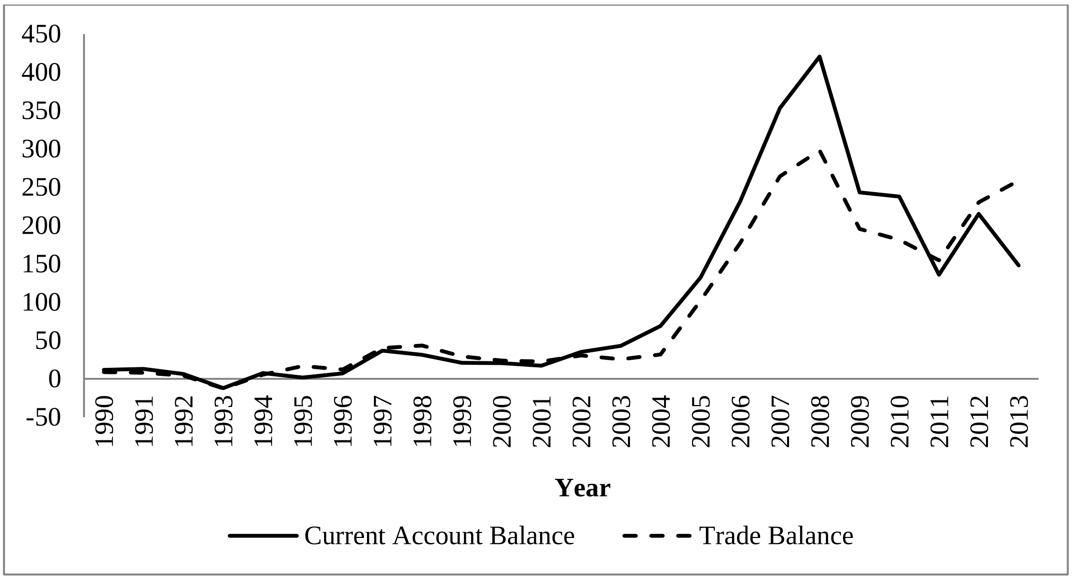

Figure 2: Chinese current account balance and trade balance over the period 1990-2013 (Billions of US Dollars)

(Source: National Bureau of Statistics of the PBOC)

The unprecented economic growth of China can also be attributed to its high and rising saving and investment rates (Vincelette et al., 2010; Yang, 2012). Historically, China has high saving rates such that prior to the economic reforms domestic saving as a percentage of the GDP was around 35 percent. Economic reforms, including the decentralization of economic production and removal of the barriers of isolated Chinese economy against foreign trade and investment, gave rise to the growth of household and corporate savings, which in turn boosted domestic investment. Another major factor behind the rapid economic growth of China could be the inward FDI flows. FDI inflows have generally been the main component of capital inflows and inward FDI flows were slightly affected during the Asian crisis of 1997-1998 (Prasad and Wei, 2005). Figure 3 clearly illustrates the increasing trend of annual FDI flows to China. While FDI inflows rose gradually over the period 1982-1991, it surged dramatically afterwards and increased to 291 billion US Dollars by the end of 2013. Currently, China ranks second in the FDI inflows after the US (Morrison, 2014).

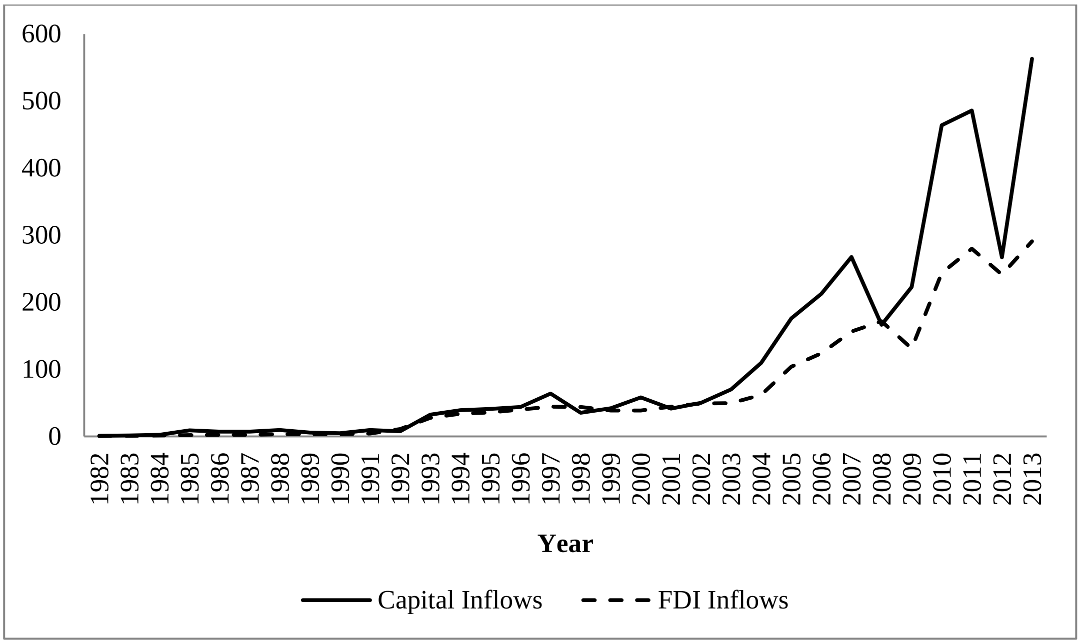

Figure 3: Annual capital flows and FDI flows to China during the period 1982-2013 (Billions of US Dollars)

(Source: State Administration of Foreign Exchange)

CHAPTER 4

DATA

To explore the existence of the FH puzzle in China, we utilize gross domestic saving and gross capital formation as a percentage of GDP. Our data covers the period from 1970 to 2013 which is the widest interval available. This period includes both the gradual transition of the Chinese economy from a command economy to a market-oriented one and the 2008-2009 global financial crises. As in many other studies investigating the FH puzzle, annual data is employed to avoid seasonality issues. All data is extracted from WDI database of the World Bank.

Figure 4 clearly illustrates the increasing trend in both saving and investment rates. More specifically, with the effects of economic reforms discussed in the previous chapter, saving and investment rates have increased from 29 to 52 and 49 percentage points by the end of 2013, respectively. Obviously, the gradual implementation of far-reaching reforms including decentralization of economy, trade liberalization, and exchange rate regime changes induced a substantial growth in Chinese household and corporate savings, which in turn boosted domestic investment. Another important point gleaned from Figure 4 is the comovement of saving and investment rates, though it is more prominent during the period 1970-1981, just before the implementation of the dual-exchange rate system. It can be also inferred that while in some years before 1994 domestic savings were insufficient to finance domestic investment, after 1994 the saving rate always surpasses the investment rate leading to current account surpluses. The comovement of domestic savings and investment illustrated by Figure 4 will be investigated further by utilizing appropriate cointegration tests in the following chapters.

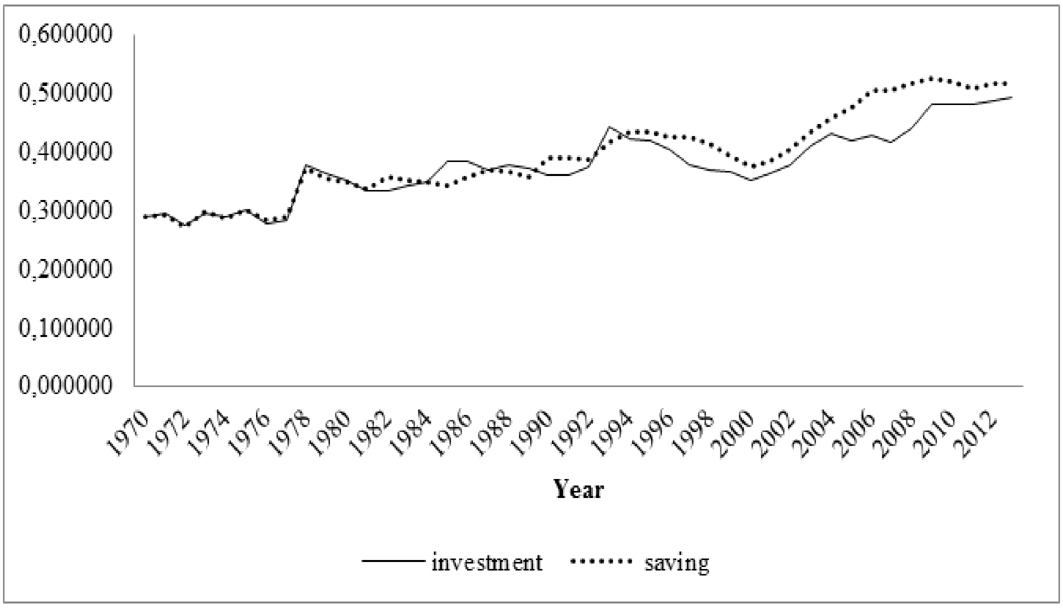

Figure 4: Saving and investment rates of China over the period 1970-2013

(Source: WDI database of the World Bank)

CHAPTER 5

METHODOLOGY

The modeling approach in this study covers three steps. The first step is to specify the order of integration of the employed series through the unit root tests of Zivot and Andrews (1992) and Lumsdaine and Papell (1997). In the next step, taking the standard Engle-Granger approach as a benchmark, we adopt the cointegration tests proposed by Gregory and Hansen (1996) and Maki (2012). Once cointegration between investment and saving is established by allowing for endogenous structural breaks, our final step is estimating the cointegrating regression.

5.1. Unit Root Tests

The first step of cointegration analysis is determination of the integration order of the series. It is known that the ADF (Dickey and Fuller, 1979; Said and Dickey, 1984) and PP (Phillips and Perron, 1988) tests, the most commonly employed unit root tests in empirical studies, perform relatively well when applied to time series being exposed to no structural break(s). However, as indicated by Perron (1989), these tests are biased towards accepting the false null hypothesis of a unit root when the time series is stationary around a break. On the other hand, Leybourne et al. (1998) demonstrate that if the true DGP is integrated of order one with a break, the standard unit root tests can lead to spurious rejection of the unit root null hypothesis. As mentioned earlier, Chinese economy has undergone some dramatic changes during the sample period of our analysis. Obviously, these changes might have significant impact on investment and saving in China. To account for these changes and propose more reliable results, unit root tests allowing for structural breaks should be utilized. For that reason, we employ Zivot and Andrews (1992) and Lumsdaine and Papell (1997) unit root tests which allow for one and two structural breaks, respectively, to ascertain the order of integration for investment and saving.

5.1.1. Zivot and Andrews (1992) Unit Root Test

Zivot and Andrews (1992) develop a unit root testing procedure allowing for one endogenously-determined structural break. They propose three different models. Model A allows for a structural break in the intercept term, model B allows for a structural break in the trend term, and finally model C combines the first two models and allow for a change in both the intercept and the trend. Model A, B, and C are expressed as follows, respectively:

$$\Delta y_t = \mu + \alpha y_{t-1} + \beta t + \theta_1 du_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \tag{5.1}$$

$$\Delta y_t = \mu + \alpha y_{t-1} + \beta t + \gamma_1 dt_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \tag{5.2}$$

$$\Delta y_t = \mu + \alpha y_{t-1} + \beta t + \theta_1 du_t + \gamma_1 dt_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \tag{5.3}$$

where y_t denotes the time series of interest, ε_t is i.i.d. disturbance term with variance σ^2, k is the augmentation order that ensures the i.i.d. structure of ε_t, du_t is the dummy variable for a mean shift occurring at time TB, and dt_t is the corresponding trend shift variable defined as:

$$du_t = \begin{cases} 1 & if\ t > TB \\ 0 & otherwise \end{cases} \quad \text{and} \quad dt_t = \begin{cases} t - TB & if\ t > TB \\ 0 & otherwise \end{cases} \tag{5.4}$$

Implementation of the unit root test of Zivot and Andrews (1992) requires a grid search procedure due to the location of the structural break being unknown. In this respect, the models are estimated by OLS and the *t*-statistic for testing the unit root null hypothesis $(\alpha = 0)$ is calculated for each potential structural break (TB), which is in the interval $[0.10T, 0.90T]$, where T represents the sample size. Although Zivot and Andrews (1992) suggest imposing 15% trimming on each end of the sample, we run the grid search with 10% trimming due to having a relatively small sample (44 observations). For each value of TB, the optimal lag length k is determined by using the general to specific approach as in Zivot and Andrews (1992). More specifically, we start with a predetermined maximum lag length $k_{\max}$ and check for the significance of the final lag. If it is significant the maximum order $k_{\max}$ is chosen, otherwise it is reduced by one lag until the last lag becomes significant. The test statistic is then the minimum *t*-statistic over all ADF *t*-statistics and so the selected break date is the one which provides the strongest evidence in favour of stationarity of the time series.

While the asymptotic critical values are provided by Zivot and Andrews (1992), they highlight the fact that with small sample sizes, the distribution of the test statistic may differ substantially from the asymptotic distribution. In order to overcome this problem, they suggest bootstrapping finite sample critical values. In this framework, under the assumption that the errors driving the data series are normal ARMA (*p,q*) processes, an ARMA (*p,q*) model is estimated for each first difference series of interest (Δy_t) with the orders *p* and *q* being selected according to the AIC. The estimated ARMA model is then treated as the true DGP. Using the DGP the test statistic is calculated through the aforementioned grid search procedure. Repeating this procedure for 5000 times provides the empirical distribution function of the test statistic and hence the critical values corresponding exactly to our data.

5.1.2. Lumsdaine and Papell (1997) Unit Root Test

By allowing for the possibility of two endogenous structural breaks in level and trend, Lumsdaine and Papell (1997) extend the models A, B, and C of Zivot and Andrews (1992) and propose models AA, CA, and CC, respectively, as:

$$\Delta y_t = \mu + \alpha y_{t-1} + \beta t + \theta_1 du1_t + \theta_2 du2_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \tag{5.5}$$

$$\Delta y_t = \mu + \alpha y_{t-1} + \beta t + \theta_1 du1_t + \theta_2 du2_t + \gamma_1 dt1_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \tag{5.6}$$

$$\Delta y_t = \mu + \alpha y_{t-1} + \beta t + \theta_1 du1_t + \theta_2 du2_t + \gamma_1 dt1_t + \gamma_2 dt2_t + \sum_{j=1}^{k} d_j \Delta y_{t-j} + \varepsilon_t \tag{5.7}$$

where $du1_t$ and $du2_t$ are dummy variables for mean shifts, $dt1_t$ and $dt2_t$ are dummy variables for trend shifts occurring at times $TB1$ and $TB2$ $(TB2 > TB1 + 2)$, respectively. That is:

$$du1_t = \begin{cases} 1 & if\ t > TB1 \\ 0 & otherwise \end{cases} \quad \text{and} \quad du2_t = \begin{cases} 1 & if\ t > TB2 \\ 0 & otherwise \end{cases} \tag{5.8}$$

$$dt1_t = \begin{cases} t - TB1 & if\ t > TB1 \\ 0 & otherwise \end{cases} \quad \text{and} \quad dt2_t = \begin{cases} t - TB2 & if\ t > TB2 \\ 0 & otherwise \end{cases} \tag{5.9}$$

In this framework, model AA allows for two breaks in the intercept term, while model CA accounts for two breaks in the intercept and one break in the trend term. The final model CC includes two breaks in the intercept and the trend term.

Similar to the approach of Zivot and Andrews (1992), Lumsdaine and Papell (1997) employ a grid search procedure to test the null hypothesis of a unit root. By ruling out the possibility that the breaks occurred in consecutive dates, the search is conducted for each $TB1$ and $TB2$ with 10% trimming and the augmentation order k being selected according to the general to specific approach. As in Zivot and Andrews (1992), the minimum ADF *t*-statistics (maximum in absolute values) and the break dates that provide the least support for the null of a unit root are selected. Although critical values are provided by Lumsdaine and Papell (1997), we follow the bootstrapping approach of Zivot and Andrews (1992) to circumvent any possible distortion due to using a relatively small sample.

5.2. Cointegration Tests

In order to examine the saving-investment link, the standard two-step Engle and Granger (1987) procedure requires first estimation of the long-run equilibrium model in the form:

$$I_t = \alpha + \beta S_t + \varepsilon_t \tag{5.10}$$

where I_t is the gross domestic investment as a proportion of GDP, S_t is the gross domestic saving as a proportion of GDP, α is the constant, and ε_t is the stochastic disturbance term. In model (5.10), coefficient β which is known as *'saving retention coefficient'* measures the degree of capital mobility. If a country has perfect international capital mobility, domestic investment can be financed by worldwide pool of saving and the value of β approaches to 0. If the capital is immobile in a country, domestic investment can solely be financed by domestic saving which leads to a unitary saving retention coefficient (Özmen and Parmaksız, 2003a). Once the long-run equilibrium model (5.10) is estimated through OLS, the second step of the Engle-Granger approach is testing for cointegration relationship between investment and saving, i.e. stationarity of the $\hat{\varepsilon}_t$ sequence.

The long-run equilibrium model of the Engle-Granger approach is formed under the assumption that the cointegrating relationship between savings and investment is subject to no structural changes. However, due to major economic events such as financial and economic crises and shifts in financial system the equilibrium relationship might change, which in turn may affect the reliability of the Engle-Granger cointegration test. Leybourne and Newbold (2003) and Kellard (2006) illustrate that the Engle-Granger test overwhelmingly finds spurious cointegration when the breaks in level and/or slope of independent time series are neglected, whereas Campos et al. (1996), Gregory et al. (1996), and Gabriel et al. (2001) reveal that ignoring the existence of structural breaks leads to substantial decrease in the power of standard cointegration tests. Noriega and Ventosa-Santaularia (2006) show that in the case of independent variables at least one of which includes structural breaks, the Engle-Granger test does not possess a limiting distribution and diverges with probability approaching one asymptotically, but the direction of divergence cannot be known priori. In other words, depending on the location and size of the breaks in DGP, the *t*-statistic may diverge to minus infinity which induce a spurious cointegration, whereas the divergence may result in the opposite direction (towards infinity) implying correctly nonrejection of the null hypothesis of no cointegration. On the other hand, Noriega and Ventosa-Santaularia (2012) analyze the asymptotic behavior of the Engle-Granger test for two cointegrated variables, where there is a trend break in the regressor. In this case, the Engle-Granger test diverges to minus infinity, thus correctly rejecting the null of no cointegration. However, they also prove that when the structural break is in the dependent variable, the test correctly identifies cointegration when the break occurs in the first half of the sample. If the break is in the second half, the test erroneously indicates no cointegration. Considering these limitations of the Engle-Granger cointegration test in the presence of structural breaks together with the major structural changes in Chinese economy during our sample period, we proceed with the Gregory and Hansen (1996) cointegration test which accounts for an endogenously-determined structural break.

5.2.1. Gregory and Hansen (1996) Cointegration Test

Gregory and Hansen (1996) extend the Engle-Granger approach by allowing a single structural break in the intercept and/or slope coefficients at an unknown time. They propose a residual-based procedure to test the null hypothesis of no cointegration against the alternative hypothesis of cointegration with one structural break. In the spirit of Zivot and Andrews (1992), three different models are introduced for the structural change in the cointegrating relationship. The first model is the level shift model (C) which takes the following form:

$$I_t = \alpha_1 + \alpha_2 D_t + \beta_1 S_t + \varepsilon_t \tag{5.11}$$

where D_t is the dummy variable defined as:

$$D_t = \begin{cases} 0 & if\ t \le [T\tau] \\ 1 & if\ t > [T\tau] \end{cases} \tag{5.12}$$

In this setting, α_1 is the intercept before the shift, α_2 is the change in the intercept at the time of the shift. The unknown parameter τ represents the relative timing of the change, T denotes the sample size, and [ ] denotes the integer part. The second model is the level shift with trend model (C/T) which takes the form:

$$I_t = \alpha_1 + \alpha_2 D_t + \gamma t + \beta_1 S_t + \varepsilon_t \tag{5.13}$$

where t represents a time trend. Finally, the third model is the regime shift model (C/S), wherein both intercept and slope coefficients are allowed to change as:

$$I_t = \alpha_1 + \alpha_2 D_t + \beta_1 S_t + \beta_2 S_t D_t + \varepsilon_t \tag{5.14}$$

where β_1 is the cointegrating slope coefficient before the regime shift and β_2 is the change in the slope coefficient.

In all three models, a grid search procedure is employed to calculate the test statistic to test the null hypothesis of no cointegration. More specifically, the above models are estimated recursively by allowing the breakpoint to vary such that $[0.10T] \le \tau \le [0.90T]$. For each value of τ, the residual sequence $\hat{\varepsilon}_{t\tau}$ is obtained through OLS. Once the residuals are obtained, the ADF and Phillips test statistics, $ADF(\tau)$, $Z_\alpha(\tau)$, and $Z_t(\tau)$ are calculated to test for stationarity of the residuals, i.e. existence of cointegration.[5] The test statistics of interest, $ADF^*, Z_\alpha{}^*$, and Z_t^* are then obtained as:

$$ADF^* = \inf_{\tau \in T} ADF(\tau) \tag{5.15}$$

$$Z_\alpha{}^* = \inf_{\tau \in T} Z_\alpha(\tau) \tag{5.16}$$

$$Z_t^* = \inf_{\tau \in T} Z_t(\tau) \tag{5.17}$$

[5] For further information about Z_α and Z_t test statistics, see Phillips (1987).

In this way, the test statistics and the break point which provide the least support for the null of nonstationarity of the residuals and hence no cointegration are chosen. In other words, we select the values which provide the strongest evidence in favour of cointegration. The critical values for finite samples are derived through Monte Carlo simulations and tabulated by Gregory and Hansen (1996).

5.2.2. Maki (2012) Cointegration Test

While the cointegration test of Gregory and Hansen (1996) performs well when the cointegrating relationship is exposed to a single break, it will be misspecified in the presence of multiple breaks. In this respect, Maki (2012) proposes a new cointegration test that allows for an unknown number of breaks. Four different models depending on whether the changes affect the intercept, the slope or the trend are designed as:

$$I_t = \mu + \sum_{i=1}^{m} \mu_i D_{i,t} + \beta S_t + \varepsilon_t \tag{5.18}$$

$$I_t = \mu + \sum_{i=1}^{m} \mu_i D_{i,t} + \gamma t + \beta S_t + \varepsilon_t \tag{5.19}$$

$$I_t = \mu + \sum_{i=1}^{m} \mu_i D_{i,t} + \beta S_t + \sum_{i=1}^{m} \beta_i S_t D_{i,t} + \varepsilon_t \tag{5.20}$$

$$I_t = \mu + \sum_{i=1}^{m} \mu_i D_{i,t} + \sum_{i=1}^{m} \gamma_i t D_{i,t} + \beta S_t + \sum_{i=1}^{m} \beta_i S_t D_{i,t} + \varepsilon_t \tag{5.21}$$

where μ_i, β_i, and γ_i represent changes in the level, slope and trend coefficients, respectively, $D_{i,t}$ is a dummy variable taking the value of 1 if $t > TB_i (i = 1,...m)$ and of 0 otherwise, where m is the maximum number of breaks and TB_i represents the time period of the break. The first model (5.18) is the level shift model which captures the changes in the intercept. While the second model (5.19) adds a trend term to the level shift model, the third model (5.20), called regime shift model, considers structural breaks occurring both in the intercept and the slope. Finally, the fourth model (5.21) accounts for structural breaks in the intercept, the trend, and the slope terms.

Given the models, the null hypothesis of no cointegration against the alternative hypothesis of cointegration with i number of breaks $(i \le m)$ is tested by implementing a grid search procedure in the spirit of Bai and Perron (1998). The first step of the algorithm of Maki (2012) is setting the maximum number of breaks, m. Then, to find the first break, the selected model is estimated for each TB_1 with 10% trimming and the residual sequences are obtained. The first break is then selected by minimizing the SSR over these estimations. Using the residual sequences, ADF *t*-statistics for the null of nonstationarity of the residuals, i.e. nonexistence of cointegration, are calculated and the minimum *t*-statistic, τ_1 is selected. If $i = 1$, then τ_1 will be the test statistic to test for cointegration with one structural break. If $i = 2$, on the other hand, the first break is integrated into the model and the algorithm is pursued with searching for the second break. Imposing 10% trimming and ruling out the possibility of having breaks in consecutive periods, the model is estimated for each TB_2 and the residual sequences are derived as before. Then, the second break is chosen to minimize SSR of the estimations. From the residual sequences, the minimum ADF *t*-statistic, τ_2 is obtained. The test statistic to test for cointegration with two structural breaks is then the minimum *t*-statistic over the set $\tau = \tau_1 \cup \tau_2$. This procedure is repeated until m break points are allowed in the cointegrating relationship and the test statistic will be the minimum *t*-statistic over the set of $\tau = \tau_1 \cup \tau_2 \cup ... \cup \tau_m$. The critical values changing with the number of structural breaks allowed in the long-run equation are provided by Maki (2012).

5.3. Estimation of Long-Run Coefficients

Once structural breaks are specified and cointegration is established through the cointegration tests of Gregory and Hansen (1996) and Maki (2012), the next step is the construction of the long-run equilibrium model between domestic savings and investment with the structural break dummies.

The application of OLS to a cointegrating equation delivers super-consistent estimators, as shown by Stock (1987). However, the statistical inferences derived from the OLS approach could be unreliable due to the presence of serial correlation and endogenity biases, which do not affect the consistency but induce nonzero mean and nonnormality in the limiting distribution of the test statistics (Dolado and Marmol, 1996; Hayakawa and Kurozumi, 2006; Vogelsang and Wagner, 2011). To overcome this problem two alternative estimation procedures are proposed. These are the FMOLS estimation approach of Phillips and Hansen (1990) and the DOLS estimation procedure proposed by Stock and Watson (1993). While the FMOLS utilizes a semi-parametric approach to deal with serial correlation and endogenity problems, the DOLS employs a parametric approach by adding leads and lags of the differences of the variables to the long-run regression. Although asymptotically they produce similar results, it is not very clear which one performs better in small samples. In practice, the FMOLS approach is preferable to the DOLS estimation procedure for small samples since it does not reduce the degrees of freedom the way parametric approaches like the DOLS do, as indicated by Seck (2012) and Shakeel et al. (2013). In our analysis, we will implement both FMOLS and DOLS procedures to derive robust statistical inference on the estimated saving retention coefficient.

CHAPTER 6

EMPIRICAL RESULTS

Taking the standard ADF and PP unit root tests as benchmarks, this chapter discusses first the results of the Zivot and Andrews (1992) one-break and Lumsdaine and Papell (1997) two-break unit root tests. Empirical findings from the cointegration tests of Gregory and Hansen (1996) and Maki (2012) are then described in the subsequent subsection. The final subsection presents the estimated long-run relationship between domestic savings and investment, which accounts for the structural breaks detected by the cointegration tests.

6.1. Unit Root Test Results

To explore the validity of the FH puzzle within a cointegration framework, it is essential to establish the nonstationarity of domestic savings and investment. To ascertain the order of integration, we initially employ two popular conventional unit root tests, ADF and PP. Following Hall (1994) and Ng and Perron (1995), the lag length of the ADF regression is selected through the general to specific approach at 10% significance level with a maximum autoregressive order of 4. The bandwidth for the PP test is determined using the Newey-West automatic bandwidth selection procedure for a Bartlett Kernel. Since Figure 4 suggests the probable existence of a linear trend in investment and saving, both tests are carried out by allowing for an intercept and intercept with a linear trend in the test regressions. Table 1 presents the ADF and PP test statistics for investment $\left(I_t\right)$ and saving $\left(S_t\right)$ with the corresponding lag lengths and bandwidths. According to the results, both ADF and PP tests do not reject the null hypothesis of a unit root in both of the series at 5% significance level.

Table 1: ADF and PP Unit Root Test Results

	ADF		*PP*	
	Intercept	*Intercept and trend*	*Intercept*	*Intercept and trend*
Investment	-0.996	-2.833	-0.597	-2.963
	(0)	(0)	(6)	(2)
Saving	-0.634	-3.478	-0.576	-2.814
	(0)	(4)	(2)	(1)

Notes: The 5% critical values for ADF and PP tests are –2.931 and -3.518 for the test regressions with an intercept and intercept with a linear trend, respectively. The selected bandwidth and order of augmentation are given in parentheses.

Given the low power of the standard ADF and PP tests in the presence of structural breaks, we continue with the unit root tests of Zivot and Andrews (1992) and Lumsdaine and Papell (1997), which allow for one and two endogenous structural breaks, respectively. In both tests, the augmentation order is chosen according to the general to specific approach, as in ADF and PP unit root tests. The grid search procedure implemented to find the test statistics and the break points is carried out with 10% trimming.

As mentioned before, Zivot and Andrews (1992) propose three different models depending on whether the structural change affects the intercept or the trend term. Although there is no consensus has emerged so far regarding on which model is superior, Perron (1989) suggests that most macroeconomic time series could be sufficiently modelled by using model A or model C. Following Perron (1989), many studies (including Narayan, 2005a; Yavuz, 2006; Tang and Lean, 2011; Adebola and Dahalan, 2012) employ model A (5.1) and model C (5.3) together in their empirical analysis. Recently, comparing model A and C, Sen (2003) argues that model C is preferable to model A when the structure of the break is unknown. More specifically, Sen (2003) reveals that applying model A causes a substantial loss in power when the break occurs according to model C. However, if the model C is used when in fact the break occurs according to model A, the loss in power is quite negligible. In order to eliminate any possible loss in power of the test, we prefer to employ both model A and model C. Hence, the test is conducted by estimating the test regressions (5.1) and (5.3), which allow for a change in the intercept (model A) and a change both in the intercept and slope (model C), respectively. Table 2 provides the test results together with the finite sample critical values, simulated through the bootstrap procedure explained in the previous chapter. According to the results, allowing for a one-time structural break provides no additional evidence in favour of stationarity of investment and saving rates. Being consistent with ADF and PP test results, the unit root test of Zivot and Andrews (1992) reveals nonstationarity of the series.

Table 2: Zivot and Andrews (1992) Unit Root Test Results

	Investment		*Saving*	
	Model A	*Model C*	*Model A*	*Model C*
TB	1996	1996	2005	1998
k	1	1	4	4
t_α	-4.319	-5.034	-4.245	-4.974
	(-4.80)	(-5.08)	(-4.80)	(-5.08)
	[-6.087]	[-6.574]	[-6.965]	[-7.188]

Notes: *TB* denotes the structural break date and *k* indicates the appropriate augmentation order for the test regressions. While the values in parentheses are the asymptotic critical values provided by Zivot and Andrews (1992), exact critical values obtained from 5000 bootstrap replications are given in brackets.

Since the unit root test of Zivot and Andrews (1992) may lose power and deliver misleading results when the series are confronted with more than one break, we proceed with the test of Lumsdaine and Papell (1997). Extending model A and model C of Zivot and Andrews (1992) to model AA and model CC to allow for two endogenous breaks, equations (5.5) and (5.7) are estimated and the test results are reported in Table 3. The results corroborate those obtained from the unit root test of Zivot and Andrews (1992), concluding that both investment and saving rates exhibit nonstationary behavior.

Table 3: Lumsdaine and Papell (1997) Unit Root Test Results

	Investment		*Saving*	
	Model AA	*Model CC*	*Model AA*	*Model CC*
$TB1$	1988	1977	1977	1977
$TB2$	1996	1999	2005	1998
k	1	3	4	4
t_{α}	-5.064	-6.284	-4.960	-5.772
	(-6.24)	(-6.82)	(-6.24)	(-6.82)
	[-7.046]	[-7.714]	[-8.104]	[-7.447]

Notes: *TB1* and *TB2* denote the structural break dates and *k* indicates the appropriate augmentation order for the test regressions. While the values in parentheses are the critical values provided by Lumsdaine and Papell (1997), exact critical values obtained from 5000 bootstrap replications are given in brackets.

6.2. Cointegration Test Results

Given nonstationarity, *I(1)* structures of investment and saving, we continue with the cointegration analysis to examine the long-run relationship between investment and saving rates. As such, we commence with the standard Engle and Granger (1987) cointegration approach and test for stationarity of the residuals of the long-run equilibrium model (5.10). To allow for a possible structural change in the cointegrating relationship and circumvent the limitations of the Engle-Granger cointegration test in the presence of a structural break, we next apply the Gregory and Hansen (1996) procedure. As discussed before, Gregory and Hansen (1996) suggest three different model specifications, which allow for level shift (5.11), level shift with trend (5.13), and regime shift (5.14). In practice, although there is no consensus on which model is superior, the regime shift model is particularly appropriate to examine the impact of a policy change on the saving-investment link. Thus, being in line with the other studies investigating the FH puzzle under policy changes and structural breaks (including Özmen and Parmaksız, 2003a, 2003b; Dursun and Abasız, 2014), we employ the regime shift model (C/S) for the cointegration analysis. The model (5.14) is estimated and the test statistics $ADF(\tau)$,

$Z_\alpha(\tau)$, and $Z_t(\alpha)$ together with the break points are determined through a grid search procedure with 10% trimming, as outlined in the previous chapter.

The results of the Engle-Granger and Gregory-Hansen cointegration tests are presented in Table 4. According to the results, the Engle-Granger test provides evidence for the existence of cointegration between savings and investment at 10% significance level. Accounting for a possible change in the cointegrating relationship, the Gregory and Hansen test, on the other hand, supports the existence of cointegration based on the ADF statistic only if the significance level is extended to 10 percent. The corresponding year of the structural break is found as 1994. The relatively poor evidences yielded by the cointegration tests of Engle-Granger and Gregory and Hansen (1996) may be due to the presence of the multiple breaks. Based on his Monte Carlo experiments, Maki (2012) reveals that the standard Engle-Granger test and the one-break cointegration test of Gregory and Hansen (1996) are subject to a substantial power loss when the cointegration relationship is exposed to multiple breaks.

Table 4: Engle and Granger (1987) and Gregory and Hansen (1996) Cointegration Test Results

	Engle-Granger	*Gregory-Hansen*		
	ADF	*ADF*	Z_α	Z_t
TB	-	1994	1994	1994
Test Statistic	-3.131*	-4.879*	-26.074	-3.969
Critical values				
5%	-3.46	-4.95	-47.04	-4.95
10%	-3.13	-4.68	-41.85	-4.68

Notes: While *TB* denotes the structural break date, (*) indicates rejection of the null hypothesis of no cointegration at 10% significance level.

In order to circumvent any power loss, we proceed with the multiple-break cointegration test of Maki (2012). The test is implemented by estimating the model (5.20), which is a direct extension of the one-break regime shift model of Gregory and Hansen test to multiple breaks. The results are reported in Table 5. MB_i indicates the case where the maximum number of breaks is set equal to *i* where *i*=1,..,5. For each case, the previously outlined grid search procedure is implemented with 10% trimming to find the test statistics and the break points. It appears that when we allow for one structural break, the test provides evidence of a cointegration relationship being exposed to a change after the year 1993 at 10% significance level. Integrating the possibility of a second break, on the other hand, leads to a stronger evidence for cointegration with the year of structural breaks being 1993 and 2008. The estimated break points coincide with the exchange rate regime shift from a fixed exchange rate system to a managed floating exchange rate system in China and the 2008-2009 global financial crises. Allowing for more than two breaks, however, reveals no further evidence for the existence of cointegration and additional structural breaks.

Table 5: Maki (2012) Cointegration Test Results

	MB_1	MB_2	MB_3	MB_4	MB_5
*TB*1	1993	1993	1984	1984	1978
*TB*2	-	2008	1993	1993	1984
*TB*3	-	-	2008	2004	1993
*TB*4	-	-	-	2008	2004
*TB*5	-	-	-	-	2008
Test Statistic	-4.879*	-5.453**	-5.358	-5.651	-5.852
Critical values					
5%	-4.895	-5.363	-5.703	-6.011	-6.357
10%	-4.626	-5.070	-5.402	-5.723	-6.057

Notes: Critical values are extracted from Maki (2012). (**) and (*) denote rejection of the null hypothesis of no cointegration at 5% and 10% significance levels, respectively.

6.3. Long-Run Coefficient Estimation Results

Having established the existence of cointegration, we continue with the estimation of the cointegrating equation (5.20) with the structural break dummies for the years 1993 and 2008 to observe how the detected break points affect the relationship between domestic savings and investment in China. In this sense, we adopt the FMOLS and DOLS estimation procedures, which account for serial correlation and endogenity problems. While FMOLS is performed using the Bartlett Kernel with Newey-West bandwidth, DOLS is implemented with leads and lags determined according to AIC. Table 6 presents estimates of the saving retention coefficient.

As mentioned earlier, the estimates of DOLS method depend on the number of leads and lags included in the regression to deal with serial correlation and endogenity problems. As far as we know, the determination of optimal number of leads and lags remains unexplored issue in the econometric literature. Following Kao et al. (1999), we allow for one lead and two lags in the regression. However, when we checked for the sensitivity of the results by applying different number of leads and lags, the estimates underwent slight changes, but the overall conclusions remained unchanged.

Table 6: Estimation of the Saving Retention Coefficient

	DOLS	*FMOLS*
S_t	0.970*** (9.486)	0.996*** (10.687)
$D93_t S_t$	-0.426*** (-2.921)	-0.436*** (-3.102)
$D08_t S_t$	0.083*** (3.230)	0.082*** (3.452)

Notes: Numbers in parentheses denote *t*-statistics and $D93_t$ and $D08_t$ are the impulse dummies taking the value 1 if $(t > 1993)$ and $(t > 2008)$, respectively, and 0 otherwise. (***) denotes statistical significance of the estimator at 1% significance level.

It is seen that the results obtained from the DOLS procedure are almost identical to those of the FMOLS, confirming the robustness of the results. According to the DOLS (FMOLS) the saving retention coefficient is 0.970 (0.996) over the period 1970-1993, which corresponds to the period of fixed exchange rate regime. With this finding it appears that the vast majority of incremental saving is retained within the country to finance the domestic investment. Following the interpretation of FH, this high correlation between investment and saving is an evidence for low capital mobility, which is not surprising given the relatively low FDI in China during that period, as illustrated in Figure 4. Comparing with the existing literature, a similar high correlation under fixed exchange rate is observed by Miller (1988), Alexakis and Apergis (1994), and De Vita and Abbott (2002) for US, Özmen and Parmaksız (2003b) for France, Narayan (2005a) for China, and Kaya-Bahçe and Özmen (2008) for some East Asian countries.

Over the period of 1994-2008, however, it seems that the relationship between savings and investment has weakened with the saving retention coefficient being equal to 0.544 and 0.560 according to the DOLS and FMOLS procedures, respectively. Given that the regime of fixed exchange rate gave way to the managed floating exchange rate regime in 1994, the substantial decline in the saving retention coefficient is not surprising. As De Paula (2007) and Köse and Prasand (2012) argue, the management of fixed exchange rate regime requires capital control system on both inflows and outflows mainly through the prohibitions and quantitative restrictions to protect the country against the risks associated with the fluctuations in international capital movements. Under a flexible exchange rate regime, on the other hand, the restrictions on capital flows across the borders are relaxed, the degree of financial integration with the global economy increases and a broad movement towards liberalization of capital account is observed (Corbin, 2001; Özmen and Parmaksız, 2003b; De Paula, 2007). Hence, domestic investment could be financed by foreign saving as well, which in turn could induce a substantial decline in the saving retention coefficient, as observed in our case.

Our DOLS (FMOLS) estimation results reveal further an increase in the correlation between savings and investment with the saving retention coefficient being 0.627 (0.642) after the global financial crisis of 2008-2009. Due to the rapid integration with the world economy and high dependency on the external market, the Chinese economy is quite vulnerable to external shocks. With the global financial crisis of 2008-2009, the country's upward trend of global trade was interrupted due to the dramatic fall in external demand caused by the protectionist measures imposed by the major trade partners, EU countries and the US (Yongding, 2008). To be more specific, Chinese exports plummeted by 16% from 2008 to 2009, while FDI flows to China decreased by 12% within the same period. Accordingly, Chinese economic growth rate fell from 14.2% to 9.2% (Morrison, 2014). To dilute the effects of the global financial crisis, China boosted domestic demand by a massive, investment-heavy stimulus package in conjunction with a vast credit expansion (Burdekin et al., 2012). Furthermore, as a policy response to the financial crisis, the Chinese government implemented various interventions, which involves export restrictions, discriminatory national standards, and restrictions on the cross-border movement of capital (Erixon and Sally, 2010). Given these protectionist policies, it is not surprising to observe an increase in the correlation between Chinese domestic savings and investment. In the existing literature, similar findings are observed by Trunin and Zubarev (2013) for OECD and developing countries and Choudhry et al. (2014) for both EU and non-EU states with the outbreak of the global financial crisis.

Overall, our results suggest that the Chinese economy is in conformity with the FH hypothesis over the 1970-1993 fixed exchange rate period. During the period 1994-2013, however, the FH puzzle exists in a weak form with a low saving retention coefficient, though a slight but significant increase is observed with the global financial crisis of 2008-2009.

CHAPTER 7

CONCLUSION

This study investigates the validity of Feldstein-Horioka puzzle regarding domestic saving-investment relationship for the case of China over the period between 1970 and 2013. Given that the recent economic history of China has a number of policy changes adopted during the reform period in which China liberalized its economy and global economic downturns, it is quite probable that these turning points may have an impact on investment, saving, and the relationship between them. Our aim is to account for these structural breaks arising from the events affecting the Chinese economy. In this respect, along with the conventional methodologies, we employ the procedures which take into consideration the endogenous structural breaks.

As a preliminary analysis, both the conventional unit root tests of ADF and PP and structural break unit root tests proposed by Zivot and Andrews (1992) and Lumsdaine and Papell (1997), which allows for one and two endogenous structural breaks, respectively, confirm the nonstationary structures of investment and saving series. Once the nonstationarity of employed variables is ensured, we first apply the standard Engle and Granger (1987) cointegration test and the one-break cointegration test of Gregory and Hansen (1996), which provide evidence for the existence of long-run relationship between savings and investment at 10% significance level. Then, considering the substantial power loss when the cointegration relationship is exposed to multiple breaks, we implement the multiple-break cointegration test of Maki (2012) which delivers compelling evidence for cointegration with the structural breaks years being 1993 and 2008.

Having established the existence of cointegration, the long-run model with structural breaks detected by Maki (2012) cointegration test for two-break case is estimated through FMOLS and DOLS estimation methods proposed by Phillips and Hansen

(1990) and Stock and Watson (1993), respectively. The detected structural breaks are consistent with the recent economic history of China. Our empirical results suggest that during the period of fixed exchange rate regime (corresponds to 1970-1993 in our sample period), the saving retention coefficient is almost unitary. This finding indicates the low level of capital mobility in the FH argument, which is not unexpected situation as illustrated by the relatively low FDI flows to China during that period, as illustrated in Figure 4. Next, by introducing the managed floating exchange rate system in 1994, the substantial decrease in the saving retention coefficient is observed, which is not surprising since the regime shift towards a flexible exchange rate system contributes to free movement of capital and financial integration of China with the global economy, which in turn induce an increase in the degree of capital mobility. Our results reveal further a slight increase in the correlation between savings and investment in the aftermath of global financial crises of 2008-2009. This finding coincides with the protectionist measures, affecting mostly the cross-border movement of capital, taken in the wake of the crisis in China which was also the biggest target of such discriminatory instruments imposed by its major trading partners, the US and EU member states.

Overall, the findings obtained in our analysis provide empirical support for the FH hypothesis over the 1970-1993 fixed exchange rate era. However, by introducing the managed floating exchange regime in 1994, although a slight increase is observed with the global financial crises of 2008-2009 the link between domestic savings and investment has become substantially weaker compared to previous decades. This implies the weak form of the FH puzzle during the period 1994-2013.

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APPENDICES

A. TURKISH SUMMARY

Feldstein ve Horioka, kapalı bir ekonomide yurtiçi tasarruflar ile yatırımlar arasında güçlü bir ilişki olması gerektiğini, çünkü bu tür ekonomide yurtiçi yatırımların sadece yurtiçi tasarruflar tarafından finanse edilebileceğini belirtmiştir. Diğer taraftan, tam sermaye hareketliliğinin olduğu bir ekonomide ise yurtiçi tasarruflar ve yatırımlar arasında bir ilişkinin bulunmayacağını, çünkü yurtiçi tasarrufların en uygun yatırım şartlarını sağlayan ülkelere doğru hareket ederken, yurtiçi yatırımların ise dünya tasarruf havuzu tarafından finanse edileceğini ifade etmiştir. Feldstein ve Horioka, bu argümanın ampirik olarak geçerliliğini sınamak için 16 OECD ülkesi için 1960-1974 dönemini kapsayan çapraz kesit çalışması yapmıştır. Bu çalışmada elde edilen bulgular, yurtiçi tasarruflar ve yatırımlar arasında güçlü bir ilişki olduğunu ve bu ilişkinin yıllar itibarıyla zayıflamadığını ortaya koyarak, düşük sermaye hareketliliğine işaret etmiştir. Ancak, elde edilen bulgular, bu dönemde finansal piyasaların serbestleştirilmesi ve sermaye kontrollerinin azaltılmasına yönelik atılan adımlarla ters düşmektedir. İşte bu çelişkili durum literatürde Feldstein ve Horioka sorunsalı olarak adlandırılmaktadır.

Feldstein ve Horioka sorunsalını inceleyen çalışmalar temel olarak iki gruba ayrılmaktadır. Birinci gruptaki çalışmalar, Feldstein ve Horioka'nın sermaye hareketliliği derecesini ölçmek için tasarruf-yatırım ilişkisini inceleyen yaklaşımının doğru olmadığını savunmaktadır. Bu çalışmalar, tam sermaye hareketliliğinin olduğu durumda dahi tasarruflar ve yatırımların, her iki değişkeni etkileyebilen dışsal faktörler sebebiyle birlikte hareket edebileceğini iddia etmektedir. Örneğin; Sinn (1992), Obstfeld ve Rogoff (1995), Coakley vd. (1996), Jansen (1996) ve Coakley ve Kulasi (1997), cari işlemler dengesinin tasarruflar ve yatırımlar arasındaki farka eşit olduğundan bu iki makroekonomik değişken arasındaki güçlü bir ilişkinin sermaye hareketliliği derecesine bağlı olmaksızın uzun dönem cari işlemler dengesinin sürdürülebilirliğini ortaya koyduğunu iddia etmektedir. Benzer şekilde, Summer (1988), Bayoumi (1989), Artis ve Bayoumi (1989), Gundlach ve Sinn (1991) ve Levy (1995), cari işlemler hesabını dengede tutmayı hedefleyen politikaların benimsenmesi durumunda, yüksek seviyeli sermaye hareketliliğinin güçlü tasarruf-yatırım ilişkisi ile birlikte var olabileceğini ifade etmektedir. Daha belirgin olarak, yurtiçi tasarruflar ve yatırımlar arasındaki güçlü bir ilişkinin varlığı düşük sermaye hareketliliğini değil, cari işlemler hesabındaki dengesizlikleri düzeltmeyi amaçlayan para ve maliye politikalarının uygulandığını göstermektedir. Bu gruptaki çalışmalara göre, tasarruf ve yatırımlar arasındaki güçlü ilişkinin arkasındaki diğer bir sebep ülke büyüklüğü etkisidir. Harberger (1980), ülkelerin büyüdükçe daha az yabancı kaynaklara ihtiyaç duyduğunu ve yatırımlarının yurtiçi tasarruflarla finanse edildiğini, bunun da sermaye hareketliliği derecesine bağlı olmaksızın güçlü bir tasarruf-yatırım korelasyonunu beraberinde getirdiğini belirtmektedir. Ayrıca, Bahmani-Oskooee ve Chakrabarti (2005) 1960-2000 dönemi için 126 ülkede yüksek gelirli ülkelerin - orta ve düşük gelirli ülkelere kıyasla - daha güçlü tasarruf ve yatırım ilişkisine sahip olduğunu göstererek, ülke büyüklüğü etkisini ampirik olarak ortaya koymaktadır.

Literatürdeki diğer grup ise Feldstein ve Horioka'nın sermaye hareketliliği derecesini ölçme yaklaşımını desteklemiş ve bu sorunsalı farklı ekonometrik metotlar uygulayarak açıklamaya çalışmıştır. Feldstein ve Horioka'yı takip ederek, Feldstein (1983), Frankel vd. (1986) ve Feldstein ve Bacchetta (1989) çapraz kesit yöntemini uygulamış, ancak gelişmekte olan ülkelerdeki tasarruf ve yatırım arasındaki yüksek korelasyon bulgusunu destekler sonuçlar elde edebilmiştir. Diğer taraftan, bazı araştırmacılar ise panel veri analizi metodunu kullanarak Feldstein ve Horioka sorunsalını açıklamaya çalışmıştır. Bu çalışmaların birçoğu, örneğin Corbin (2001), Chakrabarti (2006), Adedeji ve Thornton (2008) ve Pelgrin ve Schich (2008), Feldstein ve Horioka yaklaşımında düşük sermaye hareketliliği şeklinde yorumlanan yüksek tasarruf-yatırım ilişkisini gelişmiş ülkeler için elde etmiştir. Bu çalışmalara karşın, Krol (1996) ve Kollias vd. (2008) ise 21 OECD ve 15 Avrupa Birliği ülkesi için 1962-1990 ve 1962-2002 dönemlerini kapsayan çalışmalarında yurtiçi tasarruflar ve yatırımlar arasında düşük seviyede ilişki gözlemlemiştir. Coiteux ve Olivier

(2000) ve Jansen (2000) ise bu ampirik sonuçları eleştirmiş ve Lüksemburg'un örneklemden çıkarılması durumunda, Feldstein ve Horioka bulgularını destekler şekilde sonuçların tersine döndüğünü göstermiştir. Diğer taraftan, Murthy (2009) 14 Latin Amerika ve 5 Karayip ülkesini ele alarak, 1960-2002 döneminde, bu süreçte finansal entegrasyonun artması, bankacılık sektörünün liberalleşmesi ve sermaye kontrollerinin gevşetilmesi yönünde yaşanan gelişmelerle tutarlı bir şekilde, Feldstein ve Horioka argümanının geçerli olmadığını ortaya koymuştur. Murthy (2009)'a benzer şekilde, Kim vd. (2005) ve Bangake ve Eggoh (2011) bazı Asya ve Afrika ülkeleri için tasarruf ve yatırımlar arasında düşük korelasyon gözlemlemiştir.

Çapraz kesit ve panel veri analizinin kullanıldığı çalışmalarda, bazı araştırmalar, yüksek sermaye hareketliliği sebebiyle tasarruf ve yatırımlar arasında ilişki olmadığını veya zayıf ilişki olduğunu gösterebilirken, bazı araştırmalar ise Feldstein-Horioka'nın ampirik bulgularına karşıt kanıt elde edememiştir. Ekonometrik literatürde çapraz kesit ve panel veri analizleri bazı açılardan eleştirilmektedir. Örneğin; Hussein (1998), Athukorala ve Sen (2002) ve Dursun ve Abasız (2014), tasarruf-yatırım ilişkisinin anılan yaklaşımlarla modellendiğinde, örnekleme ekonomik olarak büyük ve finansal olarak gelişmiş ülkelerin dahil edilmesi durumunda, güvenilir sonuçlar elde edilemeyebileceğini öne sürmüştür. Farklı ekonomik yapılar, farklı hükümet politikaları ve farklı finansal krizlerden dolayı tasarruf-yatırım dinamiklerinin ülkeden ülkeye farklılaşabileceği savunulmuştur. Caporale vd. (2005), Narayan (2005b) ve Mastroyiannis (2007), bu farklılıkların göz ardı edilmesi halinde yanlış çıkarımlar yapılabileceğinin altını çizmiştir.

Bu eksiklikler göz önünde bulundurularak, Feldstein-Horioka sorunsalı zaman serisi metotlarıyla ülkeler için ayrı ayrı olarak analiz edilmeye başlanmıştır. Uluslararası sermaye hareketliliğinin zamanla değişen bir olgu olması ve tek bir katsayı ile tahmin edilemeyeceğinden bahisle, bazı araştırmalar yurtiçi tasarruflar ve yatırımlar arasındaki ilişkinin politika değişiklikleri ve yapısal kırılmalara maruz kalabileceğini hesaba katmıştır. Bu çalışmalar iki kategoride toplanabilmektedir. Birinci kategorideki çalışmalar, yapısal kırılmaları dışsal olarak belirleyerek Engle ve Granger (1987) veya ARDL eşbütünleşme yöntemlerini kullanmaktadır. Diğer kategoride ise yapısal kırılmaların modelde içsel olarak belirlendiği eşbütünleşme testleri uygulanmaktadır. Örneğin; Miller (1988), Alexakis ve Apergis (1994) ve De Vita ve Abbott (2002) ABD için yurtiçi tasarruflar ve yatırımlar arasındaki ilişkiyi sabit ve dalgalı kur rejimleri için ayrı ayrı incelemiş ve elde edilen bulgular tasarruf-yatırım ilişkisinin dalgalı kur sisteminin uygulamaya konulmasıyla birlikte zayıfladığını göstermiştir. Pelagidis ve Mastroyiannis (2003) ve Mastroyiannis (2007) Yunanistan için politika değişikliklerinin tasarruf-yatırım ilişkisine etkisini dışsal olarak belirlenen periyotlar üzerinde analiz etmiştir. Bulgular, Avrupa Birliği'ne katıldıktan sonra Yunanistan'da tasarruf ve yatırım ilişkisinin zayıfladığını ortaya koymuştur. Ayrıca, Lemmen ve Eijfinger (1995) ve Sarno ve Taylor (1998), döviz kontrollerinin ve sermaye hareketlerini engelleyen kuralların kaldırıldığı 1979 yılını dışsal yapısal kırılma tarihi olarak aldığı çalışmalarda İngiltere için benzer sonuçlar elde etmiştir.

Yukarıda bahsi geçen çalışmalar yapısal kırılma tarihlerinin önceden bilindiği varsayımına dayanarak yapılmaktadır. Her ne kadar belirlenen yapısal kırılma noktaları ekonomik açıdan anlamlı tarihler olsa da bu yöntem, Özmen ve Parmaksız (2003a,2003b) tarafından ön-test yanlılığına sahip olması nedeniyle eleştirilmektedir. Buradan hareketle, literatürde yapısal kırılma noktalarını modelde içsel olarak belirlenmesine imkan tanıyan eşbütünleşme testleri kullanılmaya başlanmıştır.

Bu çerçevede, Özmen ve Parmaksız (2003a,2003b), Narayan ve Narayan (2010), Verma ve Saleh (2011) ve Ketenci (2012), Gregory ve Hansen (1996)'in tek kırılmalı eşbütünleşme testini uygulamıştır. Özmen ve Parmaksız (2003a) İngiltere'de tasarruf-yatırım ilişkisini döviz kontrollerinin kaldırılmasıyla birlikte yok olduğu sonucuna varırken, Narayan ve Narayan (2010) ve Verma ve Saleh (2011) G7 ve Suudi Arabistan için ilişkinin olmadığını göstermiştir. Ketenci (2012) ise Estonya ve Portekiz haricinde 23 Avrupa Birliği ülkesinde tasarruf ve yatırım arasındaki eşbütünleşmenin varlığını doğrulamıştır. Diğer taraftan, tasarruf-yatırım ilişkisinin birden fazla kırılmaya maruz kalabileceğinden hareketle, Dursun ve Abasız (2014), iki yapısal kırılmaya imkan veren Hatemi-J (2008) eşbütünleşme testini uygulayarak, Feldstein ve Horioka bulgularının Türkiye için geçerli olmadığı sonucuna varmıştır.

Bahsedildiği üzere, literatür yoğun olarak OECD ve Avrupa Birliği ülkelerine odaklanmış olup, Çin üzerine yapılan çalışmaların sayısı oldukça sınırlı kalmıştır. Bilindiği kadarıyla, Feldstein-Horioka sorunsalını Çin üzerinde irdeleyen çalışmalar sadece Narayan (2005a) ve Bordoloi ve John (2011) tarafından gerçekleştirilmiştir. Narayan (2005a) çalışmasında, 1952-1994 ve 1952-1998 periyotları için tasarruf-yatırım ilişkisini ARDL ve Gregory ve Hansen (1996) eşbütünleşme testleriyle incelemiştir. Elde edilen sonuçlar, her ne kadar ikinci dönem için hafif bir düşme gözlemlense de her iki dönem için de Feldstein-Horioka bulgularının Çin için geçerli olduğunu göstermiştir. Diğer taraftan, Bordoloi ve John (2011), 1950-2010 dönemi için ARDL metodunu kullanarak tasarruf-yatırım arasında eşbütünleşme ilişkisinin olduğunu göstermiştir. Ayrıca, sermaye hareketliliği derecesinin zamana bağlı hareketini değerlendirmek için tekrarlı tahmin yöntemini uygulamıştır. Elde edilen sonuçlar tasarruf-yatırım arasındaki ilişki katsayısının 1997-2003 döneminde artış gösterdiğini, 2008 yılına kadar azaldığını ve 2009'dan yılından itibaren ise tekrar artışa geçtiğini göstermiştir.

Bu çalışmada, Narayan (2005a)'a benzer şekilde, Feldstein ve Horioka sorunsalının yapısal kırılmalar varlığı altında sınanması amaçlanmaktadır. Ancak, kırılma noktası ve ilgili periyotlar dışsal olarak belirlenmemiş, Gregory ve Hansen (1996)'in bir yapısal kırılmaya imkan veren eşbütünleşme testi ile birlikte yakın bir zamanda geliştirilen Maki (2012)'nin çoklu yapısal kırılmalara imkan veren eşbütünleşme testi uygulanmıştır. Son olarak, anılan testler tarafından belirlenen kırılma noktalarının Çin'de tasarruf-yatırım ilişkisini nasıl etkilediğini gözlemlemek için eşbütünleşme regresyonu Tam Değiştirilmiş En Küçük Kareler ve Dinamik En Küçük Kareler yöntemleri ile tahmin edilmiştir.

Feldstein ve Horioka sorunsalının ampirik olarak geçerliliğini test etmek için gayri safi yurtiçi tasarruflar ve gayri safi yurtiçi yatırımların gayri safi yurtiçi hasıla içerisindeki payları kullanılmıştır. 1970 ila 2013 yılları arasındaki veriler araştırmaya dahil edilmiştir. Bu inceleme dönemi, Çin'in kapalı ekonomiden açık ekonomiye geçiş süreci ile 2008-2009 küresel finans krizini de kapsamaktadır. Diğer pek çok çalışmada olduğu gibi, mevsimsellik etkilerinden kaçınmak için yıllık veriler kullanılmıştır. Söz konusu veriler Dünya Bankası'nın World Development Indicators veri tabanından alınmıştır.

Modelleme yaklaşımı üç aşamadan oluşmaktadır. İlk aşamada serilerin entegrasyon sıralarını belirleyebilmek için Augmented Dickey Fuller ve Phillips ve Perron testlerinin yanı sıra Zivot ve Andrews (1992) ve Lumsdaine ve Papell (1997) birim kök testleri uygulanmıştır. Diğer aşamada, Engle ve Granger yaklaşımı baz alınarak Gregory ve Hansen (1996) ile Maki (2012) eşbütünleşme testleri uygulanmıştır. Yurtiçi tasarruflar ile yurtiçi yatırımlar arasında eşbütünleşmenin varlığı içsel yapısal kırılmalar altında ispatlandıktan sonra, son aşamada eşbütünleşme regresyonundan güvenilir çıkarsamalar yapabilmek için Tam Değiştirilmiş En Küçük Kareler ve Dinamik En Küçük Kareler tahmin yöntemleri uygulanmıştır.

Eşbütünleşme analizinin ilk adımı, serilerin entegrasyon sırasının belirlenmesidir. Ampirik çalışmalarda yoğunlukla kullanılan Augmented Dickey Fuller ve Phillips ve Perron testlerinin, yapısal kırılmalara maruz kalmayan zaman serilerinde başarılı sonuçlar verdiği bilinmektedir. Ancak, Perron (1989) tarafından yapılan çalışma göstermiştir ki bu testler, serinin yapısal kırılma etrafında durağan olması durumunda yanlış olan birim kök boş hipotezini kabul etme yönünde yanlı sonuçlar vermektedir. Diğer taraftan, Leybourne vd. (1998) ise doğru veri üretme sürecinin yapısal kırılma etrafında birinci dereceden entegre olduğunda, bu birim kök testlerinin birim kök boş hipotezini yanlış bir şekilde reddetme yönünde yanlı olduğunu ortaya koymaktadır. Çin ekonomisinin pek çok kırılma noktasına sahip olduğu gerçeği göz önünde bulundurulduğunda, bu kırılmaların tasarruf ve yatırımları etkilemesi muhtemeldir. Buradan hareketle, güvenilir sonuçlar elde edilebilmesi için bir kırılmaya izin veren Zivot ve Andrews (1992) ile iki kırılmaya izin veren Lumsdaine ve Papell (1997) birim kök testleri uygulanmıştır.

Tasarruf-yatırım ilişkisini incelemek için Engle ve Granger (1987) iki aşamalı eşbütünleşme testi uygulanmaktadır. Engle ve Granger yaklaşımında, tasarruflar ve yatırımlar arasındaki eşbütünleşme ilişkisinin yapısal kırılmalara maruz kalmadığı varsayımı yapılmaktadır. Ancak, ekonomik krizler ve finans piyasasında yapılan reformlar Engle ve Granger testinin güvenilirliğini etkileyebilmektedir. Leybourne ve Newbold (2003) ve Kellard (2006), bağımsız zaman serilerindeki kırılmalar ihmal edildiğinde, Engle ve Granger testinin yoğunlukla sahte eşbütünleşme sonucuna vardığını gösterirken, Campos vd. (1996), Gregory vd. (1996) ve Gabriel vd. (2001) yapısal kırılmaların varlığı göz ardı edildiğinde testte büyük ölçüde güç kaybı oluştuğunu göstermektedir. Engle ve Granger testinin bu eksiklikleri göz önünde bulundurularak, bir yapısal kırılmalı Gregory ve Hansen (1996) ve çoklu yapısal kırılmalı Maki (2012) eşbütünleşme testi uygulanmıştır.

Yapısal kırılma noktaları belirlendikten ve eşbütünleşme ilişkisi Gregory ve Hansen (1996) ve Maki (2012) testleriyle sağlandıktan sonra, diğer aşama yurtiçi tasarruflar ve yatırımlar arasındaki uzun dönem denge ilişkisinin yapısal kırılma kukla değişkenleriyle tahmin edilmesidir. Stock (1987), eşbütünleşme denklemine Sıradan En Küçük Kareler yönteminin seri korelasyon ve içsellik problemlerinden dolayı güvenilir sonuçlar vermeyebileceğini göstermektedir. Bu sorunları gidermek için Phillips ve Hansen (1990) Tam Değiştirilmiş En Küçük Kareler ve Stock ve Watson (1993) Dinamik En Küçük Kareler yöntemlerini önermektedir. Tam Değiştirilmiş En Küçük Kareler yöntemi yarı-parametrik bir yaklaşımla seri korelasyon ve içsellik problemlerini çözerken, Dinamik En Küçük Kareler yöntemi parametrik bir yaklaşım benimsemektedir. Her ne kadar asimtotik olarak aynı sonuçlar verseler de küçük örneklemde hangi metodun daha iyi sonuç verdiği bilinmemektedir. Bu sebeple, tasarruf alıkoyma katsayısı üzerinde istatistiksel olarak güçlü çıkarımlar yapabilmek için hem Tam Değiştirilmiş En Küçük Kareler hem de Dinamik En Küçük Kareler yöntemleri kullanılmıştır.

Augmented Dickey Fuller ve Phillips ve Perron testleri, yurtiçi tasarruf ve yatırım serilerindeki birim kökün varlığına ilişkin boş hipotezi %5 anlam düzeyinde reddedememektedir. Augmented Dickey Fuller ve Phillips ve Perron testlerinin yapısal kırılmaların varlığı altında düşük güce sahip olması nedeniyle, öncelikle Zivot ve Andrews (1992) testi ile model A ve model C üzerinden bir yapısal kırılma durumunda birim kökün varlığı sınanmıştır. Sonuçlara göre modele tek yapısal kırılma eklemek tasarruf ve yatırım serilerinin durağanlığına ilişkin ilave bir katkı sağlamamış, Augmented Dickey Fuller ve Phillips ve Perron test sonuçlarıyla tutarlı bir şekilde serilerin durağan olmadığı sonucuna varılmıştır. Serilerin birden fazla yapısal kırılmaya maruz kalması durumunda Zivot ve Andrews (1992) birim kök testinin güç kaybedeceği ve yanlış yönlendiren sonuçlar verebileceği için Lumsdaine ve Papell (1997) birim kök testi uygulanmıştır. Zivot ve Andrews (1992)'in model (A) ve model (C)'nin genişletilmesiyle oluşturulan model (AA) ve model (CC) baz alınarak yapılan testler sonucunda, yatırımların ve tasarrufların durağan olmayan bir yapıya sahip olduğu gözlemlenmiştir. Diğer bir deyişle, yapılan bütün birim kök test sonuçları her iki serinin de durağan olmayan bir yapıya sahip olduğu gerçeğine işaret etmektedir.

Tasarruf ve yatırım serilerinin durağan olmayan bir yapıda olduğu belirlendikten sonra, bahse konu değişkenler arasındaki uzun dönem ilişkisini incelemek amacıyla eşbütünleşme analizi yapılmaktadır. Bu amaçla, öncelikle standart Engle ve Granger eşbütünleşme yaklaşımı benimsenerek uzun dönem denge modelinin artıklarına birim kök testi uygulanmıştır. Sonuçlara göre, tasarruf ve yatırımlar arasında eşbütünleşme ilişkisinin varlığı %10 önem derecesinde ortaya konabilmektedir.

Daha sonra yapısal kırılma varlığında Engle ve Granger eşbütünleşme testinin kısıtlamaları göz önünde bulundurularak, tek yapısal kırılmalara izin veren Gregory ve Hansen (1996) eşbütünleşme testi uygulanmıştır. Model (C/S) baz alınarak yapılan testlerde, eşbütünleşme ilişkisinin varlığı sadece ADF test istatistiğine göre %10 önem düzeyinde desteklenebilmektedir. İlgili yapısal kırılma noktası ise 1994 olarak tespit edilmiştir.

Maki (2012) Monte Carlo simülasyonu yaparak, eşbütünleşme ilişkisinin çoklu yapısal kırılmalara maruz kalması durumunda, standart Engle ve Granger (1987) ile bir kırılmalı Gregory ve Hansen (1996) testlerinin büyük oranda güç kaybına uğrayacağını göstermiştir. Bu güç kaybının üstesinden gelebilmek için çoklu yapısal kırılmalara imkan tanıyan Maki (2012) eşbütünleşme testi uygulanmıştır. En fazla 5 yapısal kırılmaya kadar gerçekleştirilen test sonuçlarına göre, bir yapısal kırılma durumunda 1993'ten sonra değişikliğe uğrayan bir eşbütünleşme ilişkisinin varlığı

%10 önem düzeyinde ortaya konmaktadır. İkinci yapısal kırılmanın varlığı hesaba katıldığında ise daha güçlü sonuçlar elde edilmiş ve 1993 ve 2008 tarihlerinde yapısal kırılmaların olduğu bir eşbütünleşme ilişkisi tespit edilmiştir. Belirlenen kırılma noktaları, Çin'deki sabit kur sisteminden yönetimli dalgalı kur sistemine doğru rejim değişikliği ve 2008-2009 küresel finans kriziyle örtüşmektedir. Diğer taraftan, ikiden fazla kırılmaya izin verilmesi durumunda eşbütünleşme ilişkisinin varlığına bir kanıt bulunamamıştır.

Yapısal kırılmalar altında eşbütünleşme ilişkisinin varlığı tespit edildikten sonra, belirlenen yapısal kırılma noktalarının yurtiçi tasarruf ve yatırımlar arasındaki ilişkiyi nasıl etkilediğini incelemek için 1993 ve 2008 tarihleri için oluşturulan kukla değişkenlerle birlikte eşbütünleşme modeli Tam Değiştirilmiş En Küçük Kareler ve Dinamik En Küçük Kareler yöntemleriyle tahmin edilmiştir. Testler, Tam Değiştirilmiş En Küçük Kareler ve Dinamik En Küçük Kareler metotlarının neredeyse aynı sonuçlar verdiğini göstermektedir. Elde edilen sonuçlara göre, sabit kur rejimi dönemini kapsayan 1970-1993 döneminde bire yakın tasarruf alıkoyma katsayısı belirlenmiştir. Feldstein ve Horioka yaklaşımında düşük sermaye hareketliliği olarak yorumlanan bu durum, Çin'e bu tarihlerde yapılan yabancı doğrudan yatırımların çok sınırlı kalması gerçeğiyle örtüşmektedir. 1994-2008 döneminde ise tasarruf alıkoyma katsayısında büyük düşüş gözlemlenmiştir. 1994 yılında dalgalı kur sistemine geçilmesiyle birlikte sermaye kontrollerinin azalmasına bağlı olarak yaşanan liberalleşme süreci, katsayıda gözlemlenen düşmeyi teyit eder niteliktedir. Son olarak, 2009 yılından sonra katsayıda hafif bir artış meydana gelmiştir. Bu durum ise 2008-2009 küresel finans krizi döneminde Çin'de ve dünya genelinde benimsenen aşırı korumacı politikalar sonucu olarak sermaye hareketliliği derecesinin bir nebze düşmesiyle uyumlu bir bulgu olarak yorumlanabilir.

Sonuç olarak, bu çalışmada elde edilen bulgular göstermiştir ki 1970-1993 sabit kur rejiminde Çin ekonomisi Feldstein ve Horioka hipoteziyle uyumlu sonuçlar vermektedir. Her ne kadar 2008-2009 küresel finans krizinden sonra hafif bir artış gözlemlense de sermaye hareketliliği derecesinin yükselmesine yönelik yaşanan gelişmelerle tutarlı olarak 1994-2013 döneminde bu katsayıda ciddi şekilde düşüş gözlemlenmiştir.

B. TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü X

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı : ORMAN
Adı : ETHEM ERDEM
Bölümü : İKTİSAT

TEZİN ADI (İngilizce) : THE FELDSTEIN-HORIOKA PUZZLE IN THE PRESENCE OF STRUCTURAL BREAKS: EVIDENCE FROM CHINA

TEZİN TÜRÜ : Yüksek Lisans X Doktora ☐

1. Tezimin tamamı dünya çapında erişime açılsın ve kaynak gösterilmek şartıyla tezimin bir kısmı veya tamamının fotokopisi alınsın. X

2. Tezimin tamamı yalnızca Orta Doğu Teknik Üniversitesi kullanıcılarının erişimine açılsın. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☐

3. Tezim bir (1) yıl süreyle erişime kapalı olsun. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.) ☐

Yazarın İmzası ……………… Tarih ………………..