A COMPARATIVE STUDY FOR NONLINEAR STRUCTURE OF THE INTEREST RATE PASS-THROUGH

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ABSTRACT

A COMPARATIVE STUDY FOR NONLINEAR STRUCTURE OF THE INTEREST RATE PASS-THROUGH

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This study investigates the interest rate pass through from the money market rate to the lending rate by utilizing monthly data of fifteen countries, grouped as high income, upper middle income and lower middle income, over the period 1999:01-2011:09. Taking the linear cointegration test of Engle-Granger as benchmark, we employ threshold cointegration tests of Enders and Siklos (2001) in order to account for the possible nonlinearities in the pass-through process. Empirical results reveal that the pass through process is complete in three countries; Republic of Korea, Latvia and Malaysia and the adjustment of the lending rate is symmetric in two countries; Armenia and Republic of Korea. Moreover, it is observed that the adjustment of the lending rate is upward sticky in six countries; Bolivia, Philippines, Malaysia, Dominican Republic, Thailand and Croatia, whereas it is downward sticky in seven countries; Ukraine, Sri Lanka, Latvia, Peru, Kuwait, Hong Kong and Czech Republic. Furthermore, our estimation results suggest that heterogeneities in the pass-through mechanism across countries can be mainly explained by income level, inflation, market power, financial sector development and market volatility.

Keywords: Interest rate pass-through, threshold cointegration, asymmetric adjustment, threshold error correction model

ÖZ

FAİZ ORANI YANSIMASININ DOĞRUSAL OLMAYAN YAPISININ KARŞILAŞTIRMALI ÇALIŞMASI

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Yüksek Lisans, İktisat Bölümü
Tez Yöneticisi: Dr. Dilem Yıldırım

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Bu çalışma 01/1999 ve 09/2011 zaman aralığında, yüksek gelirli, orta gelirli ve düşük gelirli olarak gruplandırılmış 15 ülkenin aylık verilerini kullanarak para piyasası faiz oranının kredi faiz oranına yansımasını incelemektedir.Engle-Granger'ın doğrusal eştümleşme sınamasını baz alarak yansıma mekanizmasındaki olası doğrusalsızlıkları açıklayabilmek için Enders ve Siklos'un eşikli eştümleşme sınaması uygulanmaktadır. Ampirik sonuçlar faiz yansıması sürecinin Güney Kore, Letonya ve Malezya olmak üzere üç ülkede tamamlanmış olduğunu ve kredi faiz oranı uyumunun Güney Kore ve Ermenistan olmak üzere iki ülke için bakışımlı olduğunu göstermektedir.Buna ek olarak, Bolivya, Filipinler, Malezya, Dominik Cumhuriyeti, Tayland ve Hırvatistan olmak üzere altı ülke için kredi faiz oranı uyumunun yukarı yönlü yapışkan olduğu ve Ukrayna, Sri Lanka, Letonya, Peru, Kuveyt, Hong Kong, Çek Cumhuriyeti olmak üzere 7 ülke için bu uyumun aşağı yönlü yapışkan olduğu gözlenmektedir. Ayrıca, tahmin sonuçlarımız yansıma mekanizmasının ülkeler arası heterojenliğinin temel olarak gelir düzeyi, enflasyon, piyasa gücü, finans sektöründeki gelişmişlik ve piyasa oynaklığıyla açıklanabileceğini göstermektedir.

Anahtar kelimeler: faiz yansıması, eşikli eştümleşme, bakışımsız uyum, eşikli hata düzeltme modeli.

To My Family

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LIST OF ABBREVIATIONS

AIC	Akaike Information Criterion
CV	Coefficient of Variation
ECM	Error-Correction Model
ECT	Error-Correction Term
EG	Engle-Granger
GDP	Gross Domestic Product
GNP	Gross national Product
IPT	Interest Rate Pass-Through
MTAR	Momentum Threshold Autoregressive
TAR	Threshold Autoregressive

CHAPTER 1

INTRODUCTION

Monetary policy is important for an economy in order to cope with the cyclical downturns while attaining the price stability and promoting the economic growth. This study analyses the dynamics of the monetary policy that is implemented through the interest rate channel. Via this channel, most of the central banks use their short term official rates to control the retail rates of banks which in turn enable them to control the real side of the economy. Effectiveness of the monetary policy depends on how fast and to what extend the retail rates respond to the changes in the official rate.

The interest rate pass through (IPT) process includes two steps. In the first step, central banks aim to alter the money market rate by changing the short term official rates; and in the second step retail rates of banks change following changes in the money market rate. The first step of the interest rate pass through is assumed to be complete, so that changes in the official rate are fully transmitted to the money market rate. As many studies[1] show, the second step, however, may not be complete and the speed of the pass through could change across countries. According to the studies[2], low level of competition among banks and asymmetric information are the possible reasons behind an incomplete IPT. Moreover, adjustment of retail rates to changes in the money market rate (or the official rate) might differ across countries due to differences in level of income, inflation rate,

[1] Cotterelli and Kourelis (1994), Mojon (2000), Sorensen and Werner (2006), Adams (2011), Leuvensteijn (2011), Gigineishvili (2011), Hoffman (2006), Crespo-Cuaresma, Egert and Reininger (2006), Chinois and Leon (2005), de Bondt (2005), Liu, Margaritis and Tourani-Rad (2007), Hansen and Welz (2011), Friasancho-Mariscal and Howells (2011), Jobst and Kwapil (2008), Tai, Sek and Har (2012)

[2] Sander and Kleimeier (2004a), Payne and Waters (2008), Wang and Lee (2009)

market uncertainty and the level of development of the financial sector. Furthermore, an important number of studies[3] show that retail rates adjust asymmetrically to changes in the money market rate depending on different nonlinear drivers. Main pillars of this asymmetry are given as switching, searching and menu costs, the market power and moral hazard problems caused by imperfect information.

In this study, we aim to explore the pass through of the money market rate on the lending rate[4] over the sample period January 1999 – September 2011, in fifteen countries which can be grouped according to the income levels as; high, upper middle and lower middle. Various macroeconomic and financial indicators are utilized to explain the heterogeneities in terms of the interest rate pass through process across our sample countries. In order to reveal and compare the dynamics of the pass through mechanism in our sample countries, we start with investigation of the long-run relationship between the lending rate and the money market rate in order to assess the completeness of the pass through process in these countries. Next, taking the possibility of asymmetric adjustment of lending rates into account, we perform the threshold autoregressive (TAR) and momentum threshold autoregressive (MTAR) cointegration tests of Enders and Siklos (2001). Finally, we employ threshold error correction models to uncover both short-run and long-run dynamics of the interest rate pass through mechanism.

Our empirical findings show that the pass through mechanism is incomplete in majority of our sample countries. Even though we expect to find a complete pass through for high income countries, lending rates of majority of high income countries exhibit incomplete pass through due to low level of competition in the banking sector, high market volatility and relatively less developed financial market. For

[3] Sholnick (1999), Crespo-Cuaresma, Egert, Reininger (2004), Mizen and Hofmann (2002), Fuertes, Heffernan and Kalotychou (2009), Gambacorta and Iannotti (2005), Karagiannis, Panagopoulos and Vlamis (2010), Cecchin (2011), Liu, Margaritis and Tourani-Rad (2007), Amasekara (2005), Tkacz (2001), Payne and Waters (2008), Payne (2007a 2007b), Wang and Lee (2009), Thompson (2006), Sander and Kleimeier (2002, 2004a, 2004b), Hovarth (2004) and Sznajderska (2012).

[4] The pass through from money market rate to deposit rate will be explored in a further study.

almost all of our sample countries[5] we observe substantial asymmetry in the adjustment of lending rates. Moreover, the lending rate appears to be upward rigid for Bolivia, Philippines, Malaysia, Dominican Republic, Thailand and Croatia, while significant downward rigidity is observed for the lending rates of Sri Lanka, Ukraine, Latvia, Peru, Kuwait, Hong Kong and Czech Republic. Heterogeneities in terms of market volatility and market power seem to be possible reasons to observe different form of asymmetries across countries. Furthermore, our nonlinear threshold error correction model estimates suggest that the money market rate is weakly exogenous in all countries, which constitutes the basis of our univariate modeling.

Contributions of this study are twofold. First, we explore the pass through mechanism in seven countries[6] which has not been studied so far. Second, we reveal substantial differences in terms of completeness, speed of adjustment and type of asymmetry in adjustment across countries by taking income level, macroeconomic and financial indicators into account.

This study is organized as follows; Chapter 1 briefly introduces the study, Chapter 2 reviews the theoretical and empirical literature of the interest rate pass-through mechanism, Chapter 3 presents the data with preliminary analysis, Chapter 4 describes the TAR and MTAR models, Chapter 5 discusses the empirical results and finally Chapter 6 concludes the study.

[5] The adjustment of the lending rate to changes in the money market rate is symmetric only in Republic of Korea and Armenia.

[6] Croatia, Kuwait, Dominican Republic, Peru, Ukraine, Armenia and Bolivia.

CHAPTER 2

LITERATURE REVIEW

Official short-term interest rates are one of the principal tools of implementing monetary policy for many central banks. When the central bank changes its official rate, it aims to affect first the money market rate, marginal cost of funds faced by banks, and then the retail (loan and deposit) rates offered by banks to non-financial institutions and households. Changes in retail rates will alter spending on durable and investment goods along with the goals of monetary policy. Hence, effectiveness of monetary policy depends on how complete and fast the pass-through to the money market and retail rates is.

In the literature, the first step of the interest rate pass through (IPT) process is generally assumed to be complete that is, changes in the official rate are fully transmitted to the money market rate. With this assumption almost all existing studies focus on the pass-through from the official rate or the money market rate to retail rates.

Despite the importance of the speed, completeness and dynamics of the interest rate pass through to observe the impact of the monetary policy on real side of economy; earlier studies are more concentrated on the pass through of exchange rates rather than interest rates. However, with the introduction of Euro and especially after the 2008-2009 world financial crisis, the way retail rates respond to money market and/or official rate changes has become a growing concern of researchers. Consequently, literature on the interest rate pass through (IPT) to retail rates has grown in the last decades.

Depending on financial and money market conditions, retail rates may adjust slowly to money market rate (official rate) changes, suggesting a sticky structure, which in

turn may breed an incomplete pass through. For example, in low income countries with low level of gross domestic product (GDP) and an undeveloped financial sector, banks may adjust their retail rates slowly due to being in a less competitive environment, where the variety of banks' products is limited and consumers are not informed well about the market and choices they have. As suggested by the standard Cournot model in microeconomics, those banks will have more power over the market and be more profitable, which may result in a sluggish adjustment. In high income countries, on the other hand, due to developed financial sector and high competition among banks, which implies a low bank concentration ratio (a competitiveness measure), we would expect a faster adjustment in retail rates. There is no doubt that the IPT process will be affected by consumers' behaviors as well. High demand for loans or other products will lead to higher number of suppliers which in turn decreases the bank concentration ratio, increases competitiveness of the market along with the adjustment of retail rates. Regarding money market conditions, the inflation rate and market uncertainty could be quite effective on the IPT. In a high inflationary environment, banks should update their rates (especially the lending rate, in order to make sure that the real interest rate is positive) more frequently, speeding up the pass through. Higher volatility of the money market rate or the official rate, on the other hand, may slow down the adjustment, since banks will hesitate to make changes.

Being in line with the discussion above, Cotterelli and Kourelis (1994), reveal that less barriers to competition speed up the pass through mechanism. Similarly, Mojon (2000), Sorensen and Werner (2006), Adams (2011), Leuvensteijn (2011) and Gigineishvili (2011) show that bank concentration (competition) lowers (increases) the adjustment speed of retail rates following changes in the money market rate (or the official rate). Gigineishvili (2011) reveals further that the IPT is faster for countries with higher per capita GDP. Regarding effect of monetary conditions, Cotterelli and Kourelis (1994) and Gigineishvili (2011) provide empirical support for the positive impact of inflation on speed of adjustment, while Giginieishvili (2011), Cotterelli and Kourelis (1994), Mojon (2000) and Sander and Kleimeier (2004b) point out that the higher the market volatility, the lower the speed of the IPT process is.

Beside these, there are also studies aim to explore whether there is a structural break effect on the speed and completeness of the IPT. In this sense, Hofmann (2006), Egert, Crespo-Cuaresma, and Reininger (2007), Chionis and Leon (2005) and de Bondt (2005) examine the effect of introduction of the single currency, Euro, on the pass through of interest rates. Analyzing different types of retail rates through error correction models, they find out that the speed of pass through has increased with the introduction of the euro for all EU members, except Germany. Similarly, Liu, Margaritis and Tourani-Rad (2007), uncovers that introduction of official cash rate[7] in New Zeland has increased the speed of pass through. Hansen and Welz (2011), Friasancho-Mariscal and Howells (2011) and Jobst and Kwapil (2008) investigate the effect of 2008 crisis on the speed of pass through. The overall conclusion is crisis has weakened the interest rate pass through in Sweden, Austria, US and EU as well as UK if deposit rates are considered. Tai, Sek and Har (2012) obtain similar results for Asian countries after the Asian crisis.

The literature discussed above presumably assumes symmetric adjustment of interest rates to money market rate changes. However, generally, it is not the case. Besides financial and money market conditions discussed above, there are various reasons to expect an asymmetric pass-through. Existence of switching costs[8] and searching costs[9] are some of the reasons to observe asymmetries in adjustment. Existence of these costs increase the market power of banks, Lowe and Rohling (1992), and enable banks to increase (decrease) their lending rates faster (slower) when the money market rate rises (falls), Scholnick (1999). Secondly, asymmetric pass-through of lending rates may arise from the imperfect information problem. According to Striglitz and Weiss (1981), for banks, riskiness of the loan is as important as the interest revenue collected. Since the demand for loans would be less elastic for risky borrowers, an increase in the lending rate will attract more risky borrowers compared to credible ones. In order to overcome the moral hazard

[7] A policy –controlled benchmark interest rate, on money market and residential lending rates in New Zeland. Liu et Al. (2007)

[8] The costs incurred when customers change their banks or change the type of loan they are using.

[9]For banks,e.g. cost of gathering information about the customer; for customers, e.g. cost of learning the rates offered and the payment schedule by each individual bank,

problem, banks may act slowly following an increase in the money market rate. Moreover, Hannan and Berger (1991), Neumark and Sharpe (1992) and Scholnick (1996) argue that asymmetric adjustment may stem from collusive pricing arrangements and adverse customer reaction. Collusive pricing arrangement theory suggests that it is unprofitable for a bank to act against collusive pricing behaviour. In cases of both increasing and decreasing the lending rate the bank faces costs. Yet, additional cost generated by decreasing the lending rate is greater than the cost while increasing it.Therefore, lending rates should be downward sticky.On the other hand, adverse customer reaction theory suggests that when a bank acts against the collusive pricing and alters the lending rate, customers may react negatively to the change. If additional costs generated by altering the lending rate depend heavily on negative reaction of the cumstomers, the bank will act more slowly to increase its lending rate. Thirdly, menu costs[10] (adjustment costs) might lead banks to act slowly when changes in money market rate are relatively small, but respond faster following large changes in the money market rate. Finally, as Dueker (2000) suggests, asymmetric pass-through is expected due to business cycles. He asserts that banks are risk averse so that they act slowly to lower their lending rates during cyclical downturns, suggesting that the expansionary monetary policy will be less effective on the economy compared to the contractionary monetary policy.

Due to the reasons discussed above, recent literature is mainly focused on asymmetric structure of the IPT in order to explore the dynamics of the adjustment process more precisely. Empirical studies investigating asymmetries in the interest rate pass-through employ generally nonlinear threshold error-correction models (ECMs), where the long run equilibrium is represented in terms of cointegration between official rate or the money market rate and the retail loan rate. Within this framework, the pass-through is examined for a number of countries in studies: Mizen and Hofmann (2002) and Fuertes, Heffernan and Kalotychou (2009) for UK, Tkacz (2001), Scholnick (1999), Karagiannis, Panagopoulos and Vlamis (2010), Thompson (2006), Wang and Lee (2009), Payne and Waters (2008), and Payne (2006,2007) for US, Karagiannis et al. (2010) and Sander and Kleimeier (2002,2004) for EU countries, Scholnick (1999) for Canada, Crespo-Cuaresma,

[10] The cost of changing the initial lending rate such as cost of advertising or announcement, labor time devoted to apply changes.

Egert, Reininger (2004), for Czech Republic, Hungary and Poland, Gambacorta and Iannotti (2005), for Italy, Amasekara (2005), for Sri Lanka, Cecchin(2011), for Switzerland, Horvarth (2004), for Hungary, Sznajderska (2012), for Poland, Liu et Al. (2007) for New Zealand and Wang and Lee(2009) for Asian countries.

The studies allowing for asymmetry in the IPT process can be separated into two in terms of determination of the threshold value. While some of the studies determine the threshold value exogenously, others treat the threshold as an unknown parameter and estimate it by an appropriate methodology. In this sense, Scholnick (1999), Crespo-Cuaresma et al. (2004), Mizen and Hofmann (2002) and Fuertes et Al. (2009), Gambacorta and Iannotti (2005), Karagiannis et al. (2010), Cecchin (2011) and Liu et al. (2007) set exogenous threshold values, while Tkacz (2001), Payne and Waters (2008), Payne (2006, 2007), Wang and Lee (2009), Thompson (2006), Sander and Kleimeier (2002, 2004a), Hovarth (2004) and Sznajderska (2012) utilize methods allowing for an endogenously determined threshold value.

The first group of studies on asymmetric IPT set threshold value to zero in order to observe asymmetries driven by negative/positive deviations from the equilibrium. However the threshold is not necessarily zero, it may change according to the structure of the data. In this sense, finding a consistent estimator for the unknown threshold value is important to explore the IPT process more precisely. All of the studies[11] in the second group except for Tkacz (2001) employ Threshold Autoregressive (TAR) and Momentum Threshold Autoregressive (MTAR) models proposed by Enders and Siklos (2001) to test for asymmetry and cointegration while estimating the unknown threshold value through the methodology of Chan (1993).

Empirical studies on the asymmetric pass through of American interest rates with an endogenously determined threshold value reach to opposing conclusions. While Tkacz (2001) fail to detect an asymmetry in the adjustment of the prime rate to changes in the Federal Funds rate, Payne and Waters (2008) and Payne (2007) reveal significant asymmetries in the adjustment of prime rate and adjustable rate

[11] Tkacz (2001) estimates threshold using Hansen's grid search method.

mortgages: on newly built homes and previously owned homes, respectively, with the rates reacting slower (faster) when there is an increase (decrease) in the Federal Funds rate. Analyzing the spread between the prime rate and the deposit rate, Thompson (2006) points out that the spread is more sluggish when it is above its threshold value.

Sander and Kleimeier (2002, 2004) employ both exogenously and endogenously determined threshold values to explore the asymmetric nature of the IPT in fifteen EU countries. According to their findings, majority of EU countries have asymmetry in the IPT. They argue further that the introduction of euro has not changed the heterogeneous nature of the IPT across Euro area. In other words, changes in money market rates result in different pass through nature in the area even after the introduction of euro.

In terms of asymmetric adjustment of interest rates in other countries; Wang and Lee (2009) uncover that, lending rates adjust asymmetrically in Philippines, Taiwan, and Hong Kong, exhibiting downward stickiness. In Poland, relatively longer term credits show downward rigidity whereas short term loans such as credit rates to consumers exhibit upward rigidity. Hovarth (2004) and Sznajderska (2012) also reveal that larger shocks are eliminated rather quickly in Hungary and Poland, respectively.

This study aims to explore the pass through from the money market rate to the retail loan rates in 15 different countries. Similar to the most recent studies we aim to reveal asymmetries, nonlinearites,in the responses of loan rates through univariate threshold autoregressive (TAR) and momentum threshold autoregressive (MTAR) models of Enders and Siklos (2001). Our study, however, differs from the existing ones in that we account not only for asymmetries but also income differences across countries. In that sense, we group Croatia, Czech Republic, Hong Kong, Kuwait and Republic of Korea as high income, Latvia, Malaysia, Dominican Republic, Peru and Thailand as upper middle income and Ukraine, Armenia, Sri Lanka, Philippines and Bolivia as lower middle income countries. Among our sample countries, the pass

through from money market rate (or the official rate) to lending rates is studied for the countries Hong Kong, Republic of Korea, Malaysia, Philippines and Thailand Wang and Lee (2009), Sri Lanka by Amasekara (2005), Czech Republic by Crespo-Cuaresma et al. (2004) and Sander and Kleimeier (2004b), and Latvia by Sander and Kleimeier (2004b). Investigation of the IPT for the rest of the countries in our sample; Croatia, Kuwait, Dominican Republic, Peru, Ukraine, Armenia and Bolivia will be first in literature.

CHAPTER 3

DATA

This study utilizes monthly data of fifteen countries – (Kuwait, Hong Kong, Republic of Korea, Czech Republic, Croatia, Latvia, Malaysia, Dominican Republic, Peru, Thailand, Ukraine, Armenia, Sri Lanka, Philippines, Ukraine) to analyze the interest rate pass through process from the money market rate to the lending rate. For each country; money market and lending rate monthly series covering the period of January 1999 to September 2011 are obtained from International Financial Statistics (IFS) database. The starting date of 1999 is selected in order to avoid the effects of the Asian crisis in 1997 and 1998, which results in extraordinary behaviors in interest rates.

Countries in interest are grouped according to country classification method of the World Bank. High income group refers to the countries with gross national income (GNI) per capita of $12.476 or more. Countries that have GNI per capita between $4,036 and $12,475 fall into the upper middle income group and finally lower middle income group covers the countries with GNI per capita between $1,026 and $4,035[12]. Table 1 summarizes the countries according to their income levels.

Table 1: Groups of Countries

HIGH INCOME	UPPER MIDDLE INCOME	LOWER MIDDLE INCOME
Kuwait	Latvia	Ukraine
Hong Kong	Malaysia	Armenia
Republic of Korea	Dominican Republic	Sri Lanka
Czech Republic	Peru	Philippines
Croatia	Thailand	Bolivia

[12] Countries are grouped according to their 2011 GNI per capita levels.

Figures 1, 2 and 3 show the money market and lending rate series as well as the markup – (the difference between these two rates) - of high, upper middle and lower middle income countries, respectively. Indications of the figures are manifold. First of all, lending rates and money market rates seem to move together for all groups of countries, implying existence of a cointegration relationship. This co-movement will be tested statistically in the following sections. Secondly, almost all lending rates have smooth structures compared to money market rates. This is probably because of the precautionary motive of the banking sector. Even though lending rates react to the changes in money market rates, it takes time for banks to change the lending rates because of the adjustment and menu costs. Thirdly, the time lag appears to be larger for lending rates to follow a rise in money market rates. For instance, in Thailand, the money market rate starts to rise in July 2004 but the lending rate responds to this increase around July 2005, approximately one year later. However, adjustment responses differ when there is a decrease in the money market rate. That is, a decrease in the money market rate observed in September 2009 is passed through to the lending rate only a couple of months later. The possible reason behind this asymmetry could be the profit maximization behavior of banks. With this approach, banks decline the lending rates following money market rate decreases faster to attract more customers and act more slowly to increase in order to avoid losing customers.

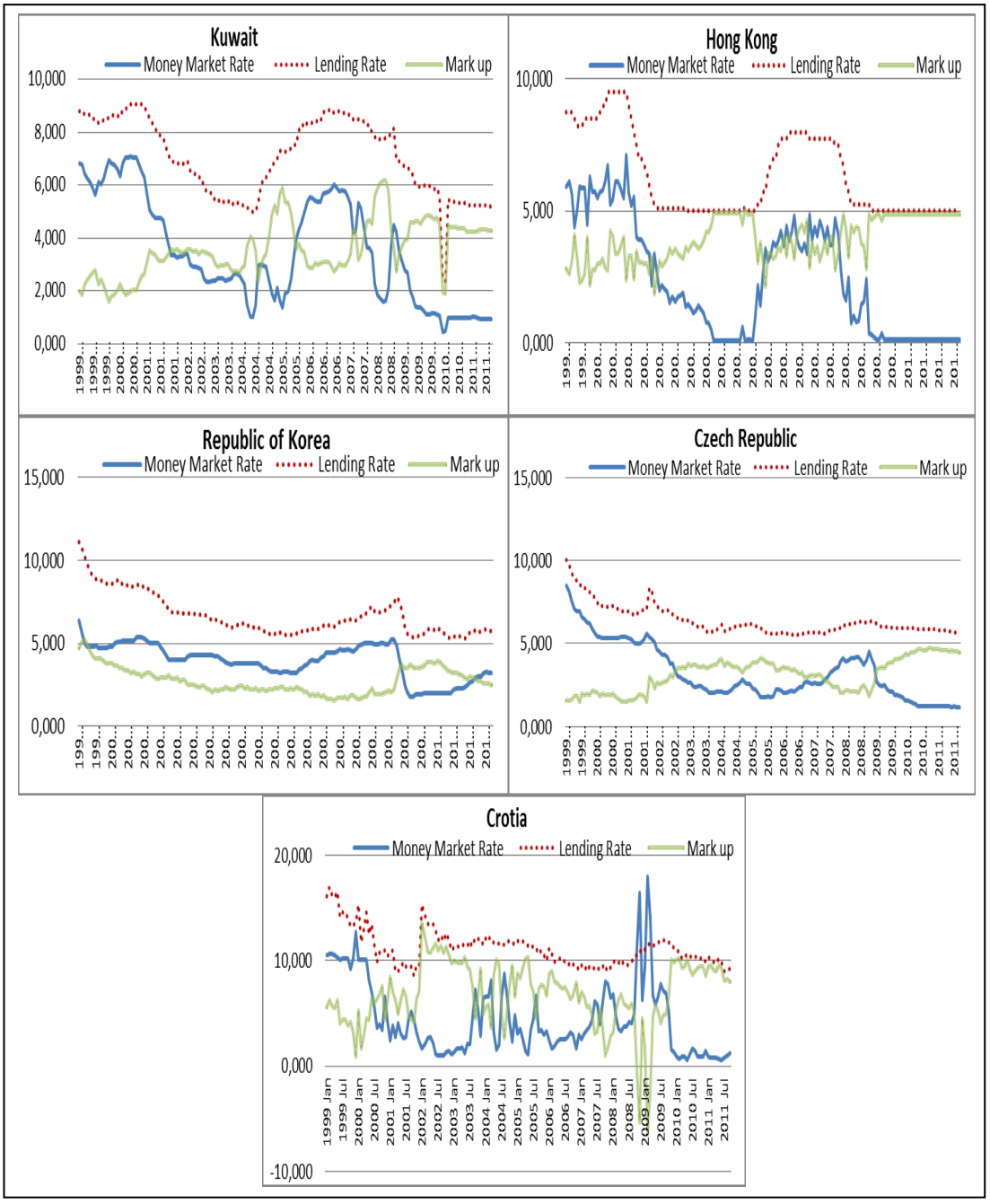

FIGURE 1: Money market rate, lending rate and markup series of high income countries over the period 1999:01 to 2011:09. (Source: International Monetary Fund, International Financial Statistics Database)

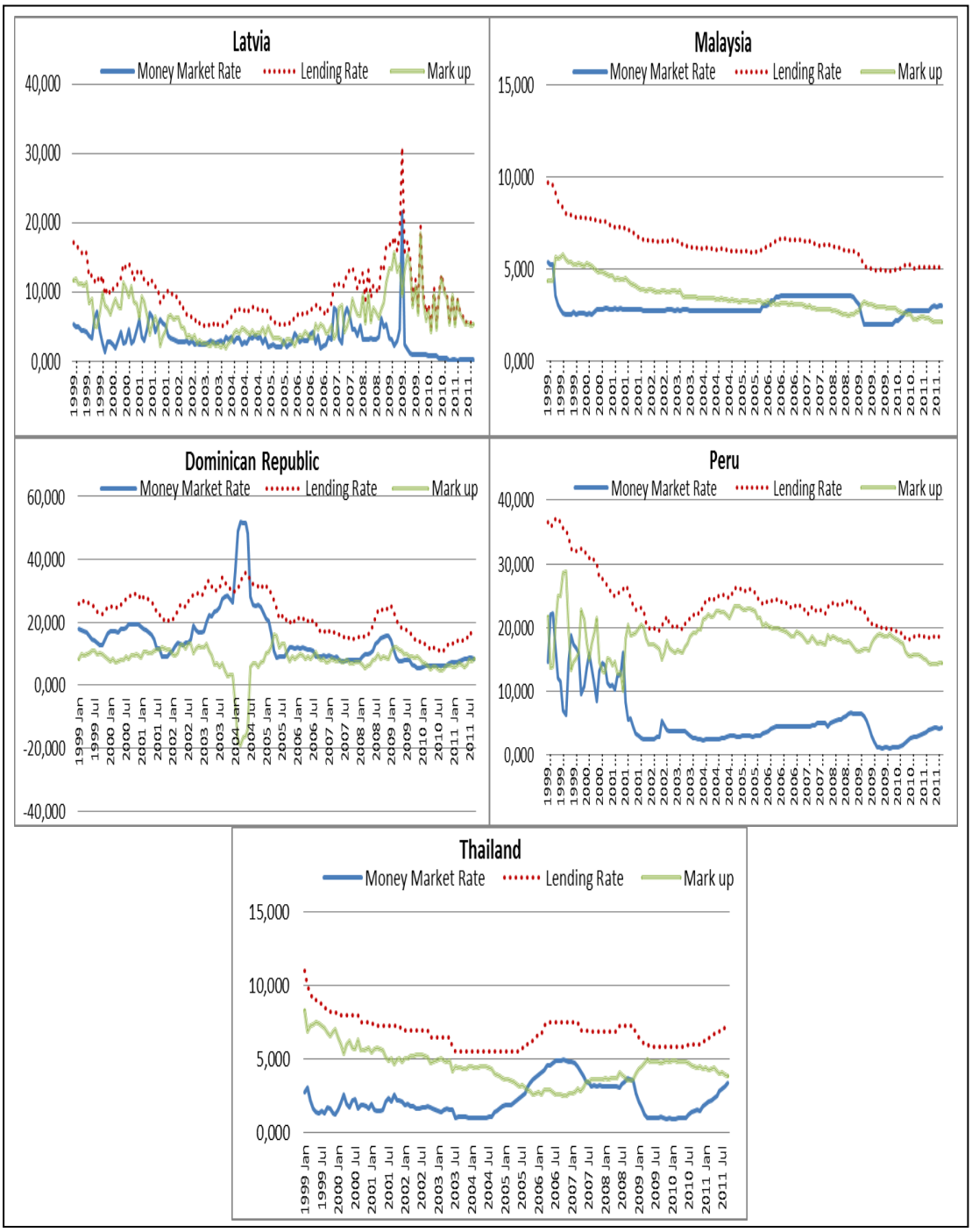

Figure 2: Money market rate, lending rate and markup series of upper middle income countries over the period 1999:01 to 2011:09. (Source: International Monetary Fund, International Financial Statistics Database)

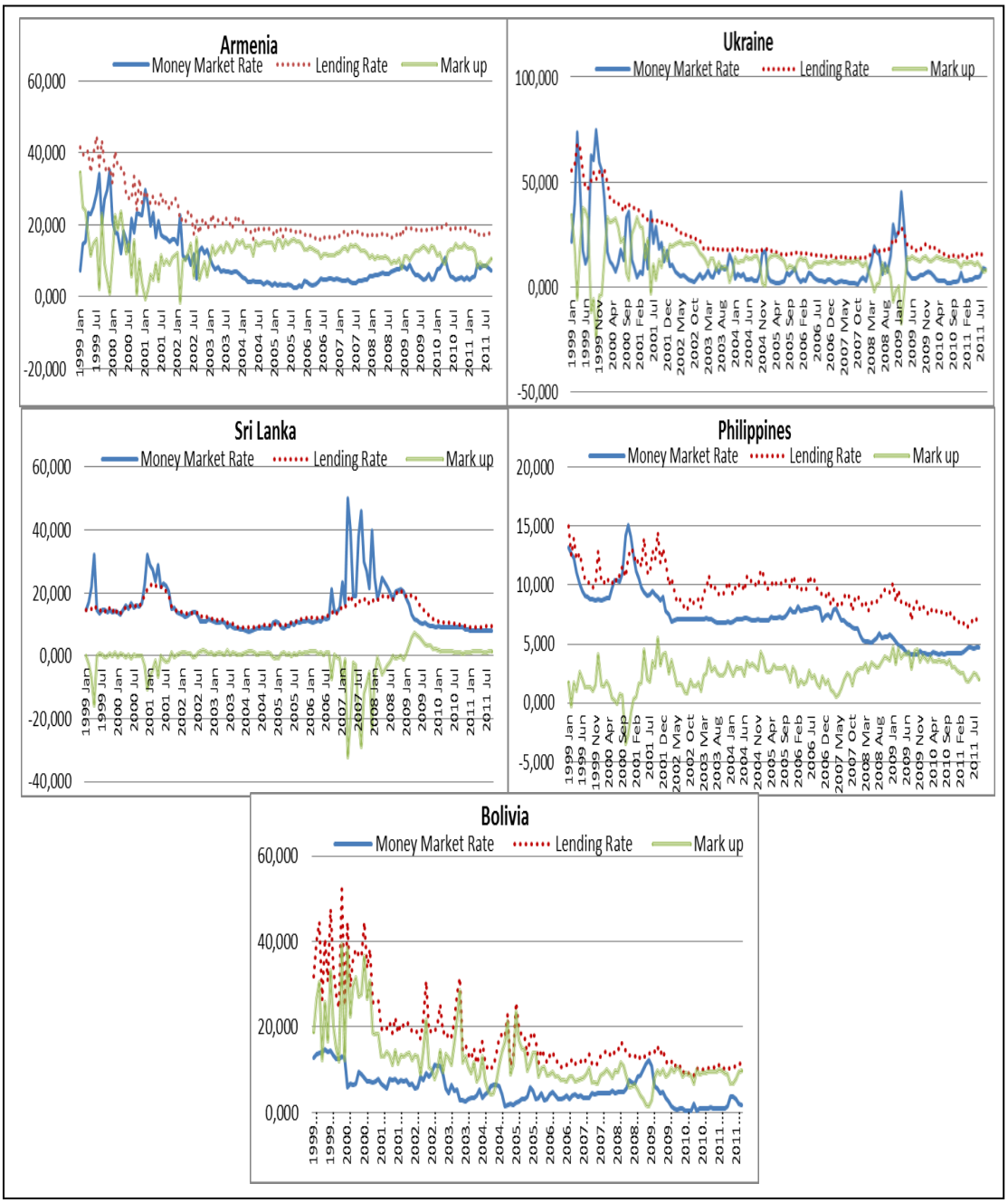

Figure 3: Money market rate, lending rate and mark up series of high income countries over the period 1999:01 to 2011:09 (Source: International Monetary Fund, International Financial Statistics Database)

Moreover, as seen in Figures 1-3, the spread (markup) between two rates is smaller for high income economies, generally lower than five percent. For the upper middle income group, on the other hand, the markup gets as high as almost thirty percent, and for lower middle income countries, a markup that is around forty percent is experienced. Inflation could be the main cause of such differences among income groups. As expected, the inflation rate in lower middle income countries is much higher than the one in upper middle and high income groups. The annual average inflation rate over the period from 1999 to 2011 is between 0.2% and 3.5% for high income countries, %2.3 and %11.7 for upper middle income group, %4 and %13.2 for lower middle income group[13]. Moreover, as may be expected, the markup becomes negative during crisis which occurs more frequently in lower middle income group countries[14].

Finally, the negative relationship between money market rates and the markups can be easily seen from the figures. Simply, when the money market increases (decreases) while the lending rate stays relatively same, we will observe a decline (rise) in markup, resulting in a negative correlation between the money market rate and the markup. Given this, it can be concluded that the slower the adjustment of lending rates the stronger the negative relationship would be. As an example, the coefficient of correlation between the money market rate and the markup is -0.029 in Latvia, indicating very weak negative linear relationship and hence, raising the possibility of complete pass-through. For Philippines, on the other hand, a relatively

[13] Sri Lanka is the only country that does not suit to this relation. It has one of the highest inflation rates (9.61%) within our sample countries with a markup very close to zero. However, this surprising relation originates from the fact that most of the large banks in Sri Lanka are state-owned. In order to promote economic growth, state banks do not add noticeable markup to their marginal costs-(money market rate).

[14] A negative markup denotes that banking sector is open to outside shocks and there is a coordination problem between policy makers and banks. During crisis, money market rates increase sharply and unexpectedly. As it takes time for banks to adjust their rates, they have lower lending rate (or price) than the money market rate (or the marginal cost) during the shocks, signaling that banking sector is making losses raising the risk of bankruptcy. Lower middle income countries face this problem more frequently, related to their underdeveloped financial system and openness to shocks.

high correlation coefficient of -0.668 is observed and this may suggest an incomplete IPT process[15].

As a preliminary analysis, we prefer to employ Ng and Perron (2001)[16] unit root tests, since they are modified versions of the existing unit root tests with better performance in terms of power and size distortions. Unit root test results together with the corresponding critical values are represented in Table 2. As is frequently the case for interest rates, a conventional unit root analysis does not reject the null hypothesis of a unit root in each interest rate series for all countries at the 5 percent level. Although macroeconomic arguments may point to the stationarity of interest rates, our data have statistical properties associated with nonstationary, or near-nonstationary, I(1) series. Consequently, and following earlier studies, we proceed to a cointegration analysis of the pass-through.

[15] See Appedix-A for correlation coefficients of all countries.

[16] Ng and Perron (2001) constructed four different unit root test statistics that are estimated using generalized least squares (GLS) de-trended data for each variable. These test statistics are modified forms of Phillips and Perron statistic, the Bhargava (1986) statistic and Elliot, Rothenberg and Stock (ERS) point optimal statistic. Traditional unit root tests typically suffer from severe finite sample power and size problems, whereas Ng-Perron test corrects for size distortions and has good power in finite sample.

TABLE 2: Ng and Perron (2001) Unit Root Test Results

		Money Market Rate				Lending Rate			
		MZa	*MZt*	*MSB*	*MPT*	*MZa*	*MZt*	*MSB*	*MPT*
HIGH INCOME	*Kuwait*	-0.691	-0.347	0.501	16.855	-0.535	-0.276	0.516	18.018
	Hong Kong	-0.004	-0.003	0.689	30.187	-2.612	-0.992	0.380	8.781
	Republic of Korea	-0.907	-0.503	0.555	18.148	0.079	0.069	0.875	45.282
	Czech Republic	0.599	0.659	1.100	76.311	0.474	0.658	1.388	114.054
	Croatia	-2.720	-1.005	0.370	8.480	-0.359	-0.217	0.606	23.098
UPPER MIDDLE INCOME	*Latvia*	-2.149	-0.806	0.375	9.640	-0.346	-0.210	0.607	23.230
	Malaysia	-0.894	-0.554	0.619	20.976	0.751	1.002	1.335	112.871
	Dominican Repulic	-6.903	-1.807	0.262	3.733	-3.526	-1.213	0.344	6.949
	Peru	-0.191	-0.162	0.851	40.535	0.249	0.199	0.800	40.540
	Thailand	-5.640	-1.640	0.291	16.077	-0.968	-0.495	0.511	54.783
LOWER MIDDLE INCOME	*Ukraine*	-7.466	-1.916	0.257	12.243	-3.061	-1.118	0.365	26.950
	Armenia	-0.507	-0.502	0.991	48.180	0.242	0.258	1.068	66.638
	Sri Lanka	-4.718	-1.485	0.315	5.308	-16.929	-2.887	0.171	5.520
	Phillipines	-0.215	-0.139	0.645	26.112	0.306	0.217	0.711	33.901
	Bolivia	-1.623	-0.707	0.436	11.970	-0.473	-0.302	0.640	24.321

Critical Values for Ng-Perron Test	*(with intercept)*				*(with intercept and slope)*			
	MZa	*MZt*	*MSB*	*MPT*	*MZa*	*MZt*	*MSB*	*MPT*
1%	-23,8	-3,42	0,143	4,03	-13,8	-2,58	0,174	1,78
5%	-17,3	-2,91	0,168	5,48	-8,1	-1,98	0,233	3,17

Notes: The lag order for all unit root tests has been chosen using the modified AIC (MAIC) suggested by Ng and Perron (2001). The critical values for the above tests have been taken from Ng and Perron (2001).

CHAPTER 4

METHODOLOGY

In this study, we investigate the interest rate pass through from money market rates, proxy for official rates, to retail lending rates. Under the assumption of weak exogeneity of money market rates to lending rates, we utilize a single equation modeling approach to reveal short run and long run dynamics of the pass through mechanism.

4.1 Linear Cointegration

Given the *I(1)* structures of the interest rates along with the co-movement of lending rates (lr) and money market rates (mmr) observed from Figures 1-3, our starting point for formulizing the pass through process is the linear cointegration test. In this sense, we utilize the Engle and Granger (1987) cointegration test to figure out the relationship between lending rate and money market rate and estimate the following long run equilibrium regression by the Ordinary Least Squares (OLS) method:

$$lr_t = \alpha + \beta mmr_t + u_t \quad (1)$$

where mmr_t and lr_t refer to the money market and lending rates, respectively, and u_t is the stochastic disturbance term measuring the deviation of the lending rate from its equilibrium path. In this regression, α captures the mark-up between mmr and lr, while β, the degree of pass through, measures the magnitude of the change in mmr that is passed on to lr in the long run. The pass through is complete

if $\beta = 1$, since under this circumstance, any change in the mmr is fully transmitted to the lr. On the other hand, if $\beta < 1$ the pass through is incomplete, in the sense that, even in the long run, changes in mmr are reflected partially on lr. Completeness of the pass through mechanism is an indicator of the effectiveness of monetary policy, for this reason, the null hypothesis of complete pass through: $H_0 : \beta = 1$, is statistically tested[17].

Once the residuals, $\hat{u}_t$, are obtained from the regression (1), the second step of Engle-Granger testing methodology involves testing for cointegration, stationarity of $\hat{u}_t$ through the regression:

$$\Delta\hat{u}_t = \rho\hat{u}_{t-1} + \sum_{i=1}^{p} \lambda_i \Delta\hat{u}_{t-p} + \nu_t \qquad (2)$$

[17] Although β in equation (1) exhibits the degree of pass through, Benarjee, Dolado, Hendry and Smith (1986) indicate that the estimator of the degree of pass through may suffer from biasedness and underestimation problems. To overcome this problem, Bardsen (1989) suggests the following ARDL model:

$$\Delta lr_t = \alpha_0 + \sum_{i=1}^{p-1} \alpha_i^* \Delta lr_{t-i} + \sum_{i=0}^{q-1} \beta_i^* \Delta mmr_{t-i} + \alpha_p^* lr_{t-p} + \beta_q^* mmr_{t-q} + \varepsilon_t$$

where *p* and *q* are the optimal lag lengths observed by Akaike's Information Criterion with the upper limit of $p, q = \text{int}\left[12 \times \left(\frac{T}{100}\right)^{0.25}\right]$ where T is the sample size.

The unbiased estimator of the coefficient that measures the degree of pass through is

$$\hat{\theta} = \frac{-\hat{\beta}_q}{\hat{\alpha}_p}$$

with the corresponding standard error being;

$$se(\hat{\theta}) = \sqrt{\left(\hat{\alpha}_p^*\right)^{-2}\left[\hat{\text{var}}(\hat{\beta}_q^*) + \left(\hat{\theta}\right)^2 \hat{\text{var}}(\hat{\alpha}_p^*) + 2\hat{\theta}\,\hat{\text{cov}}(\hat{\alpha}_p^*, \hat{\beta}_q^*)\right]}$$

Finally, testing for a complete pass-through turns to testing the null hypothesis of $H_0 : \theta = 1$

where, ν_t is identically and independently distributed (iid) disturbance term and *p* is the lag order that ensures the iid structure of ν_t. Then, simply rejecting the null hypothesis of $\rho = 0$ implies stationarity of $\hat{u}_t$, namely existence of a long-run equilibrium between the money market and lending rate.

4.2 Nonlinear Cointegration

As discussed in Chapter 2, there are many reasons to expect an asymmetric structure in the interest rate pass through. In the presence of asymmetry, nonlinearity, the linear cointegration test proposed by Engle and Granger (1987) may be misleading, since it assumes symmetric adjustment to the equilibrium. Enders and Siklos (2001) address to this misspecification problem and suggest nonlinear cointegration tests allowing for a threshold autoregressive (TAR) and momentum threshold autoregressive (MTAR) type adjustments.

In order to test for TAR type cointegration, similar to Engle-Granger methodology, we first obtain residuals from equation (1), and then estimate the following secondary regression:

$$\Delta\hat{u}_t = I_t\rho_1\hat{u}_{t-1} + (1-I_t)\rho_2\hat{u}_{t-1} + \sum_{i=1}^{p}\lambda_i\Delta\hat{u}_{t-p} + \nu_t \qquad (3)$$

where ν_t is the iid disturbance term, ensured by the lag order *p* and I_t is the Heaviside Indicator function such that:

$$I_t = \begin{cases} 1 & if \quad \hat{u}_{t-1} \geq \tau \\ 0 & if \quad \hat{u}_{t-1} < \tau \end{cases} \qquad (4)$$

where, τ is the unknown threshold value, such that if the previous period's residual , $\hat{u}_{t-1}$, is above this threshold, the speed of adjustment is measured by ρ_1 and if it is below the threshold, ρ_2 is the coefficient for speed of adjustment. It is easy to see that when $\rho_1 = \rho_2$, the TAR model turns to the standard Engle- Granger model. Hence, Engle-Granger cointegration test which assumes symmetric adjustment is a special case of the TAR model.

In order to obtain a consistent estimator for the unknown threshold value, τ, we follow the procedure proposed by Chan (1993). In this context, we start with ranking the residuals obtained from equation (1) in ascending order. Then, for each potential threshold value τ, which is typically in the middle 70% of the ordered values of the residuals, we estimate the TAR model (3) by OLS. Finally, the consistent estimator of the threshold value is determined by minimizing the sum of squared residuals over these estimations.

Once the threshold value is observed, the TAR model is estimated by OLS and the existence of the cointegration between the lending rate and money market rate is tested by the null hypothesis of: $H_0 : \rho_1 = \rho_2 = 0$. The test statistic is symbolized as Φ and does not follow a standard F distribution, due to the threshold value being unidentified under the null hypothesis of no cointegration (the well-known Davies (1987) problem). To address this issue, Enders and Siklos (2001) perform a Monte Carlo simulation in order to obtain the relevant critical values.

When significance of the cointegration is achieved and necessary and sufficient conditions[18] for the stationary of $\hat{u}_t$ holds, the next step is testing for significance of asymmetry. As such, the null hypothesis of $\rho_1 = \rho_2$ is tested by a standard F test. Chan and Tong (1989) show that; if consistency of the estimated threshold value is

[18] According to the study of Petrucelli and Woolford (1984), ρ_1 and ρ_2 should be negative and $(1+\rho_1)(1+\rho_2) < 1$ for any threshold value.

established, the asymptotic normality of the coefficients will hold, which in turn allows us to employ standard F test.

The steps of testing for MTAR type asymmetric cointegration are not far different from the TAR model. The main difference between these two models is simply the type of asymmetry that is considered. The TAR model assumes that the adjustment rate of residuals, ρ_1 and ρ_2, differ depending on whether one lagged value of residuals is above or below the threshold value. Hence, if the threshold value takes a value close to zero, asymmetry with regard to the sign of the disequilibrium is expected. However, the MTAR model considers the asymmetry that may be caused by the change in the $\hat{u}_{t-1}$ rather than its level form.

In order to utilize the MTAR model, we start with estimation of the equation (1) and obtain residuals. Then, employing the residuals, equation.(3) is estimated with the following indicator function:.

$$I_t = \begin{cases} 1 & if \quad \Delta\hat{u}_{t-1} \geq \tau \\ 0 & if \quad \Delta\hat{u}_{t-1} < \tau \end{cases} \tag{5}$$

where, τ is the unknown threshold value estimated following the methodology of Chan (1993), as in TAR type asymmetry. ρ_1 (ρ_2) is the adjustment coefficient if previous period's change in residuals is relatively large (small), in other words, change in $\hat{u}_{t-1}$ is greater than or equal to (less than) the threshold value.

4.3 Nonlinear Threshold Error Correction Model

When a non-linear cointegration relationship is achieved, the next step should be constructing an appropriate threshold error-correction model to reveal both short run and long run dynamics of the interest rate pass through simultaneously. The asymmetric error correction model (ECM) has the form:

$$\Delta lr_t = \varphi_0 + \sum_{i=1}^{p} \varphi_i \Delta lr_{t-i} + \sum_{i=1}^{p} \delta_i \Delta mmr_{t-i} + \gamma_1 I_t \hat{u}_{t-1} + \gamma_2 (1 - I_t)\hat{u}_{t-1} + \nu_{1t} \quad (6)$$

where p is required number of lagged variables of lending rate and money market rate that ensures the i.i.d. structure of the error term ν_{1t}, $u_{t-1} = lr_{t-1} - \alpha - \beta mmr_{t-1}$ and the indicator function I_t takes the form given in (4) and (5) for TAR-ECM and MTAR-ECM, respectively. γ_1 (γ_2) is the error correction term or the speed of adjustment of lending rates to the long-run equilibrium in when is $\hat{u}_{t-1} \geq \tau$ ($\hat{u}_{t-1} < \tau$) for the TAR model and $\Delta\hat{u}_{t-1} \geq \tau$ ($\Delta\hat{u}_{t-1} < \tau$) for the MTAR model. φ_i and δ_i are the coefficients of the lagged values of change in the lending rate and the money market rate, respectively. Significance of φ_i represents that changes in lending rate depends on not only the changes in the money market rate but also its own past. δ_i , on the other hand, shows whether the previous periods' changes in the money market rate shapes this period's change in the lending rate. Consequently rejection of the null hypothesis of $H_0 : \delta_1 = ... = \delta_p = 0$ indicates that money market rate Granger causes the lending rate in the short run.

Similar to many existing studies in the interest rate pass-through literature, we assume that the lending rate is affected by money market rate changes while the money market rate is weakly exogenous to the lending rate. Even though it is important to examine the exogeneity in order to investigate the pass-through

mechanism in a more comprehensive manner, very few studies[19] perform weak exogeneity of the money market rate and granger-causality tests. To test for the validity of weak exogenity assumption we re-construct the nonlinear ECM with the dependent variable being the money market rate as follows:

$$\Delta mmr_t = \varphi_0 + \sum_{i=1}^{p} \varphi_i \Delta lr_{t-i} + \sum_{i=1}^{p} \delta_i \Delta mmr_{t-i} + \gamma_1 I_t \hat{u}_{t-1} + \gamma_2 (1 - I_t)\hat{u}_{t-1} + \nu_{2t} \quad (7)$$

This form of ECM allow us to explore the weak exogeneity of the money market rate making use of the error correction terms γ_1 and γ_2 ,such that if both error correction terms are statistically insignificant, weak exogeneity assumption will be supported. φ_i and δ_i are the coefficients of the lagged values of change in the lending rate and the money market rate, as before. Significance of φ_i represents that changes in the money market rate depends on previous periods' changes in the lending rate. Failure of rejection of the null hypothesis: $H_0 : \varphi_1 = ... = \varphi_p = 0$ suggests that the money market rate is not Granger caused by the lending rate. However, as Engle, Hendry and Richard (1983) underlines, changes in the money market rate may be affected by changes in the lending rate, in other words the money market rate may be Granger caused by the lending rate in the short-run, but this does not violate the weak exogeneity of the money market rate. On the other hand, δ_i are the coefficients on the previous periods' changes in the money market rate, hence rejecting the null hypothesis $H_0 : \delta_1 = ... = \delta_p = 0$ shows that a change in the money market rate does not have impacts on changes in latter periods.

[19] Payne(2007), Enders and Siklos (2001), Amasekara (2005)

CHAPTER 5

EMPRICAL RESULTS

As mentioned before, our aim is to explore the pass through of the money market rate on the lending rate over the sample period January 1999 – September 2011, in fifteen countries which can be grouped according to their income levels as; high, upper middle and lower middle making use of financial and macroeconomic indicators. As such, after discussing the long-run relationship between the lending rate and the money market rate for these countries through linear and nonlinear cointegration tests (section 5.1), the estimated threshold ECMs are provided in section 5.2.

5.1 Linear and Nonlinear Cointegration Test Results

Given the nonstationary structures of the interest rates, we first employ the standard Engle-Granger cointegration approach in order to test for cointegration between the lending rates and the money market rates. As such, we first estimate the long run equilibrium equation given in (1). Before proceeding with the Engle-Granger cointegration test results, we discuss the estimates of (1) in order to gain some inference regarding the mark-up (down) and the degree (extend) of the pass-through. Table 3 represents the estimation results of (1) for all countries. Regarding the mark-up pricing policy, overall we observe that the mark-up values increase as the income level decreases so that lowest mark-up values are observed in high income countries. Moreover, it is seen that countries with high (low) markups

Table 3: Estimated Long-run Equilibrium Relationships

	α	β	$\beta = 1$
HIGH INCOME			
Kuwait	4.845 (0.118)	0.633 (0.029)	*No*
Hong Kong	4.668 (0.063)	0.689 (0.020)	*No*
Republic of Korea	3.161 (0.250)	0.897 (0.061)	*Yes*
Czech Republic	4.839 (0.068)	0.474 (0.019)	*No*
Croatia	10.165 (0.201)	0.227 (0.036)	*No*
UPPER MIDDLE INCOME			
Latvia	6.676 (0.478)	0.957 (0.121)	*Yes*
Malaysia	3.806 (0.397)	0.885 (0.135)	*Yes*
Dominician Republic	13.903 (0.579)	0.588 (0.034)	*No*
Peru	19.677 (0.373)	0.774 (0.052)	*No*
Thailand	6.062 (0.170)	0.325 (0.068)	*No*
LOWER MIDDLE INCOME			
Ukraine	16.093 (0.825)	0.664 (0.046)	*No*
Armenia	14.677 (0.555)	0.741 (0.046)	*No*
Sri Lanka	8.338 (0.432)	0.369 (0.026)	*No*
Philippiness	5.213 (0.265)	0.611 (0.035)	*No*
Bolivia	8.536 -1.005	1.716 (0.155)	*No*

Notes: α and β are estimated parameters of (1) with standard errors given in parentheses.

experience higher (low) inflation rate compared to other countries[20]. Since banks operating in an inflationary environment need to put higher markups while determining their lending rates as they are interested in the interest revenue collected in real terms, this result is not surprising.

However, there are also a couple of countries with high markups despite possessing low inflation rates. Inflation rates of Armenia, Croatia and Peru are 3.99%, 3%, 2.64% whereas; the estimated markups are 14.67%, 10.16% and 19.68%, respectively. One possible explanation for such unexpected reaction of banks in these countries could be the instability of the inflation rate. Before 1996, all of these three countries experienced hyper-inflation; in 1995 the inflation rate in Armenia was 176%, in 1994 the Croatian inflation rate was %107 and inflation rate in Peru was 409% in 1991. Even though, these countries had one digit inflation rate after 1997, the fluctuation of the inflation rate is much higher with relatively sharp decreases and increases compared to other countries having similar average inflation rate. These findings indicate that, banks in these countries are more pessimistic about the policy implications on price stability and hesitate to lower the markup in order to protect themselves from an unanticipated high inflation risk. Another explanation, closely related to the instability of the inflation rate, could be the adverse effect of the market rate volatility, as mentioned in Chapter 2, Saunders and Schumacher (2000) states that the higher the money market rate volatility, the higher the bank interest rate margins (mark-ups). Volatility of the money market rate leads to uncertainty about the future conditions and banks to secure their profits with high markups. Using the coefficient of variation (CV) of the money market rate as a proxy for the volatility, market volatilities for each country is given in the Appendix-B[21]. We expect higher volatility of the money market rate in an economy where the inflation rate is also highly volatile. Confirming our expectation, when we rank all of the fifteen countries according to the CV of the money market rate, we observe that

[20] For example,in Republic of Korea for our sample period the average inflation rate and mark up values are 2.99% and 3.16%, which are higher in philiphines (4,68%-5.21%)and highest in Ukraine (13.21% -16.09%).

[21] Some of the studies use the standard deviation of the money market rate as a volatility measure. However, in our case, it is more appropriate to measure volatility by the relative spread rather than the average spread since higher (lower) standard deviation of money market rate will mainly stem from the high (lower) inflation rate.

Armenia, Croatia and Peru listed among the highest volatile group. Market structure might also explain the reason of high markups observed in these three countries. According to Monti-Klein[22] model, for markets that are far from perfect competition, the demand for goods (bank products) will be less elastic which will in turn result in higher markups. In other words, it is easy and profitable for banks to set high markups in the absence of competition. Following the literature, we measure the degree of competition by the bank concentration ratio[23]. Peru and Armenia have the highest second and third bank concentration ratios among all fifteen countries. Hence, it is also possible to explain high markups in Armenia and Peru by low level of competition.

Besides Armenia, Croatia and Peru, the markup estimation for Sri Lanka is also interesting. Sri Lanka is the only country with a markup that is lower than the inflation rate[24]. As discussed in Chapter 3, most of the banks in Sri Lanka are state owned. In order to promote economic growth banks probably do not add noticeable markups, which also explains the fact that profitability[25] of banks in Sri Lanka is very low compared to other countries.

Turning to the slope coefficient of the equation (1), which is an indicator for the degree of the pass-through, we expect the process to be complete in high income countries due to economic growth and financial developments. However, as seen in Table 3, Republic of Korea[26] is the only high income country providing empirical evidence in favor of a complete pass-through. Regarding the upper middle income countries, our results reveal that money market rate changes are reflected to lending rates fully in the long-run only for Latvia and Malaysia. This finding is in line with our

[22] See Freixas and Rochet (1997) and Sander and Kleimeier (2004) for further information.

[23] See Appendix B to explore bank concentration ratios of all countries.

[24] Inflation rate in Sri Lanka is 9.61% while the markup is 8.34%.

[25] Profitability is measured by Return on Assets (ROA). See Appendix B for detail.

[26] Our results differ from Wang and Lee (2009) who find incomplete pass through for Republic of Korea and Malaysia, probably because they employ different sample period.

expectations since Latvia and Malaysia have the highest two GNP per capita levels within their group. For lower middle income countries, on the other hand, estimation results suggest incomplete pass through for all countries except Bolivia where the pass-through appears to be over complete[27].

As explained in Chapter 2, there are various reasons behind an incomplete pass-through including the degree of competition in the banking sector, existence of switching and adjustment costs, market volatility, bank efficiency, bank profitability and degree of financial development. While the degree of competition, financial development, and bank efficiency works in favor of the complete pass-through, existence of switching and adjustment cost and highly volatile money market decreases the extent of the pass-through. Following Beck and Demirgüc- Kunt (2009), we measure the degree of competition in banking sector, market volatility, bank efficiency, bank profitability and financial development by bank concentration ratio, coefficient of variation of the money market rate, interest margin, return on assets and credit to GDP ratio, respectively. It is expected that banking sector would be more competitive, therefore switching and adjustment costs would be lower and profitability of banks would be less in developed (or high income) countries compared to developing countries (upper or lower middle income). Moreover, for high income countries, we expect that banks would be more efficient, the degree of financial development is higher and money market is less volatile. Furthermore, due to these factors, we expect that pass through mechanism would be complete in high income countries.

Despite our expectations, it is seen that the bank concentration ratio is high in high income countries. More than 66% of the market share is held by largest three banks in Kuwait, Hong Kong and Czech Republic, while Republic of Korea, the only country supporting a complete pass through, has one of the lowest bank concentration ratio, 47%, among all of our sample countries. Similarly, two upper

[27] As introduced in Chapter 4, we also utilized the Bardsen approach in order to test the completeness of the pass-through, however the results were not very different from the standard t-test results.

middle income countries, Malaysia[28] and Latvia suggest a complete pass-through with bank concentration ratios of 44% and 54%, respectively.

In line with our expectations, net interest margins are very low for the countries that we found complete pass-through (Republic of Korea, Latvia, Malaysia) indicating higher bank efficiency promoting the completeness of the process. Moreover, credit to GDP ratio is very high for these countries (117% for Republic of Korea and 112% for Malaysia), which represents the high usage of credits by agents in these economies speeding up the IPT mechanism. Furthermore, low market volatility appears to be another reason for completeness of IPT. Malaysia and Republic of Korea have the lowest market volatility among all fifteen countries. For instance, the market volatility in Malaysia is four times less than the market volatility in Hong Kong.

Next we consider the high income countries for which estimation results have shown incompleteness of IPT, namely; Kuwait, Hong Kong, Croatia and Czech Republic. Contrary to the cases in Republic of Korea, Latvia and Malaysia, the indicators we employ suggest slower adjustment of retail rates and incomplete IPT. To begin with, the market volatility is high in all of these countries. Even though, the market volatility in Czech Republic (0.52) is less than Kuwait, Hong Kong or Croatia, it is twice the volatility in Republic of Korea and almost three times more than the volatility in Malaysia. Moreover, Czech Republic (41%), Croatia (54%) and Kuwait (61%) have a lower level of financial development when compared to Republic of Korea (117%) and Malaysia (112%). When we take bank profitability indicator into account the results are much or less the same. Hong Kong and Kuwait have the largest return on assets ratio among all fifteen countries arising as a possible reason for incompleteness of IPT since profitability (market power) has negative effect on speed of pass through.

[28] Malaysia has the lowest bank concentration ratio among our sample countries. See appendix for more detail.

For middle income countries suggesting incomplete pass through, overall, the market volatility is high, financial development and bank efficiency are very low. Therefore, it is not surprising to observe incomplete pass through in these middle income countries. However, Bolivia appears to be an exceptional with an over complete pass through. De Bondt (2005) argues that if the number of risky borrowers or projects is high; banks adjust very quickly to increases in the money market rate (or the official rate) in order to compensate for the risk of default on loans. Hence sensitiveness of banks to changes in the money market rate due to the risk factor could be an explanation for the over completeness of IPT in Bolivia.

Having discussed the estimates of the long-run equilibrium equation (1), we can proceed with the results of the Engle-Granger cointegration test together with the TAR and MTAR type cointegration tests of Enders and Siklos (2001). Tables 4, 5 and 6 present the results for high, upper middle and lower middle income countries, respectively.

According to the Engle-Granger test, the null hypothesis of no cointegration is rejected at the 5% significance level for high income countries, Hong Kong, Republic of Korea and Croatia for upper middle income countries, Peru, and Thailand and for lower-middle income countries Ukraine, Armenia, Philippines and Bolivia. It fails to provide a significant cointegration for the countries Sri Lanka, Latvia, Malaysia, Dominican Republic, Kuwait and Czech Republic. As discussed in Chapter 4, the Engle-Granger methodology assumes symmetric adjustment and therefore might produce misleading results if the adjustment is in fact asymmetric. For that reason we continue with TAR and MTAR type cointegration testing procedures that account for asymmetries in the adjustment process.

Estimating the equation (3) with the Heaviside indicator functions (4) and (5), we perform TAR and MTAR type cointegration tests, respectively. At the 5%

significance level, based on the F test, Φ, and corresponding simulated p-values[29], the TAR type cointegration test rejects the null hypothesis of no cointegration, $\rho_1 = \rho_2 = 0$, for the countries Republic of Korea, Malaysia, Peru, Thailand, Ukraine, Armenia, Philippines. However, it fails to support cointegration inferences of the standard Engle-Granger test for Bolivia and Republic of Korea. For the countries supporting TAR type cointegration, we continue with testing the null of symmetric adjustment $\rho_1 = \rho_2$ by a standard F-test. The results provide empirical support for asymmetric adjustment (at the 5% level) for Thailand and (at the 10% level) for Republic of Korea and Philippines Moving on to the MTAR cointegration test, equations (3) and (5), we observe that existence of the cointegration between the lending rate and the money market rate is strongly supported for all countries. Furthermore, the null hypothesis of symmetric adjustment, $\rho_1 = \rho_2$, is rejected for all cases at the 5% level with the exception being Thailand and Armenia. While we fail to detect asymmetric adjustment for Armenia, evidence of asymmetry is supported at the 10% level with the p-value of 0.060 for Thailand. The consistent estimator of the threshold value, τ, is close to zero in almost all countries demonstrating asymmetric adjustment. Therefore, the adjustment speed depends on the sign of the change in the ECT ($\hat{u}_{t-1}$). However, for Latvia and Bolivia the estimated thresholds are -1.676 and 1.180, respectively. Hence adjustment will have more momentum in one direction than other depending on these values. Moreover, based on the Akaike Information Criterion (AIC), the MTAR model appears to be the most appropriate model for all countries[30], except Hong Kong and Republic of Korea, for which TAR and Engle-Granger models gives the best fit, respectively. However, for Hong Kong we prefer to continue with the MTAR type adjustment since null hypothesis of no cointegration rejected with a lower significance level when the MTAR type asymmetry is allowed.

[29] In order to employ exact critical values for our sample size and the augmentation order of (3), we perform a Monte Carlo simulation following Enders and Siklos (2001) and provide simulated p-values.

[30] We choose MTAR model to describe the cointegration relation between the lending rate and the money market rate in Sri Lanka. EG and TAR methodologies could not detect cointegration relation, however, at the 10% significance level these two rates are asymmetrically cointegrated according to MTAR model cointegration test results.

Table 4: Cointegration Test Results for High Income Countries

	KUWAIT			*HONG KONG*			*REPUBLIC OF KOREA*		
	EG	*TAR*	*MTAR*	*EG*	*TAR*	*MTAR*	*EG*	*TAR*	*MTAR*
ρ_1	-0.128	-0.078	-0.026	-0.221[b]	-0.377[a]	-0.214[a]	-0.046[b]	-0.060[a]	-0.032[b]
	{-2.852}	[-1.417]	[-0.460]	{-3.636}	[-3.745]	[-3.198]	{-3.605}	[-3.449]	[-2.167]
ρ_2	NA	-0.312[a]	-0.264[a]	NA	-0.148[b]	-0.490[a]	NA	-0.014	-0.098[a]
		[-4.704]	[-4.122]		[-2.094]	[-4.534]		[-0.716]	[-3.828]
p	2	1	2	1	0	0	1	0	0
τ	NA	-0.528	-0.037	NA	0.254	-0.186	NA	0.720	-0.128
Φ	NA	11.832[a]	8.447[b]	NA	8.549[b]	15.290[a]	NA	6.161[c]	9.611[b]
		(0.001)	(0.033)		(0.014)	(0.000)		(0.082)	(0.017)
$\rho_1 = \rho_2$	NA	7.512[a]	8.407[a]	NA	3.724[c]	4.719[b]	NA	3.114[c]	4.924[b]
		(0.007)	(0.004)		(0.056)	(0.031)		(0.080)	(0.028)
AIC	-1.999	-1.986	-2.042	-2.046	-2.058	-2.019	-4.232	-4.124	-4.193

	CZECH REPUBLIC			*CROATIA*		
	EG	*TAR*	*MTAR*	*EG*	*TAR*	*MTAR*
ρ_1	-0.107[b]	-0.169[a]	-0.057	-0.179[b]	-0.236[a]	-0.370[a]
	{-3.186}	[-4.130]	[-1.567]	{-3.756}	[-3.958]	[-5.128]
ρ_2	NA	-0.032	-0.308[a]	NA	-0.088	-0.104[c]
		[-0.643]	[-4.494]		[-1.168]	[-1.780]
p	1	0	0	1	1	0
τ	NA	-0.399	-0.114	NA	-1.188	0.146
Φ	NA	8.677[b]	11.252[a]	NA	8.308[b]	14.634[a]
		(0.013)	(0.005)		(0.017)	(0.001)
$\rho_1 = \rho_2$	NA	4.426[b]	10.375[a]	NA	2.461	8.210[a]
		(0.037)	(0.002)		(0.119)	(0.005)
AIC	-3.746	-3.768	-3.800	-0.339	-0.343	-0.358

Notes: ρ_1 and ρ_2 are estimated values with t statistics given in parenthesis. p indicates the required number of lagged changes to ensure iid residuals in (2) and (3). τ is the estimated threshold value and Φ refers to the sample value for threshold cointegration test with simulated p-values (30.000 replications) given below in parenthesis. NA indicates that asymmetry test, $\rho_1 = \rho_2$, is not reported due to lack of evidence for cointegration. AIC is the Akaike Information Criterion. Significance levels are denoted as a, b and c for 1, 5 and 10 %, respectively.

Table 5: Cointegration Test Results for Upper Middle Income Countries

	LATVIA			*MALAYSIA*			*DOMINICAN REPUBLIC*		
	EG	*TAR*	*MTAR*	*EG*	*TAR*	*MTAR*	*EG*	*TAR*	*MTAR*
ρ_1	-0.154	-0.213[a]	-0.100[c]	-0.019	-0.037[a]	-0.065[a]	-0.094	-0.069	-0.299[a]
	{-3.032}	[-3.516]	[-1.852]	{-2.815}	[-4.674]	[-4.184]	{-2.765}	[-1.466]	[-4.795]
ρ_2	NA	-0.026	-0.506[a]	NA	0.015	-0.008	NA	-0.119[b]	-0.041
		[-0.296]	[-3.536]		[1.397]	[-1.015]		[-2.536]	[-1.060]
p	1	1	1	3	3	3	2	2	3
τ	NA	-2,456	-1,676	NA	0.238	0.035	NA	-3,696	0.588
Φ	NA	6.165[c]	8.158[b]	NA	11.848[a]	9.495[b]	NA	4,089	11.843[a]
		(0.081)	(0.044)		(0.001)	(0.016)		(0.295)	(0.004)
$\rho_1 = \rho_2$	NA	3.072[c]	6.826[b]	NA	NA	10.598[a]	NA	0.608	12,564
		(0.082)	(0.010)			(0.001)		(0.437)	(0.000)[a]
AIC	1,340	1,332	1,307	-5,243	-5,330	-5,301	0.803	0.812	0.720

	PERU			*THAILAND*		
	EG	*TAR*	*MTAR*	*EG*	*TAR*	*MTAR*
ρ_1	-0.154[b]	-0.195	-0.102[b]	-0.078[a]	-0.101[a]	-0.094[a]
	{-3.796}	[-3.630]	[-2.443]	{-5.943}	[-6.953]	[-3.554]
ρ_2	NA	-0.103	-0.499[a]	NA	-0.003	-0.038[a]
		[-1.752]	[-4.840]		[-0.121]	[-2.701]
p	1	1	1	0	0	0
τ	NA	3,007	-0.488	NA	-0.795	0.032
Φ	NA	7.854[b]	14.229[a]	NA	24.015[a]	9.898[b]
		(0.024)	(0.000)		(0.000)	(0.014)
$\rho_1 = \rho_2$	NA	1,362	12.988[a]	NA	10.751[a]	3.590[c]
		(0.245)	(0.000)		(0.001)	(0.060)
AIC	0.606	0.610	0.535	-3,780	-3,836	-4,025

Notes: ρ_1 and ρ_2 are estimated values with t statistics given in parenthesis. p indicates the required number of lagged changes to ensure iid residuals in (2) and (3). τ is the estimated threshold value and Φ refers to the sample value for threshold cointegration test with simulated p-values (30.000 replications) given below in parenthesis. NA indicates that asymmetry test, $\rho_1 = \rho_2$, is not reported due to lack of evidence for cointegration. AIC is the Akaike Information Criterion. Significance levels are denoted as a, b and c for 1, 5 and 10 %, respectively.

Table 6: Cointegration Test Results for Lower Middle Income Countries

	UKRAINE			*ARMENIA*			*SRI LANKA*		
	EG	*TAR*	*MTAR*	*EG*	*TAR*	*MTAR*	*EG*	*TAR*	*MTAR*
ρ_1	-0.201[b]	-0.175[a]	-0.119[c]	-0.410[a]	-0.419[a]	-0.371[a]	-0.097	-0.016	-0,019
	{-3.675}	[-2.951]	[-1.732]	{-5.371}	[-5.132]	[-4.162]	{-1.790}	[-0.236]	[-0,303]
ρ_2	NA	-0.295[a]	-0.328[a]	NA	-0.352[a]	-0.428[a]	NA	-0.234[a]	-0.307[a]
		[-2.922]	[-4.944]		[-3.146]	[-4.360]		[-3.164]	[-3.647]
p	5	5	4	2	1	1	4	5	5
τ	NA	-4.656	-0.080	NA	1.209	-1.822	NA	2.045	-0.675
Φ	NA	7.321[b]	12.747[a]	NA	16.695[a]	16.659[a]	NA	4.973	6,605[c]
		(0.029)	(0.002)		(0.000)	(0.000)		(0.154)	(0.099)
$\rho_1 = \rho_2$	NA	1.213	5.426[b]	NA	0.257	0.198	NA	5.063[b]	8,222[a]
		(0.273)	(0.021)		(0.613)	(0.657)		(0.026)	(0.005)
AIC	2.824	2.829	2.802	2.130	2.129	2.129	0.704	0.661	0.639

	PHILIPPINES			*BOLIVIA*		
	EG	*TAR*	*MTAR*	*EG*	*TAR*	*MTAR*
ρ_1	-0.276[b]	-0.407[a]	-0.495[a]	-0.240[b]	-0.270[a]	-0.366[a]
	{-3.901}	[-4.060]	[-4.654]	{-3.547}	[-3.306]	[-4.097]
ρ_2	NA	-0.172[c]	-0.144[c]	NA	-0.184[c]	-0.094
		[-1.913]	[-1.697]		[-1.714]	[-0.986]
p	1	1	1	1	1	1
τ	NA	0.743	0.440	NA	-2.102	1.180
Φ	NA	9.344[a]	11.539[a]	NA	6.445[c]	8.644[b]
		(0.009)	(0.004)		(0.065)	(0.033)
$\rho_1 = \rho_2$	NA	3.332[c]	7.315[a]	NA	0.440	4.496[b]
		(0.070)	(0.008)		(0.508)	(0.036)
AIC	-0.594	-0.603	-0.629	3.207	3.218	3.190

Notes: ρ_1 and ρ_2 are estimated values with t statistics given in parenthesis. p indicates the required number of lagged changes to ensure iid residuals in (2) and (3). τ is the estimated threshold value and Φ refers to the sample value for threshold cointegration test with simulated p-values (30.000 replications) given below in parenthesis. NA indicates that asymmetry test, $\rho_1 = \rho_2$, is not reported due to lack of evidence for cointegration. AIC is the Akaike Information Criterion. Significance levels are denoted as a, b and c for 1, 5 and 10 %, respectively.

Discussion of the estimated speed of adjustments requires more attention, as they will uncover the nature of the pass through. In this sense, we will discuss them first on a country specific base (Section 5.1.1), and then accounting for the possible income effect, we will provide a discussion across the income groups (Section 5.1.2).

5.1.1 Country Specific Results

As discussed in Chapter 2, existence of switching and searching costs is one of the possible reasons to expect asymmetric adjustment of retail rates. These costs are higher for banks and customers if banks are operating in a less competitive environment. High degree of competition in banking sector may force banks to act slower (faster) to increases (decreases) in the money market rate, indicating upward stickiness of lending rates. Market volatility is another factor that may cause asymmetric adjustment. Higher market volatility implies frequent and sharp changes in official rate which creates shocks to banking sector leading to uncertainty and asymmetric information problems. Hence, in order to avoid short-run losses, banks may act slowly when decreasing their lending rates, initiating downward stickiness of the lending rates. Beside these factors, collusive pricing arrangement and adverse customer reaction hypothesis may explain the downward and upward stickiness of lending rates respectively.

Regarding the speed of adjustments observed from MTAR type cointegration, it is seen that Ukraine lending rates respond more to money market rate changes when change in the ECT is positive. Payne (2007) argues that negative realizations of the change in ECT stem from the rise in the money market rate which in turn decreases the gap between the lending rate and the money market rate. Therefore, negative changes in ECT point to increases in the money market rate.

Figure 4,5 and 6 plots the changes in the ECT along with the estimated threshold value for high income, upper middle income and lower middle income countries,

respectively. Being in line with the estimated speed of adjustment coefficients, Figure 6 illustrates that negative changes in the ECT dies quicker compared to positive changes for Ukraine. This clearly implies that Ukraine lending rate follows money market rate increases closely, while they are reluctant to follow declines in the money market rate. High market volatility (highest among all countries), uncertainty about the market and high inflation rate could be possible reasons behind this downward rigidity.

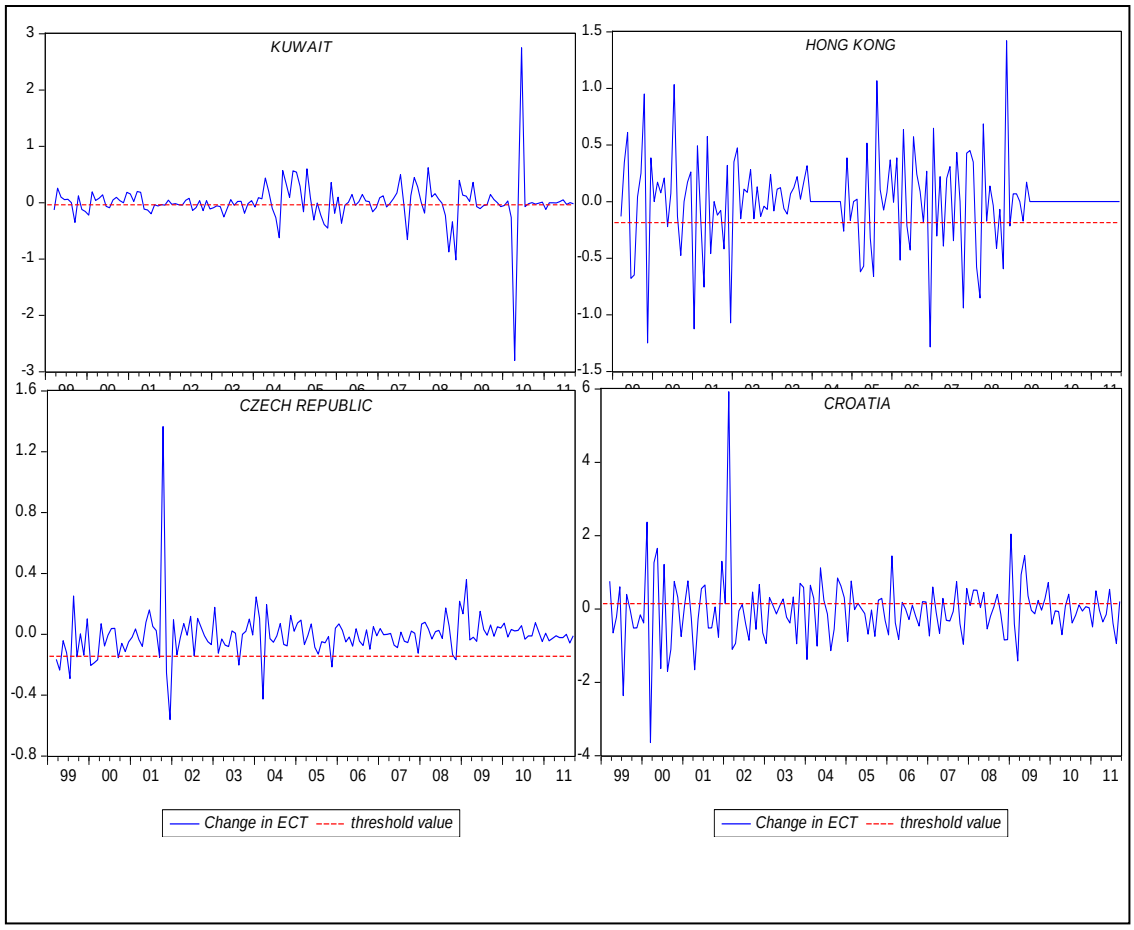

FIGURE 4: Change in the Error-Correction Term Series of High Income Countries

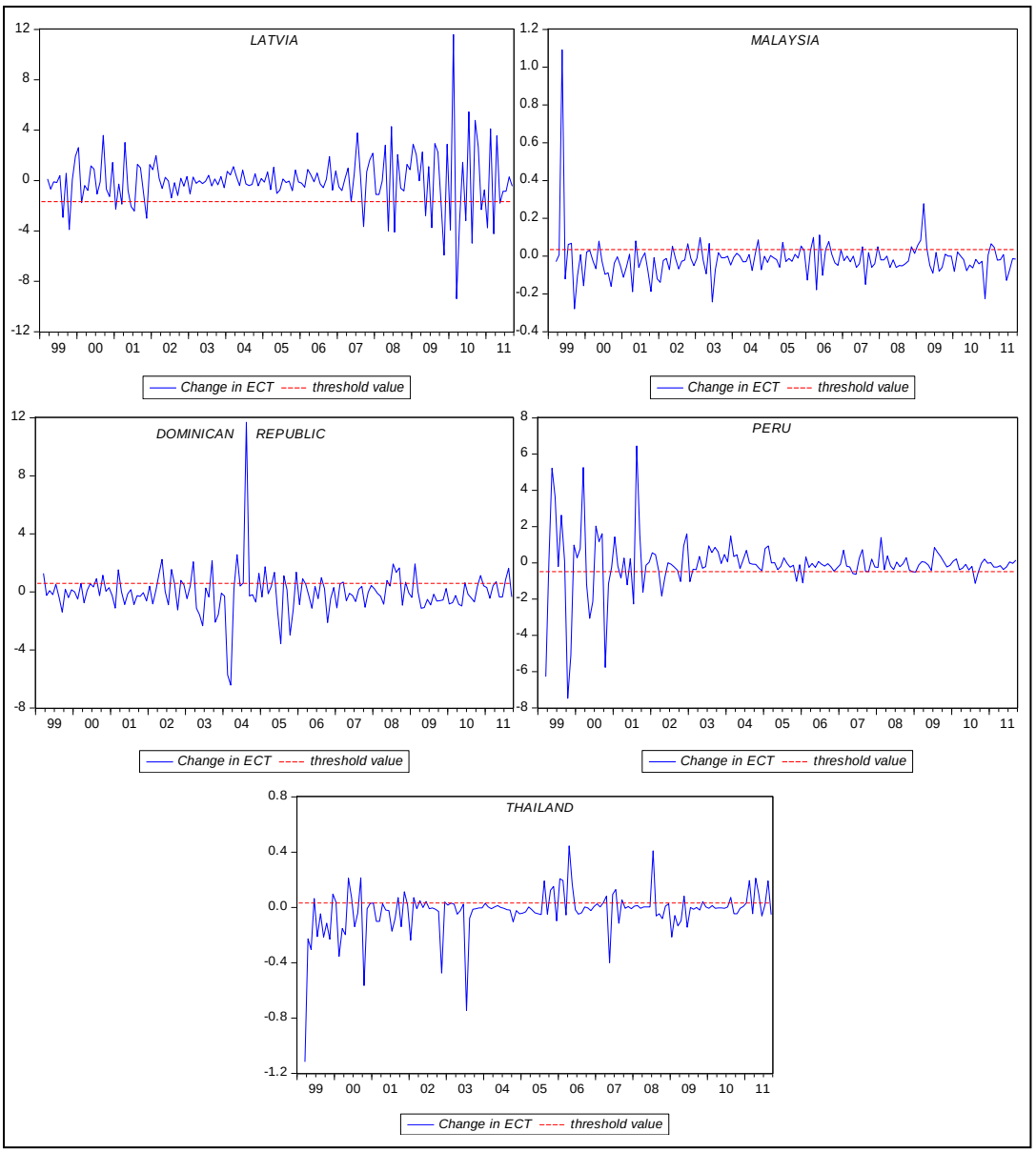

Figure 5: Change in Error-Correction Term Series of Upper Middle Income Countries

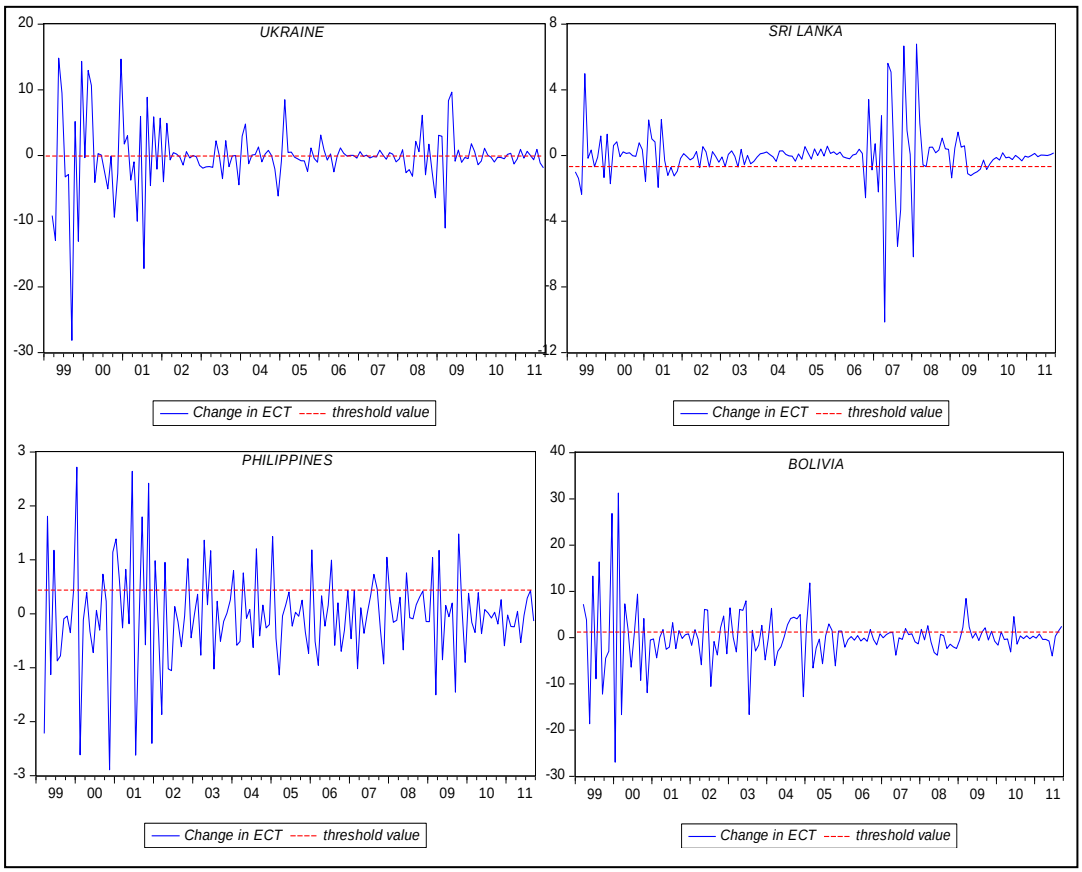

Figure 6: Change in Error-Correction Term Series of Lower Middle Income Countries

Adjustment of the lending rate is also downward sticky in Sri Lanka, Latvia, Peru, Kuwait, Czech Republic and Hong Kong. The type and causes of asymmetry in the adjustment of lending rates seem to be similar for these countries. As clearly seen from Figures 4, 5 and 6 and being supported by estimated speed of adjustments, in these countries, change in the error correction term decays with a smaller rate when change is above the threshold value (which is substantially zero except Latvia). Moreover, estimated speed of adjustment, ρ_1, is insignificant at the 5% significance level for Sri Lanka, Ukraine, Latvia, Kuwait and Czech Republic and at the 1% significance level for Peru. Statistically insignificant ρ_1 indicates that the convergence of lending rates to the equilibrium when the change in the ECT is above the threshold value is not statistically significant which strengthens the

downward stickiness of lending rates in these countries. Main cause of this type of asymmetry seems to be the fact that the banking sector is highly concentrated in most of these countries except Latvia. Banks in these countries have noticeable market power which enables them to adapt to the increases in the money market rate more quickly compared to the decreases. Moreover, high market volatility in Hong Kong and Peru and Latvia supports the downward sluggishness of lending rates in these countries. Among the countries for which we observe downward sluggishness of lending rates, Latvia is the only country having a threshold value substantially different from zero (-1.676). It seems that for Latvia, the speed of adjustment increases when the increase in the money market rate is above a certain level. Hence, we can deduce that banks in Latvia act slowly to small changes in the money market rate, but act faster when increase in money market rate is noticeably large. High and relatively unstable inflation may the hidden cause of such asymmetry.

Unlike the countries discussed above, we observe upward stickiness of lending rates in Philippines, Malaysia, Thailand, Dominican Republic, Croatia and Bolivia. Figures 4, 5 and 6 depict the fact that positive deviations from the equilibrium are eliminated quickly, which is also supported by estimated speed of adjustments with faster adjustment following positive changes in the ECT. Moreover, the speed of adjustment when the change in ECT is below the threshold value, ρ_2, is statistically insignificant at the 10% significance level for Bolivia, Malaysia, Dominican Republic and at the 5% significance level for Philippines and Croatia. Insignificance of ρ_2 supports our finding in terms of upward stickiness in these countries since adjustment of lending rates to increases in the money market rate is statistically insignificant. Upward stickiness of lending rates may be attributed to high degree of competition in Malaysia, Thailand, Croatia and Bolivia whereas it may be attributed to low market volatility in Philippines, and Dominican Republic. As discussed in chapter 2, we expect lower profitability of banks if the degree of competition in banking sector is high which in turn indicates that banks have low market power. In the light of this peculiar expectation and corresponding to it, bank concentration ratio is widely used in the literature in order to measure the degree of competition. However, we cannot ignore the fact that banks may operate in competitive market even though the concentration is high. Therefore, we take the profitability of banks in

Dominican Republic in consideration in order to make sure that high concentration results from less competition. Profitability of banks in Dominican Republic is very low[31] which may be due to high competition in banking sector, supporting the upward rigidity of the lending rate. Among these countries Bolivia is unique in terms of estimated threshold value which is substantially positive. The positive threshold indicates that adjustment is faster following large decreases in the money market are realized. Integrating the over completeness of the IPT mechanism in Bolivia into the discussion, it is possible that Bolivian banks not only pass the increases in the money market rate to the lending rate, but also increase the markups on the lending rate. Larger markups prevent losses that would occur due to sudden increases in the money market rate which may be the reason for banks to act slowly to small decreases and any increase in the money market rate. Moreover, due to high inflation, banks in Bolivia anticipate increases rather than decreases in the money market rate, hence, they hesitate to adjust to small decreases and wait for a noticeable decrease in the money market rate. When a relatively large fall in the money market rate is realized, banks act faster due to the high degree of competition among banks.

When we consider the collusive pricing arrangements and adverse customer reaction hypothesis, the downward rigidity of lending rates in Ukraine, Peru, Latvia[32], Czech Republic, Hong Kong[33] and Kuwait is supported by collusive pricing arrangements theory, whereas upward rigidity of lending rates in Philippines, Bolivia,

[31] Lowest among all countries. Profitability measured by returns on assets.

[32] Sander and Kleimeier (2004b), Crespo-Cuaresma et al (2004) and Amarasekara (2005) find symmetric adjustment of lending rates in Latvia, Czech Republic and Sri Lanka respectively, while we uncover significant asymmetries for these countries. The type of loans under consideration, sample periods and the methodology utilized may have caused differences in findings.

[33] Our inference in favor of downward rigidity of the lending rates in Hong Kong is in line with the MTAR approach of Wang and Lee (2009), though some substantial differences regarding other countries remain. While they fail to find significant cointegration between the lending rates and the money market rate for Thailand, Republic of Korea and Malaysia, we provide strong empirical evidences for cointegration. Moreover, contrary to our findings, they conclude that Philippines' lending rates exhibit downward rigidities. The possible reason for these different inferences could be simply the sample period employed.

Thailand, Dominican Republic, Malaysia and Croatia is supported by the adverse customer reaction theory. It is worth to note that Republic of Korea and Armenia are the only countries with symmetric[34] IPT mechanism according to our estimation results.

5.1.2. Results for Country Income Groups

As discussed in chapter 2, inflation has positive impact on the speed of adjustment. From tables 4, 5 and 6, we realize that speeds of adjustment parameters are higher for especially lower middle income group countries. Adjustment of lending rates to changes in the money market rate seems to be faster for Latvia, Peru and Dominican Republic within upper middle income group confirming the positive effect of inflation on pass through. On the other hand, inflation rate is lower for high income countries as a group. However, all countries except Republic of Korea experience relatively quick adjustment of rates. Contrary to other income groups, most outstanding reason to find speedier adjustment in these countries is the high level of income since GDP per capita, which is expected to increase the speed of pass through as indicated by Gigineshvili (2011). In addition, highly developed financial sector seems to increase the speed of pass through in Croatia, Hong Kong and Kuwait, while low level of market volatility boosts the speed of adjustment in Czech Republic. Among our sample countries, lending rates in Malaysia, Thailand and Republic of Korea seem to adjust slower in both directions compared to other countries despite the positive effect of low market volatility, low concentration and high level of financial development. The inflation rate is low in all these three countries. One possible explanation for low speed of adjustment could be the menu costs. Banks in these countries wait long enough to change their rates to avoid adjustment costs such as cost of advertising, printing menus, labor time devoted for the adjustments.

[34] As discussed in Chapter 2, insignificant switching and searching costs, high level of competition, perfect information about the market conditions may produce symmetric adjustments in these countries. Comparison of the speed of adjustments suggests that the IPT process works faster in Armenia. High inflationary environment may force Armenian banks to change their rates quickly whereas Korean banks act slowly due to menu costs caused by the low level of inflation.

As shown in figures 4-6, we observe that threshold cuts only large spreads of the changes in the ECT for almost all countries[35] which indicates that the speed of adjustment is speedier when there is a large change in the ECT whether it is positive or not[36]. Hence, size of the change in the money market rate is as important as the sign of the change in terms of effectiveness of the monetary policy. Small increases or decreases in the official rate (or the money market rate) will not have significant impact on the lending rate especially in short-run. When we consider the figures 4-6, it is clear to see that spreads are wider in lower middle income countries. Due to high inflation, policy makers need to take more drastic measures.

When we consider the type of asymmetry (downward or upward rigidity) results, we observe that income level plays only a marginal role in explanation of the type of asymmetry. Taking market structures into consideration, we expect upward stickiness of lending rates in high income countries. However, high income level does not guarantee high level of financial development, high level of competition among banks or low market volatility. Due to these conditions, we find upward rigidity in some lower income countries such as Bolivia and Malaysia, while we observe downward rigidity in most of the high income countries; Hong Kong, Kuwait, Czech Republic. Hence, even though countries are homogenous in terms of income level within their group, they are not homogenous in terms of financial and macroeconomic indicators.

Having established the MTAR type cointegration between the lending rate and the money market rate for all countries (except Republic of Korea and Armenia), we continue with estimation of MTAR type nonlinear ECMs given in (6) and (7) with the indicator function (5) and the consistent estimate of the threshold value τ presented in Tables 6, 7 and 8.

[35] Size of the change in the ECT seems to have marginal effect in Ukraine and Kuwait.

[36] Similar to findings of Sznajderska (2012) for Poland

5.2. Threshold ECM Results

The speed of adjustment parameters ρ_1 and ρ_2 obtained from the MTAR model and given in Tables 4, 5 and 6 are in line with the error correction terms (γ_1 and γ_2) observed from the nonlinear threshold ECM models presented in Tables 7, 8 and 9 for all countries[37]. Hence, as expected, all inferences discussed in detail in the previous section are valid for threshold ECMs.

As mentioned before, our single equation modeling relies on the weak exogeneity assumption of the money market rate to the lending rate. This assumption is satisfied when the error-correction term does not have a significant impact on changes in the money market rate; namely when γ_1 and γ_2 are statistically insignificant in the money market rate equations. Our results support the weak exogeneity of the money market rate at the 5% significance level[38].

Moreover, as seen in Tables 7 – 9; the null hypothesis $H_0 = \varphi_1 = ... = \varphi_p = 0$ could be rejected at the 1% significance level for Thailand, Ukraine, and Sri Lanka and at the 5% significance level for Hong Kong when the ECM model presented by equation (7) is estimated. This indicates that, the lending rate granger causes the money market rate in the short-run only for Thailand, Ukraine, Sri Lanka and Hong Kong. However, these results do not indicate that the money market is determined by the lending rate but imply that changes in the money market rate may be affected

[37] The exceptions are Ukraine and Hong Kong.

[38] Estimated speed of adjustment coefficient is significant at the 5% level in Dominican Republic, however, the estimated value is positive which indicates that the money market rate does not converge to an equilibrium, suppoting the weak exogeneity of the money market rate. On the other hand, the money market rate in Latvia converges to the equilibrium when change in ECT is below the threshold value. A bi-variate model instead of a uni-variate model may fit better to interest rate pass through analysis of Latvia.

by the changes in the lending rate in the short-run, without violating the weak exogeneity of the money market rate[39].

[39] See Engle et al. (1983) for further information

Table 7: Estimated Threshold Error-Correction Models for High Income Countries

	KUWAIT		*HONG KONG*		*CZECH REPUBLIC*		*CROATIA*	
	lr	*mmr*	*lr*	*mmr*	*lr*	*mmr*	*lr*	*mmr*
φ_0	-0.036	-0.029	-0.004	-0.020	-0.015	-0.027[b]	-0.049	-0.088
	[0.228]	[0.297]	[0.733]	[0.660]	[0.166]	[0.049]	[0.426]	[0.556]
φ_1	0.150[c]	-0.031	0.225[a]	0.211	-0.092	0.156[c]	-0.190[b]	0.123
	[0.066]	[0.681]	[0.005]	[0.476]	[0.197]	[0.077]	[0.024]	[0.544]
φ_2	-0.284[a]	-0.037	0.490[a]	0.640[b]	NA	NA	-0.151[c]	0.005
	[0.001]	[0.629]	[0.000]	[0.024]			[0.053]	[0.981]
φ_3	NA	NA	NA	NA	NA	NA	NA	NA
φ_4	NA	NA	NA	NA	NA	NA	NA	NA
δ_1	0.190[b]	0.534[a]	0.035	-0.314[a]	0.225[a]	0.290[a]	0.017	-0.036
	[0.041]	[0.000]	[0.192]	[0.002]	[0.001]	[0.001]	[0.582]	[0.640]
δ_2	-0.061	-0.154[c]	0.011	-0.202[b]	NA	NA	-0.026	-0.455[a]
	[0.513]	[0.079]	[0.633]	[0.022]			[0.403]	[0.000]
δ_3	NA	NA	NA	NA	NA	NA	NA	NA
δ_4	NA	NA	NA	NA	NA	NA	NA	NA
γ_1	0.015	0.090[c]	-0.061[b]	0.127	-0.067[b]	-0.059	-0.324[a]	-0.017
	[0.794]	[0.094]	[0.027]	[0.219]	[0.048]	[0.157]	[0.000]	[0.928]
γ_2	-0.244[a]	0.005	-0.043	0.375[c]	-0.397[a]	-0.162[c]	-0.076	-0.010
	[0.000]	[0.936]	[0.404]	[0.052]	[0.000]	[0.056]	[0.163]	[0.939]
$Q(4)$	3.959	1.265	1.471	0.677	2.199	0.816	1.836	0.140
	[0.412]	[0.867]	[0.832]	[0.954]	[0.699]	[0.936]	[0.766]	[0.998]
$\varphi_i = 0$	8.198[a]	0.189	38.555[a]	4.136[b]	1.683	3.181[c]	3.548[b]	0.196
	[0.000]	[0.828]	[0.000]	[0.018]	[0.197]	[0.077]	[0.031]	[0.822]
$\delta_i = 0$	2.123	19.593a	0.870	5.454[a]	10.554[a]	11.548[a]	0.535	17.752[a]
	[0.123]	[0.000]	[0.421]	[0.005]	[0.001]	[0.001]	[0.587]	[0.000]

Notes: For each country, the first column represents the lending rate equation (6) and the second one the money market rate equation (7). In all equations the augmentation order is selected to ensure the absence of serial correlation of order 4 according to the Ljung-Box Q statistics, $Q(4)$. P- values are given in brackets and significance levels are denoted as a, b and c for 1, 5 and 10%, respectively.

Table 8: Estimated Threshold Error-Correction Models for Upper Middle Income Countries

	LATVIA		*MALAYSIA*		*DOMINICAN REPUBLIC*		*PERU*		*THAILAND*	
	lr	*mmr*	*lr*	*mmr*	*lr*	*mmr*	*lr*	*mmr*	*lr*	*mmr*
φ_0	-0.086	-0.035	-0.027[a]	-0.006	-0.038	-0.076	-0.071[c]	-0.070	-0.016	0.011
	[0.634]	[0.836]	[0.000]	[0.666]	[0.658]	[0.665]	[0.089]	[0.569]	[0.175]	[0.527]
φ_1	-0.531[a]	-0.027	-0.077	-0.050	0.230[a]	0.067	0.276[a]	0.012	0.158[b]	0.526[a]
	[0.000]	[0.799]	[0.443]	[0.823]	[0.004]	[0.679]	[0.001]	[0.823]	[0.033]	[0.000]
φ_2	-0.043	-0.031	0.009	0.156	NA	NA	0.117	-0.361	NA	NA
	[0.721]	[0.780]	[0.914]	[0.424]			[0.145]	[0.424]		
φ_3	-0.077	0.051	NA	NA	NA	NA	NA	NA	NA	NA
	[0.494]	[0.629]								
φ_4	-0.212[b]	-0.018	NA	NA	NA	NA	NA	NA	NA	NA
	[0.033]	[0.847]								
δ_1	0.047	-0.515[a]	0.293[a]	0.334[a]	0.132[a]	0.446[a]	0.015	0.261[a]	0.148[a]	0.198[b]
	[0.713]	[0.000]	[0.000]	[0.002]	[0.001]	[0.000]	[0.572]	[0.001]	[0.008]	[0.014]
δ_2	-0.091	-0.438[a]	0.069	0.076	NA	NA	0.085[a]	-0.233[a]	NA	NA
	[0.484]	[0.000]	[0.190]	[0.508]			[0.001]	[0.003]		
δ_3	-0.010	-0.456[a]	NA	NA	NA	NA	NA	NA	NA	NA
	[0.938]	[0.000]								
δ_4	-0.010	-0.111	NA	NA	NA	NA	NA	NA	NA	NA
	[0.927]	[0.301]								
γ_1	-0.042	0.030	-0.019	0.039	-0.092[b]	0.291[a]	-0.026	0.041	-0.052[c]	0.069
	[0.531]	[0.630]	[0.253]	[0.284]	[0.042]	[0.002]	[0.109]	[0.960]	[0.081]	[0.108]
γ_2	-0.643[a]	-0.484[b]	-0.018[b]	-0.020	-0.038	0.011	-0.075[c]	0.485	-0.050[a]	-0.030
	[0.000]	[0.010]	[0.026]	[0.261]	[0.163]	[0.848]	[0.063]	[0.126]	[0.002]	[0.183]
$Q(4)$	4.692	6.124	6.887	1.438	1.491	6.864	5.570	4.816	5.267	2.917
	[0.320]	[0.190]	[0.142]	[0.838]	[0.828]	[0.143]	[0.234]	[0.307]	[0.261]	[0.572]
$\varphi_i = 0$	8.285[a]	0.230	0.303	0.348	8.700[a]	0.172	9.922[a]	1.302	4.615[b]	24.617[a]
	[0.000]	[0.921]	[0.739]	[0.707]	[0.004]	[0.679]	[0.000]	[0.273]	[0.033]	[0.000]
$\delta_i = 0$	0.351	7.231[a]	18.878[a]	5.026[a]	12.003[a]	31.870[a]	5.765[a]	9.205[a]	7.231[a]	6.173[b]
	[0.843]	[0.000]	[0.000]	[0.008]	[0.001]	[0.000]	[0.004]	[0.000]	[0.008]	[0.014]

Notes: For each country, the first column represents the lending rate equation (6) and the second one the money market rate equation (7). In all equations the augmentation order is selected to ensure the absence of serial correlation of order 4 according to the Ljung-Box Q statistics, $Q(4)$. P- values are given in brackets and significance levels are denoted as a, b and c for 1, 5 and 10%, respectively.

Table 9: Estimated Threshold Error-Correction Models for Lower Middle Income Countries

	UKRAINE		*SRI LANKA*		*PHILIPPINES*		*BOLIVIA*	
	lr	*mmr*	*lr*	*mmr*	*lr*	*mmr*	*lr*	*mmr*
φ_0	-0.475[a]	-0.449	-0.039	-0.169	0.025	-0.020	0.037	-0.118
	[0.001]	[0.494]	[0.532]	[0.624]	[0.679]	[0.564]	[0.927]	[0.276]
φ_1	-0.129	0.248	0.010	0.267	-0.270[a]	-0.048	-0.430[a]	0.013
	[0.140]	[0.555]	[0.915]	[0.605]	[0.000]	[0.277]	[0.000]	[0.502]
φ_2	-0.110	-1.155[b]	0.141	0.726	NA	NA	NA	NA
	[0.236]	[0.010]	[0.119]	[0.150]				
φ_3	-0.355[a]	-1.217[a]	0.254[a]	1.376[a]	NA	NA	NA	NA
	[0.000]	[0.005]	[0.003]	[0.004]				
φ_4	-0.125	0.010	NA	NA	NA	NA	NA	NA
	[0.135]	[0.979]						
δ_1	0.017	-0.192[c]	0.001	-0.447[a]	0.286[b]	0.468[a]	0.035	0.059
	[0.464]	[0.084]	[0.972]	[0.000]	[0.041]	[0.000]	[0.913]	[0.493]
δ_2	-0.015	0.216[b]	-0.038[b]	-0.529[a]	NA	NA	NA	NA
	[0.481]	[0.041]	[0.023]	[0.000]				
δ_3	0.038[c]	0.091	-0.032[b]	-0.527[a]	NA	NA	NA	NA
	[0.053]	[0.338]	[0.039]	[0.000]				
δ_4	0.019	-0.066	NA	NA	NA	NA	NA	NA
	[0.326]	[0.478]						
γ_1	-0.152[a]	-0.125	-0.026	-0.103	-0.531[a]	-0.014	-0.344[a]	0.023
	[0.000]	[0.366]	[0.437]	[0.583]	[0.000]	[0.812]	[0.000]	[0.312]
γ_2	-0.072[b]	0.275[c]	-0.181[a]	-0.034	-0.137	0.041	-0.133	-0.010
	[0.024]	[0.073]	[0.001]	[0.910]	[0.113]	[0.421]	[0.160]	[0.678]
$Q(4)$	1.596	2.430	1.447	1.527	4.720	7.200	4.907	2.151
	[0.810]	[0.657]	[0.836]	[0.822]	[0.317]	[0.126]	[0.317]	[0.708]
$\varphi_i = 0$	4.746[a]	3.743a	4.324[a]	4.247[a]	13.353[a]	1.190	34.561[a]	0.453
	[0.001]	[0.006]	[0.006]	[0.001]	[0.000]	[0.277]	[0.000]	[0.502]
$\delta_i = 0$	1.903	2.946[b]	3.258[b]	17.597[a]	4.271[b]	32.911[a]	0.012	0.473
	[0.113]	[0.023]	[0.024]	[0.000]	[0.041]	[0.000]	[0.913]	[0.493]

Notes: For each country, the first column represents the lending rate equation (6) and the second one the money market rate equation (7). In all equations the augmentation order is selected to ensure the absence of serial correlation of order 4 according to the Ljung-Box Q statistics, $Q(4)$. P- values are given in brackets and significance levels are denoted as a, b and c for 1, 5 and 10%, respectively.

CHAPTER 6

CONCLUSION

In this study we investigate the nature of the pass-through of the money market rate to the lending rate in fifteen countries grouped as high income, upper middle income and lower middle income within the context of univariate threshold error-correction models. Our aim is to account for not only asymmetries but also possible heterogeneities arising from income differences. The preliminary results reveal that the pass-through from the money market rate to the lending rate is incomplete for all countries except Republic of Korea, Latvia and Malaysia. Even though income level in these countries are higher compared to most our sample countries, it seems that income has only a marginal effect on the completeness of the pass-through mechanism. We observe incomplete IPT in rest of our sample countries, possibly due to high market volatility, low degree of competition in banking sector and lower level of financial development.

TAR and MTAR cointegration tests uncover the crucial role of the nonlinearities in our pass-through analysis, as it is observed that all lending rates adjust asymmetrically following money market rate changes. Moreover, the MTAR type nonlinear adjustment appears to be more appropriate than TAR type adjustment for almost all cases except Republic of Korea and Armenia. Specifically, the loan rates of Ukraine, Sri Lanka, Latvia, Peru, Kuwait, Hong Kong and Czech Republic increase faster (slower) following a rise (fall) in the money market rate, whereas lending rates in Bolivia, Philippines, Malaysia, Dominican Republic, Thailand and Croatia exhibit upward sticky adjustment. Even though we expect upward (downward) stickiness in high (middle) income countries, these findings indicate that income does not have a substantial effect on the form of the asymmetry. Differences in the financial market and macroeconomic conditions seem to be possible reasons

for differences within and between country groups in terms of asymmetric adjustment of lending rates.

Overall, our results suggest that lending rates of the countries, where the degree of competition is high (low) and bank profitability and market volatility are low (high), exhibit upward (downward) stickiness. Unlike most of the studies in the literature, we have tested both long-run and short-run dynamics of the IPT. Our empirical results for threshold ECMs show that the weak exogeneity of the money market rate, which is the basis of our univariate analysis, is satisfied.

In this study we considered only the pass through from the money market rate to the lending rate. However, nature of the IPT to deposit rates is as important as loan rates; therefore an important task for future research could be analyzing the responses of deposit rates with different maturities. Another interesting direction for future research on the interest rate pass through could be setting a multivariate system with money market, lending and deposit rates and allowing for the interactions between lending and deposit rates.

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APPENDIX A

DESCRIPTIVE STATISTICS

Table 10: Correlation Coefficient between the Markup and the Money Market Rate

	Correlation Coefficient (Markup and the Money Market Rate)
Kuwait	-0.715
Hong Kong	-0.791
Republic of Korea	-0.135
Czech Republic	-0.917
Croatia	-0.869
Latvia	-0.029
Malaysia	-0.069
Dominican Republic	-0.704
Peru	-0.334
Thailand	-0.630
Ukraine	-0.514
Armenia	-0.415
Sri Lanka	-0.892
Philliphines	-0.668
Bolivia	0.352

Notes: Table represents the coefficient of correlation between the mark-up and the money market rate. High income, upper middle income and lower middle income countries are represented with dark grey, grey and light grey, respectively.

APPENDIX B

MACROECONOMIC AND FINANCIAL INDICATORS

Table 11: Macroeconomic and Financial Indicators

Market Volatility		*Degree of Competition*		*Financial Development*	
Malaysia	0,186	*Malaysia*	0,447	*Hong Kong*	1,432
Republic of Korea	0,266	*Ukraine*	0,458	*Republic of Korea*	1,174
Philliphines	0,310	*Republic of Korea*	0,473	*Malaysia*	1,123
Thailand	0,498	*Thailand*	0,486	*Thailand*	0,958
Czech Republic	0,519	*Latvia*	0,536	*Kuwait*	0,613
Sri Lanka	0,521	*Croatia*	0,606	*Croatia*	0,543
Kuwait	0,573	*Bolivia*	0,611	*Latvia*	0,519
Dominican Republic	0,614	*Sri Lanka*	0,650	*Bolivia*	0,451
Bolivia	0,661	*Dominican Republic*	0,661	*Czech Republic*	0,415
Latvia	0,681	*Czech Republic*	0,666	*Philliphines*	0,339
Armenia	0,754	*Kuwait*	0,689	*Sri Lanka*	0,286
Croatia	0,776	*Hong Kong*	0,691	*Dominican Republic*	0,233
Peru	0,791	*Armenia*	0,690	*Peru*	0,216
Hong Kong	0,896	*Peru*	0,728	*Armenia*	0,091
Ukraine	1,270	*Philliphines*	0,737	*Ukraine*	NA

Notes: Market volatility is measured by coefficient of variation in the money market rate. Degree of competition and financial development are measured by annual average (1999-2009) of bank concentration ratio and private credit to GDP ratio, provided by World Bank's database on Financial Development and Structure. NA indicates that the data is missing for that indicator and/or country. High income, upper middle income and lower middle income countries are represented with dark grey, grey and light grey, respectively.

Table 11 (Continued)

Bank Profitability		*Bank Efficiency*		*Average Inflation Rate*	
Hong Kong	0,023	*Dominican Republic*	0,116	*Ukraine*	13,212
Kuwait	0,023	*Peru*	0,065	*Dominican Republic*	11,692
Philliphines	0,019	*Bolivia*	0,064	*Sri Lanka*	9,610
Latvia	0,014	*Ukraine*	0,061	*Bolivia*	5,008
Malaysia	0,013	*Armenia*	0,057	*Latvia*	4,936
Ukraine	0,012	*Philliphines*	0,050	*Philliphines*	4,685
Croatia	0,012	*Sri Lanka*	0,046	*Armenia*	3,991
Bolivia	0,010	*Croatia*	0,044	*Kuwait*	3,531
Czech Republic	0,007	*Latvia*	0,033	*Croatia*	3,004
Peru	0,007	*Hong Kong*	0,032	*Republic of Korea*	2,995
Republic of Korea	0,005	*Thailand*	0,027	*Peru*	2,641
Armenia	0,004	*Republic of Korea*	0,026	*Czech Republic*	2,578
Sri Lanka	0,003	*Kuwait*	0,025	*Thailand*	2,453
Thailand	-0,007	*Malaysia*	0,024	*Malaysia*	2,271
Dominican Republic	-0,056	*Czech Republic*	0,024	*Hong Kong*	0,159

Notes: Average inflation rate is the annual average of the inflation rate calculated by CPI in local currency which is obtained from World Bank's Data Catalog. Bank profitability and bank efficiency are measured by annual average (1999-2009) of return on assets and net interest margin, provided by World Bank's database on Financial Development and Structure. High income, upper middle income and lower middle income countries are represented with dark grey, grey and light grey, respectively.

APPENDIX C

TEZ FOTOKOPİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü	
Sosyal Bilimler Enstitüsü	X
Uygulamalı Matematik Enstitüsü	
Enformatik Enstitüsü	
Deniz Bilimleri Enstitüsü	

YAZARIN

Soyadı : DEĞER
Adı : OSMAN
Bölümü : İKTİSAT

TEZİN ADI (İngilizce) : A COMPARATIVE STUDY FOR NONLINEAR STRUCTURE OF THE INTEREST RATE PASS-THROUGH

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 kullancılarının 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 imzası ..... Tarih .....